METROPOLITAN SÃO PAULO and ISTANBUL

unraveling urban segregation dynamics and assessing the role of transpatial groups in shaping urban structure

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(Doctoral Thesis)

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This thesis examines the dynamic and multidimensional nature of spatial segregation, while at the same time representing a significant step in my journey of self-discovery and development. Starting from various cities in Türkiye and extending to Brazil, I have had a variety of experiences while taking part in different economic, social and institutional hierarchies. The transition from the inviting streets where I was first greeted as a tourist to the rigid patterns of official protocols and distant bureaucratic structures that I encountered as an immigrant after a year, enabled me to personally feel the flexibility of the perception of self. Each encounter was a lesson in the intertwining of social competition and cooperation. Sometimes a helping hand, sometimes a distant approach enabled me to understand the mechanisms of belonging and exclusion at both the universal and local levels. The study that emerged within this framework was, beyond a research, a discovery that provided me with the opportunity to learn about the functioning of social structures through on-site experience, supported my personal transformation, and enriched my inferences about my identity.

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“The metropolis compels us to both collide and collaborate; indifference and solidarity coexist on the same street corner.”
— Georg Simmel, The Metropolis and Mental Life (1903)

ABSTRACT

This study examines the socio-spatial segregation in the Metropolitan São Paulo (Brazil) and Istanbul (Türkiye) through the interrelated phenomena of social competition, social cooperation, territoriality and centrality. Segregation is not only considered as a local problem, but also as a manifestation of global social group dynamics through local urban struggles. To carry out the study, an integrated analytical framework including demographic and socio-economic statistics, geographical analyses, machine learning, and spatial centrality measures was used. After picturing the general profiles of the study areas through statistical variables, Location Quotient analysis was applied to determine demographic clusters, and the main variables shaping social group distinction were determined by Random Forest algorithm. The settlement patterns of the groups were mapped using GIS tools, and how the urban structure reinforced social hierarchies was analyzed using spatial centrality measures. The findings showed that despite different local contexts, structurally similar segregated social groups emerged in both cities. It was also shown that these groups were consistent with global patterns of inequality and segregation. While some groups that settle in urban areas that are more centrally located than their counterparts consolidate opportunity through greater physical accessibility and socioeconomic dominance, the others that settles in peripheral areas struggle under conditions of exclusion, migration, and deepening resource scarcity. These patterns show that segregation is a structural outcome sustained by the social competition and cooperation inherent in human nature and point to the need for an urban planning approach that takes into account the embedded nature of local struggles within global dynamics.

Keywords: Urban segregation. Social competition. Social cooperation. Human territoriality. Socio-spatial centrality.

RESUMO

Este estudo examina a segregação socioespacial na regiões metropolitanas de São Paulo (Brasil) e Istambul (Turquia) por meio da investigação de fenômenos inter-relacionados de competição social, cooperação social, territorialidade e centralidade. A segregação não é considerada apenas enquanto um problema local, mas também uma manifestação da dinâmica global de grupos sociais por meio de lutas urbanas locais. Para realizar o estudo, adotou-se uma estrutura analítica integrada, incluindo estatísticas demográficas e socioeconômicas, análises geográficas, aprendizado de máquina e medidas de centralidade espacial. Após a caracterização dos perfis gerais das áreas de estudo por meio de variáveis estatísticas, aplicou-se a análise do Quociente de Localização para determinar os clusters demográficos, e as principais variáveis que moldam a distinção dos grupos sociais com base no algoritmo Floresta Aleatória. Os padrões de assentamento dos grupos foram mapeados utilizando ferramentas de Sistema de Informação Geográfica (SIG), e a forma como a estrutura urbana reforçava as hierarquias sociais foi analisada utilizando medidas de centralidade espacial conforme estabelecido pela Teoria da Lógica Social do Espaço (Sintaxe do Espaço). Os resultados obtidos de mostraram que, apesar dos diferentes contextos locais, grupos sociais segregados estruturalmente semelhantes emergiram em ambas as cidades. Também foi identificado que esses grupos eram consistentes com os padrões globais de desigualdade e segregação. Enquanto alguns grupos que se estabelecem em áreas urbanas mais centralizadas do que seus pares consolidam oportunidades por meio de maior acessibilidade física e domínio socioeconômico, outros assentados em áreas periféricas enfrentam dificuldades em condições de exclusão, migração e crescente escassez de recursos. Esses padrões expressam que a segregação é um resultado estrutural sustentado pela competição e cooperação social inerentes à natureza humana e apontam para a necessidade de uma abordagem de planejamento urbano que leve em conta a natureza intrínseca das lutas locais na dinâmica global.

Palavras-chave: Segregação urbana. Competição social. Cooperação social. Territorialidade humana. Centralidade socioespacial.

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1 INTRODUCTION

In any human environment, individuals are in a constant struggle with each others to improve their living conditions (CAMPBELL, 1965). This struggle manifests itself as competition on the one hand. The driving force behind the competitive behavior of individuals is the desire to pursue resources that are deemed valuable by social consensus for survival and prosperity. On the other hand, another reflection of the struggle is cooperation. This is a complementary strategy that increases the chance of securing resources and improving social position. This strategy is shaped by the individual's realization that working together generally yields greater gains than competing alone (SHERIF, 1966; LEVINE; CAMPBELL, 1972; TOOBY; COSMIDES, 1992). Thus, in line with these two dynamics, individuals form distinct social groups (TAJFEL; TURNER, 1979, TURNER, 1985).

This study examines similar and different dynamics based on some concepts through the global metropolises of São Paulo and Istanbul (Table 1). In the process, urban segregation is considered as a social and spatial reflection of the interactions of different social groups through the amount of their access to urban resources, spatial dominance and the centrality values of the areas they settle in. In addition, segregation is not seen just as the result of singular identity axes, but rather as a phenomenon with a dynamic nature in which different identity elements become salient in different situations. This dynamism underlines how flexible, strategic and contextual group boundaries and affiliations are.

Thus, the city in the study corresponds to the structural configurations related to the existence, needs, strategies and limitations of social groups on the spatial domain. Social inequality, on the other hand, is considered as systematic differences in the access levels of individuals or groups to resources such as land, income, housing, education, and health services. These differences occur between social groups shaped by the intersection of social identities (status, class, ethnicity, race, gender, etc.) and are reproduced through the spatial positioning of these groups shaped by competition and cooperation duality. In metropolises such as São Paulo and Istanbul, these inequalities determine how different social groups are positioned in urban space, both through differences within themselves and through hierarchies between groups. Social inequality is therefore characterized not only by the different circumstances of individuals, but also by the persistent reproduction of these differences by social and spatial systems.

Table 1- Key concepts and definitions

Concept	Definition
Grouping	Dynamic clustering of individuals based on intersecting social identities and shared strategies. Group boundaries are flexible and context-driven, shaped by local needs and global flows of capital and power.
Social Competition	Rivalry among social groups for scarce urban resources such as land, income, education, and services. It reproduces spatial hierarchies within cities, as advantaged territories consolidate centrality and peripheral ones face exclusion, aligned with broader global urban dynamics.
Social Cooperation	Collective strategies, like kinship ties, community associations, informal networks, used to access resources and resist marginalization. Cooperation and competition coexist, with group alliances shifting amid structural inequalities and survival pressures.
Centrality	Degree of territorial connectivity within urban networks. High-centrality areas concentrate resources and power, while low-centrality zones remain isolated. Centrality reflects and reinforces the outcomes of group competition and cooperation.
Territoriality	Spatial control asserted by social groups through formal or informal means. These claims, through walls, enclaves, or symbolic boundaries, secure identity and resources, reinforcing urban hierarchies that are both globally resonant and locally specific.
Social Inequality	Structural disparities in access to resources such as land, housing, education, and healthcare. These are shaped by intersecting identities and reproduced spatially through both local policies and global economic forces.
Urban Segregation	Spatial expression of competition and cooperation, where shifting group boundaries and affiliations lead to differentiated urban clustering. Segregation is not fixed by identity but emerges through strategic, contextual group formations within global and local urban dynamics.

Source: Author, 2025.

Furthermore, these processes develop under the influence of global capital and power circulations in addition to local contexts. Therefore, the dynamics and socio-spatial projections between these groups are also standardized on a global scale and similar spatial mechanisms are produced in different geographies. In this context, the comparative analysis of Metropolitan São Paulo and Istanbul aims to discuss how social group formations, social dynamics and spatial structures interact and how these processes pave the way for urban segregation, both with their common aspects and differences.

1.1 Formation, boundaries, and alliances of social groups

According to socio-psychological studies, three levels of social groups are defined according to the degree of perceived unity. Each types of group that meets different psychological needs is associated with perceptual characteristics such as level of interaction, similarity, permeability of membership, group size and duration. Of these, intimacy groups are small groups with high levels of interaction, similarity, entity and emotional importance among their members who share common goals and results. Membership is long-term and the groups are generally not permeable. Families, close friend groups and associations fall into this category. They meet psychological needs such as belonging, emotional bond and social support. In addition, task groups, with high interaction and cooperation among the members are also relatively small. They target a specific task or goal and are limited in duration and have medium permeability and entity levels. Members of these groups, such as work groups, unions and business friendships, come together to achieve common results. These groups also meet individuals' psychological needs based on goals and performance such as success, competence, and mastery. Social categories, on the other hand, refer to large-scale groups such as gender, ethnicity, or race. These long-lived groups have low membership permeability. However, intra-group interaction, similarity, and entity perception are low. They are important in terms of identity-based needs and provide individuals with a framework for self-definition, self-esteem, and social belonging. Finally, each types are organized at a mental and social level according to the function of meeting individual psychological needs such as belonging, success and identity (MACKIE; SMITH, 1998; LICKEL et al., 2000; SEDIKIDES; BREWER, 2001; SHERMAN et al., 2002).

Competition continues between these social groups, as well. It is a factor that affects the distribution of power, resources, and status on a societal scale (PRATTO et al., 1994). The result depends on each group’s efforts to secure position and advance common interests, especially when resources are limited. It manifests itself in economic, political, and social conflicts (DAHRENDORF, 1959). In this context, groups that mobilize their members and resources also strive to resist being marginalized and excluded by others. The intensity of competition between groups may be determined by historical resentments, cultural differences, or perceived threats to a group's status (TAJFEL; TURNER, 1979). However, significant social changes often occur as a result of groups' struggles to establish dominance or redefine the balance of power. The ongoing competition triggers the evolution of social, political, and economic structures within a society (MARX, 1867/2007).

The socio-psychological literature on groups also suggests that individuals develop favoritism toward in-groups and prejudice against out-groups. These prejudices and favoritism tendencies interact with group status to shape attitudes toward social inequality. In particular, members of high-status groups in the social hierarchy exhibit greater prejudice toward out-groups (SIDANIUS et al., 1991) and stronger favoritism toward the in-group (GUIMOND, DIF, AND AUPY, 2002). These tendencies have been observed even when group status is assigned randomly (MULLEN, BROWN AND SMITH, 1992; BETTENCOURT et al., 2001; GUIMOND; DAMBRUN, 2002). In modern societies structured by group-based hierarchies, one or a few groups within the structure have disproportionate power and resources (SIDANIUS; PRATTO, 1999; LEVIN, 2004). Members of groups perceived to have higher status are motivated to adopt belief systems and ideologies that legitimize social inequality in order to maintain their position (SIDANIUS et al., 2001). Furthermore, for these members, beliefs about inequality serve not only as a general social hierarchy bias but also as an in-group bias (SCHMITT et al., 2003). Thus, they are more likely to embrace existing inequalities as a way of maintaining their position, while members of low-status groups are more motivated to reject these inequalities and improve their own position (WILSON; LIU, 2003; DAMBRUN, DUARTE AND GUIMOND, 2004).

On the other hand, cooperation is also seen within and between social groups as a counter strategy which is important for social progress and stability (AXELROD, 1984; PUTNAM, 2000). Within groups, this strategy develops the sense of solidarity and mutual support among its members. It also enables the realization of common goals that cannot be achieved individually (TAJFEL; TURNER, 1979; OSTROM, 1990). This internal mechanism may contain sharing information, pooling resources, or collective action to solve common problems (COLEMAN, 1988). Group members work together to increase their bargaining power, influence on decision-making processes, and secure resources that will benefit the entire group (BOURDIEU, 1986; SIDANIUS; PRATTO, 1999).

Additionally, cooperation between groups is equally important. It establishes alliances by overcoming differences to build a broader social harmony and inter-group trust (PUTNAM, 2000; TAJFEL; TURNER, 1979). This makes it possible to construct networks that transcend group boundaries and facilitate access to a wider pool of opportunities and resources. As a result, this type of inter-group cooperation enables greater stability and shared prosperity, acting as a stabilizing force in socially stratified and spatially segregated urban contexts (AXELROD, 1984; OSTROM, 1990).

Mutual exchange mechanisms of unequally distributed resources among individuals are also one of the basic driving forces of cooperative behaviors in the context of economic principles such as the law of supply and demand (NOE AND HAMMERSTEIN, 1994; TRIVERS, 1971). The phenomenon here operates beyond formal contracts, through mutual dependence and common interest (JAEGGI ET AL., 2016; BOWLES AND HAMMERSTEIN, 2003). In this context, exchange relations between individuals are not only transactions, but also expressions of social strategies. Each individual adapts their relations with others according to the current market conditions and their position in social networks, and this ensures the stability of the cooperation (LEIMAR; HAMMERSTEIN, 2010). As a result, it is seen that cooperation is the result of complex social and economic interactions.

On a national and regional scale these dynamics manifest themselves in a variety of areas, including employment, education, healthcare, and housing. The primary domain where individuals and groups benefit for jobs, promotions, and career advancement is the labor market (WEBER, 1922; BOURDIEU, 1986). In addition, a critical factor in determining future job opportunities and earning potential is access to quality education (ADAMS, 1965; PUTNAM, 2000). Similarly, competition for access to affordable housing and health care continues (SASSEN, 2001; HARVEY, 2005). Thus, these social dynamics shapes the way for social groups within or in different cities to interact In turn, this affects the broader socioeconomic and political landscape (HILLIER; HANSON, 1984; CASTELLS, 1996). As a result, competition on a national scale is centered around funding, political influence, or access to markets (GRAMSCI, 1971; SIDANIUS; PRATTO, 1999). For example, labor unions may compete to secure better conditions for their members or to attract investment and job opportunities to their cities (DAHRENDORF, 1959; TILLY, 1978). Similarly, ethnic and religious groups may strive for recognition, representation, and community support (TAJFEL; TURNER, 1979; WACQUANT, 2008). Communities migrating from the same cities or regions may also cooperate to support each other, maintain cultural ties, and shape policies that affect their groups (RIBEIRO, 1997; SANTOS, 2002).

In the global context, the struggle extend beyond national borders. Global competition manifests itself in areas such as access to natural resources, production, trade, and technological innovation (SASSEN, 2001; HARVEY, 2005; MILANOVIC, 2016). Individuals strive to acquire skills and knowledge that will give them an advantage in competing in an increasingly interconnected world (BOURDIEU, 1986; CASTELLS, 1996). Nations compete to attract foreign investors, increase their economic capacity, and exert their influence on the global stage (HARDT; NEGRI, 2000; BECK, 2000). This also comes with cooperation. Nations tend to cooperate through strategic alliances and trade agreements (GIDDENS, 1990; STIGLITZ, 2002).

As might be expected, local social groups in cities and regions are affected by these global dynamics. Just as local entities become part of the global network, local economies are directly affected by global trends (GIDDENS, 1990). By adapting to technological developments and international market demands, businesses directly or indirectly become part of a larger collective movement (CASTELLS, 1996). This interconnectedness shows that local entities, even when operating in a local context, are embedded in global dynamics. Thus, global interaction also directs the formation, development and future of locally settled but globally connected groups (GIDDENS, 1990; SASSEN, 2001).

Eventually, global social groups that are not restricted by geographical borders emerge as a broader social category and unite groups across cultures and regions (CASTELLS, 1996). They shape and are shaped by the direct or indirect impact of global capital flows (HARVEY, 1982/2007). In the process, individuals within international production and service networks (SASSEN, 1991) may not realize that they contribute to the same collective structure and serve a common purpose through their actions and interactions. As these individuals participate in global markets, the influence and impact of their groups are collectively increased. They also contribute to the creation of a global civil society. Local actions and global movements are intertwined (GIDDENS, 1990; Beck, 1999).

On every layer mentioned above, the groups that skillfully navigate these dynamics gain better conditions, securing an advantage in competition and gradually rising to a stronger position within the social hierarchy (BORDIEU, 1984). In contrast, those unable to turn the process in their favor become disadvantaged. Whether a group is considered advantaged or disadvantaged is not determined solely by absolute conditions but rather by comparison with others (TAJFEL; TURNER, 1979). The amount of economic, social, and cultural capital they possess, their position in the hierarchy, and how they are perceived by the rest are crucial factors in these comparisons (BORDIEU, 1986). Thus, advantage and disadvantage are not fixed statuses but rather fluid positions continuously reshaped through social interactions and competitive processes.

Thus, it is inevitable to see society as a dynamic structure formed by the interactions between advantaged and disadvantaged groups. The balance between these groups is not static. It shifts over time in response to social, economic, and political changes A group that holds an advantageous position may become disadvantaged if it fails to maintain its competitive edge or adapt to structural transformations, while disadvantaged groups can improve their standing through solidarity, struggle, and strategic actions. Therefore, social structure is not a fixed entity but a continuous process of interaction and reconfiguration.

1.2 Spatial stratification, territoriality and centrality

A fundamental factor determining the process in question is human territoriality (HALL, 1966, ALTMAN, 1975). In addition to the drive of individuals to ensure their security and autonomy by protecting their personal space, social groups also create spatial boundaries to secure their resources, consolidate their identities, and maintain their hierarchical structures. In this way, this territorial drive manifests itself at different scales from the protection of personal space in everyday life to the organization of cities, nations, and global networks. Moreover, control of space is also directly linked to power, influence, and access to resources beyond physical location.

At the individual level, territoriality manifests itself in the way people organize their living spaces, determine their personal boundaries, and experience public spaces (HALL, 1966; ALTMAN, 1975). With social groups, this territorial behavior is transferred to the collective scale. The result of this is the reflection of social hierarchies in the spatial order, which are special regions, neighborhoods, and even city structures (NEWMAN, 1972; TAJFEL; TURNER, 1979; STOKOLS, 1987). The capacity to own and control space are important factors that define access to economic opportunities, political power, and social prestige (SIDANIUS; PRATTO, 1999; HAIDT; GRAHAM, 2007). In the process, groups that hold spatial control consolidate their power and become advantageous, while groups excluded from strategic areas become marginalized and disadvantaged in accessing resources (DOLLARD et al., 1939; SHERIF, 1966).

However, territoriality is not limited to competition. In the process of competition, situations can also arise that encourage cooperation, where groups negotiate boundaries and share resources (ALLPORT, 1954; ENGESTRÖM, 1987). Common spaces, cooperative housing systems, and autonomous zones of indigenous communities are examples of how territoriality can be managed through mutual agreements. In many societies, groups have developed mechanisms to collectively regulate access to land and resources (BANDURA, 1977; AJZEN, 1991). Political movements aimed at reclaiming public spaces, land reforms, or activist initiatives to combat unjust spatial divisions show that territoriality can also be a tool of resistance and social transformation (TAJFEL; TURNER, 1979; SIDANIUS; PRATTO, 1999).

In the age of globalization, territoriality is transformed by mobility, digital interactions, and economic flows (SASSEN, 1991). Traditional borders are being overcome by multinational corporations and digital spaces that operate independently of physical constraints (CASTELLS, 1996). As global capital establishes a decisive territorial control over urban areas, social interactions are being transformed (HARVEY, 1989). However, individuals and groups continue to claim, defend, and negotiate space in order to gain security, identity, and social advantage (BORDIEU, 1990). Thus, territoriality continues to exist as a concept where competition and cooperation, exclusion and inclusion, power and resistance intersect (COHEN, 1990).

Another phenomenon that is a determinant of the process in question is centrality which is a social, psychological and cognitive concept beyond physicality (MACARTHUR; PIANKA, 1966, ORIANS; PEARSON, 1979). Centrality is an important type of spatial ownership strategy that determines the positions of individuals and groups within the city and regulates their status and access opportunities. The spatial locations of the territories of social groups play an important role in the construction of identity (HALL, 1966; TAJFEL; TURNER, 1979) . Access to central areas is determined not only by the personal preferences of individuals, but also by power struggles between social groups (GIDDENS, 1991; SIDANIUS; PRATTO, 1999). While powerful groups maintain their status by controlling areas with high centrality, they create various spatial and social barriers such as high rents, certain social norms and practices that prevent disadvantaged groups from entering these areas (NEWMAN, 1972; WACQUANT, 2008).

Individuals tend to own central areas not only physically but also psychologically. In this context, groups that control central areas through social networks and economic opportunities see these areas as their own and construct psychological and physical boundaries that prevent the entry of external groups (ALTMAN, 1975; STOKOLS, 1987). On the other hand, for marginal groups, central areas can become foreign, difficult to reach, and sometimes places that cause control over them (DOLLARD et al., 1939; SHERIF, 1966). Thus, in addition to economic advantage, centrality also plays a critical role in terms of security, belonging, and identity construction (GIDDENS, 1991; TAJFEL; TURNER, 1979; HALL, 1966). As a result, spatial exclusion is also reinforced at the psychological level and social conflicts are increased (SIDANIUS; PRATTO, 1999; WACQUANT, 2008). Therefore, focusing not only on economic factors but also on socio-psychological mechanisms is important in understanding how centrality works.

Thus, cities become dynamic scenes where social groups compete, cooperate, build their identities and try to maintain their existence by owning a territory in a constant struggle to survive (TAJFEL; TURNER, 1979; BOURDIEU, 1984; SIDANIUS; PRATTO, 1999). In the process, some groups maintain their privileged positions with relatively high economic, social and cultural resources, the others are pushed to the opposite territories (GIDDENS, 1991; WACQUANT, 2008). For instance, for advantaged groups, gated communities, secure residences and prestigious neighborhoods are not only comfortable living spaces but also an indicator of social status (BOURDIEU, 1984; HARVEY, 2008; LOW, 2003). On the other hand, disadvantaged groups are forced to settle in areas with low infrastructure and limited services (DAVIS, 2006; WACQUANT, 2008).

In this context, urban segregation, in addition to being a result of economic differences, is also a multi-layered process shaped by social competition and cooperation (SHERIF, 1966; DOLLARD et al., 1939), as well as by territoriality and centrality relations (HALL, 1966; ALTMAN, 1975; ORIANS; PEARSON, 1979; MACARTHUR; PIANKA, 1966). Beside reflecting existed social hierarchies, these mechanisms also reinforce them by creating spatial boundaries and psychological distances. In turn, this reproduces inequality and intensify socio-spatial fragmentation (NEWMAN, 1972; STOKOLS, 1987; TAJFEL; TURNER, 1979).

Meanwhile, urban space also becomes a tool to be used in the construction and preservation of social identity. For this reason, those living in prestigious neighborhoods continue the segregation by limiting outsiders with certain social and economic barriers. On the other hand, excluded ones in the lower layers of the hierarchy prefer to stay together in certain neighborhoods such as informal settlements in order to build and preserve their own identities (WACQUANT, 2008). This tool also serves other interests. For capital groups, urban transformation is one of the most effective tools of the competition process. Real estate investments, infrastructure projects and spatial planning are strategic moves that enable groups with high economic capital to establish hegemony in the city. In the process, existing urban areas are transformed into high-value investments after being seized by capital. Projects planned for the maximization of urban rent are generally implemented in a way that prioritizes the interests of economically powerful advantaged groups without considering the needs of disadvantaged groups (SASSEN, 1991; HARVEY, 2008). This situation becomes particularly evident when powerful social and economic groups consolidate their dominance over the city. Urban transformation projects, spatial planning, and public space arrangements are not only the reshaping of the physical environment, but also the organization of the social order in favor of certain interest groups. Thence, the spatial organization of the city becomes a reflection of power relations between social classes, and these arrangements are the basic mechanisms that determine who can reach central positions in the city, who will be pushed to the peripheries, and which groups will benefit more from urban resources (SASSEN, 1991; CASTELLS, 1996; HARVEY, 2008; WACQUANT, 2008). On the other hand, for disadvantaged groups, the city is not only an area where they are excluded, but also a stage where they demand their rights through collective struggle. Cooperation networks developed against urban transformation projects, collective movements aimed at the protection of public spaces and organizations aimed at defending the rights of local people are the basic elements of this struggle (HARVEY, 2008). The networks in informal settlements, resistances developed by communities against displacement or movements defending urban common uses are examples of collective resistance strategies in the struggle over the city (WACQUANT, 2008).

As a reflection of these dynamics, as of 2022, approximately 25% of the global urban population (approximately 1.1 billion people) live in slums or informal settlements. Moreover, this number is expected to increase significantly in the next 30 years, with an additional 2 billion people. This translates into an estimated 183,000 people moving into informal settlements every day, mostly in developing regions of the world. The rapid expansion of slums reflects the widening gap between advantaged and disadvantaged groups, which in turn reinforces social exclusion and inequality (UN STATISTICS, 2023).

The distribution of informal settlements also varies, reflecting global dynamics. The East and Southeast Asia have the largest share. According to 2019 statistics, these regions host 370 million people living in slum-like conditions. Sub-Saharan Africa follows with 238 million people, while Central and South Asia has 227 million people living in slums. The rapid urbanization of these regions without adequate infrastructure causes serious problems in housing, sanitation and basic services. The lack of a balanced investment in affordable housing also deepens these inequalities. As a result, millions of people are trapped in precarious living conditions (UN STATISTICS, 2019).

This inequality also has implications across a variety of other social dimensions. For example, in the United States, racial wealth disparities remain significant. While Black households saw a 77% increase in median wealth from 2019 to 2021, it remains significantly lower than that of white households (PEW RESEARCH CENTER, 2023). Similarly, racial income inequality remains a critical problem in Brazil. Afro-Brazilians earn approximately 40% less than their White counterparts (SALATA, 2020). The racial income disparities seen in these two examples are reflective of long-standing and systemic inequalities. Meanwhile, women still earn less than men globally. The gender wage gap suggests that women earn approximately $0.83 for every dollar earned by men (STATISTA, 2024).

Studies have also shown that health disparities persist across social groups with different social identities, including racial, ethnic, and gender groups. For example, in the United States, non-elderly American Indian, Alaska Native, Hispanic, Native Hawaiian, Pacific Islander, and Black populations are more likely to be uninsured than their White counterparts. Additionally, as of 2022, life expectancy for white individuals is 77.5 years, while for Alaska Native individuals it is 67.9 years and for Black individuals it is 72.8 years. Furthermore, infant mortality rates highlight disparities. According to 2022 data, the mortality rate for black infants is 10.9 per 1,000 live births, compared to 9.1 per 1,000 for Alaska Native infants. For white infants, the rate is 4.5 per 1,000 (KAISER FAMILY FOUNDATION, 2023). Another study found that Black men and women at age 55 exhibit similar levels of frailty to White individuals who are 13 and 20 years older, respectively. Additionally, Hispanic men and women exhibit similar levels of frailty to White individuals who are 5 and 6 years older, respectively (RUSSO et al., 2024).

1.3 Study objectives

Following the ideas above, it is seen that urban segregation is not simply a one-dimensional hierarchical structure, with one group being absolutely advantaged or disadvantaged over another. Rather, social stratification within urban spaces is context-dependent and relational, shaped by intersecting factors such as economic capital, social networks, cultural practices, and territorial control. When compared in different contexts, groups may exhibit multi-layered and situational structures that are distinct from one another in terms of social, economic, and spatial variables. A group that enjoys economic privilege may be culturally marginalized in another setting, or a politically dominant group in one area may experience spatial exclusion in another. This reveals that urban segregation involves simultaneous patterns of advantage and disadvantage, producing complex, overlapping spatial orders rather than a simple binary of inclusion and exclusion.

For example, while upper-middle-class white-collar professionals are considered an advantaged group in terms of their economic capital and level of education, individuals with certain ethnic identities or immigrant status may face discrimination and social exclusion in some areas (BOURDIEU, 1986; MASSEY; DENTON, 1993). This situation shows that economic advantage does not always coincide with spatial or social advantage, and urban segregation cannot be explained solely by income levels (SASSEN, 2005; WACQUANT, 2008). Similarly, although low-income immigrant communities are economically disadvantaged, they can be strong in terms of social capital through cooperation networks, mutual aid practices, and shared cultural identities (PUTNAM, 2000). This can play a critical role in individuals’ access to housing, employment, and services by bringing with it certain advantages in urban space. For example, territories with a dense immigrant population can provide a relative safety for the members of the group with low-cost housing opportunities and ethnic solidarity mechanisms (NEWMAN, 1972; STOKOLS, 1987). Therefore, in order to understand urban segregation, instead of a single identity axis, it is necessary to consider the intersections of different identity elements. The same individual or group can be in both advantaged and disadvantaged positions in different contexts, and this creates a dynamic process of social competition and solidarity in urban space.

From a wider perspective, the globalization process shows that advantaged and disadvantaged groups living in different geographies, despite their local differences, can actually be grouped under the same super-ordinate category and are subject to similar social dynamics (GIDDENS, 1990; CASTELLS, 1996). This process not only transforms economic relations and spatial organization, but also leads to the reproduction of segregation mechanisms in cities in similar ways on a global scale (SASSEN, 2001; HARVEY, 2005). For example, high-income technology workers in London, financial sector professionals in New York, or upper-middle-class entrepreneurs in São Paulo are affected by the local spatial segregation dynamics of the cities they live in, but they are in a class and spatial formation that is closer to each other on a global scale (CASTELLS, 1996). These groups tend to concentrate in similar urban areas, exhibiting common behavioral patterns in terms of global capital flows, international integration of labor markets, and spatial preferences (SASSEN, 2001; HARVEY, 2005). High-quality housing projects, prestigious business areas shaped in global city centers, and services in line with international standards become common elements that determine the spatial practices of these groups (CASTELLS, 1996; SASSEN, 2001; HARVEY, 2005). Similarly, immigrant communities living in the suburbs of Paris, low-income groups in the slums of Istanbul, or poor groups living in the slums of Buenos Aires share a common destiny in terms of urbanization processes, despite having different cultural backgrounds (WACQUANT, 2008). Urban segregation standardizes the forms of socio-spatial exclusion that these groups are exposed to on a global scale, causing similar spatial marginalization mechanisms to be reproduced in different geographies (CASTELLS, 1996; HARVEY, 2005).

Therefore, the globalization points to the fact that social and spatial segregation in cities is shaped by both local and global power relations and economic dynamics (SASSEN, 2001; HARVEY, 2005). Social hierarchies reproduced by the same economic system in different regions structure spatial organization in cities in similar ways, ensuring that advantaged and disadvantaged groups come together under certain super-ordinate identities in the global context (WACQUANT, 2008; CASTELLS, 1996). In this context, it is necessary to analyze cities not only within the framework of individual and local dynamics, but also through the intertwined processes of segregation and integration on a global scale.

This process is particularly evident and complex in metropolitan areas as they stand out as scenes where different social groups interact intensively and sharp lines of separation are experienced at the most advanced level, being at the center of global capital flows, migration movements and technology based economic transformations (CASTELLS, 1996; HARVEY, 2005; SOJA, 2010).

As a result, metropolises becomes places of separation and areas where competition and cooperation processes are intertwined. As part of the global economic system, the dependency relations between the highly skilled workforce and low-skilled service sector workers in these cities necessitate spatial encounters. However, these encounters are often shaped within the framework of hierarchical social relations (SASSEN, 2001; WACQUANT, 2008).

Table 2- Evolutionary and socio-psychological frameworks used in the study

Approach	Key References	Core Contribution to Study
Evolutionary Theories	Darwin (1859/2009); Hamilton (1964); Trivers (1971); Smith (1982); Axelrod; Hamilton (1981)	Frame competition and cooperation as adaptive strategies; points to boundaries and group strategies.
	Tooby;Cosmides (1992)	Coalition formation logic, interprets municipal clusters as emergent coalitions in resource-based conflicts.
Cultural Evolution and Cognitive Psychology	Boyd; Richerson (1985); Richerson; Boyd (2005); Henrich (2016)	Cultural norms stabilize cooperation amid inequality, explains continuity of communal practices and institutional legacies.
	Kitayama; Park (2010); Triandis (1995)	Cultural variation shapes cooperation and competition, contextualizes behavioral differences.
	Haidt (2012)	Moral values structure group boundaries, interprets policy exclusions as moralized territorialization.
Behavioral Economics and Motivational Theories	Fehr and Gächter (2000); Adams (1965); Vroom (1964)	Cooperation influenced by fairness, sanctions, and outcome expectations, applied to explain municipal variance in cooperation.
Social Learning and Field-Based Theories	Bandura (1977); Lewin (1947); Engeström (1987)	Demonstrate how modeled behavior and spatial context influence group action, explains municipal imitation and neighborhood action.
Symbolic Interaction and Social Comparison	Mead (1934); Blumer (1969); Festinger (1954)	Groupings interpreted as symbolic constructions, competition emerges from identity-based comparisons.
inter-group Conflict and Attribution	Allport (1954); Sherif (1966); Heider (1958); Kelley; Michela (1980)	Explain inter-municipal dynamics of prejudice and conflict, used to model urban segmentation and contact barriers.
Social Network Analysis	Wasserman; Faust (1994)	Quantifies spatial cohesion and access, operationalizes centrality and network-based urban advantage.

Source: Author, 2025.

Table 3- Sociological frameworks used in the study

Approach	Key References	Core Contribution to Study
Classical and Early Modern Thought	Ibn Khaldun (1377/1978), Machiavelli (1532/2003), Bodin (1597/1967), Hobbes (1651/2017), Locke (1690/1952), Rousseau (1755/2010), Kant (1795/2015), Ferguson (1767/1996), Turgot (1770/2008)	Foundations of group solidarity, state formation, property, egoism vs. altruism tension.
Evolutionary and Early Sociology	Spencer (1864/2017; 1876/2013), Tönnies (1887/2011), Durkheim (1893/2013), Simmel (1900–1908/1950–2009), Ross (1930), Sumner (1906/2007), Small (1905/2008), Bagehot (1872/2010), Gumplowicz (1899/1975)	Cooperation and competition, social forms, status boundaries, and early social differentiation.
Conflict and Critical Theory	Marx (1867/2007), Gramsci (1971), Dahrendorf (1959), Vold (1937/1997), Silver (1994), Tilly (1998)	Class conflict, hegemony, authority, durable inequality, and institutional exclusion mechanisms.
Interpretive and Urban Sociology	Weber (1922/2019), Park; Burgess (1925/2019), Kropotkin (1902/2017), Wacquant (2008), Caldeira (2000)	Social action, informal solidarity, symbolic boundaries, and territorial stigma.
Critical Geography and Planning	Harvey (1982/2007; 2005), Sassen (1991; 2001), Santos (1994), Rolnik (1997), Castells (1996)	Global urban dynamics, peripheral urbanism, and informational exclusion.
Institutional and Social Capital Theory	Ostrom (1990), Putnam (2000), Sen (1999), Ballard; Hamann (2021)	Collective action, associational networks, and spatial inequality.
Empirical and Policy Oriented Approaches	Piketty (2014), Oxfam (2024)	Wealth concentration, global inequality data, and network; centrality metrics in spatial stratification.
Morphological and Network Analysis	Hillier; Hanson (1984)	Space syntax, centrality measures, and socio-topological analysis of urban structure.

Source: Author, 2025.

For example, although an upper-middle class professional working in financial centers shares the same physical spaces with low-income service sector workers in their daily lives, these encounters occur within asymmetric power relations and different spatial usage patterns (HARVEY, 2005). Thus, metropolises are critical areas of investigation not only to see the spatial expressions of social competition and segregation, but also to understand how cooperation and dependency relations are spatially organized, social hierarchies are embodied in space, and micro-spatial segregations within the city are linked to global-scale social and economic processes (CASTELLS, 1996; LEFEBVRE, 1991).

Given the various dimensions of the discussion in the above paragraphs, this study examines the mutual effects of social competition and cooperation dynamics and transpatial social groups living in both the Metropolitan São Paulo and Istanbul in the light of various disciplines such as biology, socio-psychology (Table 2) and sociology (Table 3). It highlights the interplay of the social groups and urban configuration characteristics of the territories they inhabit. The analysis of these interactions aims to discuss that human settlements are not merely passive scenes that are shaped by social dynamics, but also an active tool that shapes power relations, resource allocations, and social hierarchies.

The main research axis is to examine how demographic and socio-economic factors intersect with urban configuration and end up as patterns of segregation. Defining the advantaged and disadvantaged transpatial groups and documenting the mutual spatial relations in these metropolitan areas will help to understand the roles of social dynamics and urban configuration in strengthening or weakening social inequalities. This approach goes beyond treating mentioned groups as simple binary categories by emphasizing the multidimensional and dynamic nature of groupings in settlements.

For this purpose, the study combines concepts of social competition, cooperation, territoriality, centrality, in equality and urban segregation to provide a multidimensional analysis of spatial dynamics. Moving beyond traditional models that treat segregation as a result of solely top-down socio-economic forces, it argues that urban space is constantly shape and reshaped by interactions between social groups.

In this context, the following questions were asked as a starting point;

1. How do social groups shape and shaped by both social competition and cooperation in the territorial struggle over urban spaces?
2. How do configuration characteristics such as road network structure and centrality values are formed by and canalize social competition and cooperation?
3. What are the similarities and differences in the socio-spatial mechanisms including social groupings, territoriality, and centrality that underlie patterns of urban segregation?

The following hypotheses were then put forward;

1. Transpatial advantaged groups consolidate their spatial advantages and power with their relatively higher access to urban resources while disadvantaged ones face lack of access in territories with lower centrality values.
2. Despite being located in two different contexts, both Metropolitan São Paulo and Istanbul will exhibit structural similarities in terms of mentioned concepts, as they are highly effected by economic forces, social competition and cooperation dynamics in a global scale.
3. Advantaged groups are more densely located in territories with higher centrality values, while disadvantaged groups are pushed to territories that are spatially fragmented and have limited access to high centrality territories.
4. Social groupings, competition and cooperation in settlements are not just binary dynamics between advantaged and disadvantaged groups. It is shaped by the intersection of various axes including class, ethnicity, status, and the interaction of these axes determine and determined by spatial configurations.

To address the questions and hypotheses, the study uses a six-step mixed-methods framework that combines descriptive statistics, Location Coefficient (LQ) mapping, Random Forest (RF) classification, Space Syntax configurational analysis, Pearson correlation, and cross-case synthesis. Each step builds on the previous one and aims to compensate for the limitations of the others. The first step profiles socio-demographic variables, followed by mapping spatial concentrations. This is followed by modeling group boundaries, embedding social dynamics in urban form, and statistically linking social and spatial measures. The results are then used in a comparative analysis of Metropolitan São Paulo and Istanbul. By combining inductive pattern detection with deductive validation, and quantitative rigor with spatial context, this approach provides a detailed and empirical explanation of how social competition and cooperation produce urban segregation.

However, there are also some methodological and contextual limitations. First of all, São Paulo provides detailed census tract information, while Istanbul relies on neighborhoods of variable size. Therefore, the comparison is limited to municipality-level data, which reduces spatial precision and masks intra-municipality diversity. Second, indicator definitions and availability differ. For example, São Paulo provides racial/ethnic data that Istanbul does not. Or, some measures are more detailed in one case, while others are detailed in another. As a result, cross-case measures are approximate and required careful interpretation. Third, Space Syntax analysis is constrained by computational and software limitations. This allowed only a core subset of measures rather than the full suite. Fourth, data collection occurred during the COVID-19 pandemic, resulting in delays and mixed annual datasets. This also restricted the access to certain indicators. Finally, municipal governance structures and data policies differ between the two contexts, resulting in different administrative and statistical regimes. Taken together, these limitations mean that comparative results should be viewed as indicative. Future studies may overcome these limitations and allow deeper inferences to be drawn about the issue under consideration.

Yet, the study contributes to the discussion of global social hierarchies, supporting the fact that segregation is not only a local phenomenon but also intertwined with global economic and social inequalities. Comparing two metropolises, São Paulo and Istanbul, whose historical processes are different but under the influence of similar global logic, shows how settlements function as fundamental arenas and tools that are produced by and reproduce social hierarchies.

In summary, the study provides a theoretical and empirical framework to understand the issue. To do so, the second chapter (Literature Review) examines the relevant literature and forms the conceptual basis. First, sociological perspectives focus on the relationships between social dynamics, urbanization and spatial segregation are presented. Then, how socio-psychological theories handle the issue are discussed by addressing individual and group-level behavioral mechanisms. Following these, the mutual relationship between handled social dynamics and urban segregation is examined through different eras and geographies. In this framework, the historical development from ancient civilizations to the industrial revolution and modern urban landscapes from the post-industrial era to globalization are discussed. In the third chapter (Method), the methodological approaches and analytical tools used in urban segregation studies are evaluated and the method and data analysis techniques used in the research are explained. The fourth chapter (Results and Discussion) presents the empirical findings of the study. First, the cases are pictured through their population dynamics, geographical distribution and the configuration of social groups. The subsections detail the spatial and social differentiation by focusing on the subcategories of social groups. Then, the urban configurational features are analyzed and discussed. Finally, the cases are compared to highlight the similarities and differences considering the theme of the study. Finally, the fifth section (Conclusion) summarizes the findings, mentions the limits, offers suggestions for future research and planning policies.

2 LITERATURE REVIEW

Throughout history, philosophers and scientists from different disciplines have addressed the dynamics shape and shaped by the mutual interaction of social competition and cooperation in order to understand society through the lenses of sociology, evolutionary biology, social psychology and urban studies. Each perspective offers different yet interconnected insights on the mechanisms that drive these processes. While sociology examines the issue highlighting individual and group interactions within social hierarchies, social psychology focuses on the cognitive and emotional processes that drive underlying behaviors. Meanwhile, evolutionary theories emphasize the biological basis of these dynamics and urban studies focus on their mutual spatial interactions. The findings points to the fact that social competition and cooperation are neither exceptional nor isolated phenomena. Importantly, these dynamics constantly effect and are affected by social relations. Urban space, on the other hand, functions as both a tool and a stage for these processes, reinforcing belonging to groups, territoriality, centrality and resource distribution within the settlements. Given this overview, this chapter presents a targeted literature review. It synthesizes key theoretical and empirical contributions from above-mentioned science and disciplines to frame the research on group dynamics, territoriality, and centrality, inequality and segregation in metropolitan areas.

2.1 Sociological perspectives on societal dynamics

This section extends from historical perspectives to current global debates on the issue. The historical trajectory begins with foundational theories that continue to shape contemporary debates, exploring sociological perspectives on the nature of societal structures (Table 4). As the section progresses, the impact of neo-liberalization and globalization is examined through modern theoretical frameworks, emphasizing the increasing complexity of social dynamics. This progression points to the role of social competition and cooperation on shaping the societal structures across various theoretical, economic, social, and spatial contexts.

Table 4- Sociological theories

Concept	Key Theories	Implications for Urban Dynamics
Groupings	Social Group Theory (Weber, 1922); Class Conflict (Marx, 1867); Habitus and Field (Bourdieu, 1984)	Social stratification generates group formations around class, status, and symbolic capital; boundaries shaped by material conditions and symbolic distinctions are physical expressions of group identities.
Social Competition	Conflict Theory (Dahrendorf, 1959); Resource Mobilization Theory (Tilly, 1978); Urban Political Economy (Logan; Molotch, 1987)	Urban space becomes an arena of struggle over jobs, services, and symbolic prestige; capitalism intensifies competition over centrality and access, while policies often reinforce dominant interests through exclusionary zoning and development practices.
Social Cooperation	Functionalism (Durkheim, 1893; Parsons, 1951); Communitarianism (Putnam, 2000); Collective Action Theory (Olson, 1965)	Shared norms and institutions can counterbalance social fragmentation; cooperation emerges in mutual aid networks, neighborhood councils, and informal settlements resisting exclusion.
Centrality	Urban Ecology (Park and Burgess, 1925); Central Place Theory (Christaller, 1933); Global Cities Theory (Sassen, 1991)	Access to central urban zones confers economic, political, and symbolic power; peripheral areas face systemic disinvestment and stigma; global capital flows intensify spatial concentration.
Territoriality	State Theory (Bodin, 1967; Foucault, 1980); Moral Regulation (Elias, 1978); Space Syntax (Hillier and Hanson, 1984)	Space is used to enforce order, identity, and control through both institutional planning and informal claims; boundaries materialize social hierarchies and regulate inter-group visibility and access.
Social Inequality	Capital Accumulation (Harvey, 2005); Coloniality of Power (Quijano, 2000); Cultural Hegemony (Gramsci, 1971)	Economic, symbolic, and political capital is unevenly distributed across space; inequalities are reproduced through planning and labor markets entrenching socio-spatial hierarchy and structural exclusion.
Urban Segregation	Symbolic Boundaries (Lamont and Molnár, 2002); Social Closure (Weber, 1922); Spatial Justice (Soja, 2010); Assemblage Urbanism (Farias; Bender, 2010)	Intersecting material and symbolic processes: legal codes, planning systems, and cultural classifications co-produce clusters; social closure strategies block access to valued spaces for disadvantaged groups.

Source: Author, 2025.

2.1.2 Foundations of Solidarity and Sovereignty (14th–17th Centuries)

Although it is possible to start historical approaches from various times and geographies, Ibn Khaldun constitutes a meaningful beginning due to his contributions to the foundations of sociology. In his work titled Muqaddimah, he emphasizes the importance of asabiyya, which is a fundamental bond, including social solidarity, in the transition from nomadic to urban organization. According to his observations, individuals need social solidarity in order to survive. Thus, societies are formed when individuals come together to meet their vital needs. In this process, competition and cooperation are the basic dynamics. Ibn Khaldun also determines that individuals have an inherent aggressiveness by nature. Therefore, a governing authority is necessary for the establishment of social order. Thus, social solidarity has a very important role in individual survival and social stability (IBN KHALDUN, 1377/1978). Another critical observation comes from Machiavelli by emphasizing the self-directedness of human nature. He underlines the tendency of individuals to seek power and form alliances, which are the reflections of competitive and cooperative instincts that lead individuals to a lack of virtue. In addition, according to him, the balance between the ruler and the ruled is established through institutions emerged as result of competition (MACHIAVELLI, 1532/2003).

In Bodin's analysis individuals are also at the center. According to him, every individual is subjected to another and their social roles are determined by hierarchical structures. He observes that the identity elements that individuals have, such as profession or nobility, are important in determining their positions. Facts such as class distinction emerge among the winners and losers as a result of competition. In addition, the persistence of a stable social structure depends on the continuity of this competition, the resulting dissolution and reorganization, while the resource scarcity keeps being an important factor in the process. Bodin also emphasizes the need for the existence of authority in order to ensure social harmony among various groups. On the other hand, he examines the family as the building block of society. According to him, through property ownership, families come together and establish dominance in advantageous areas (BODIN; 1597/1967).

Hobbes (HOBBES, 1651/2017) also states that individuals tend to gain, increase and maintain power over others, thus, the natural state of individuals is in a dynamic competition. In such a situation, he defines anything that will enable maintaining existence as a natural right. Therefore, like Ibn Khaldun and Bodin, he suggests that the existence of a third factor over individuals, a social contract, is necessary for stability. However, he also notes that individuals must partially give up their freedom in order to achieve this social contract. Thus, cooperation can be achieved as a result of certain sacrifices. Ferguson, in addition, emphasizes these views by stating that competition and cooperation are inevitable because of human nature and necessary for social development. He points to the individual's instincts and habits as the basic determinants of interpersonal relations in a society. Competition provides social development, and cooperation provides the benefit of the gains of this development. The areas of these dynamics that he particularly points out are economic and political domains (FERGUSON, 1767/1996).

2.1.2 From Enlightenment to Early Sociology (18th–Early 20th Centuries)

Defending individual freedom and property rights, Locke states that property right leads to competition. According to him, while individuals are free and equal in the natural state, private property changes the situation (Locke, 1690/1952). Jean-Jacques Rousseau, on the other hand, argues that people are naturally good but are corrupted by social influences. He emphasizes private property and argues that the use of property rights leads to social inequality. According to him, individuals must cooperate in eliminating these inequalities (ROUSSEAU, 1755/2010).

Furthermore, Turgot defines the competitive tendency as a universal characteristic. Just like Rousseau, he points to the importance of wealth distribution and its effects on social harmony. An unequal distribution will increase tensions between individuals and groups. On the other hand, these tensions are the source of all social developments by enabling intercultural exchange. Thus, like Ferguson, he also emphasizes the positive effects of political conflict. According to him, economic competition is also important in increasing the efficiency of production, which is necessary for sustaining life (TURGOT, 1770/2008). Meanwhile, Kant suggests that there is a balance between the individual selfishness and their cooperation capacity. According to his observations, while individuals are self interested that leads to conflict and competition, they also inherently need to coexist and cooperate. This nature drives individuals to form societies, legal and political structures. With the role of institutions and laws a peaceful coexistence is created (KANT, 1795/2015).

In the 19th century, Marx approached the issue from another perspective. According to him, the main form of social competition is class struggle which is shaped around capitalism. As a result of capitalist dynamics, exploitation and alienation emerge, paving the way for competition between the working and ruling classes. However, he also emphasizes the potential for cooperation in and among the working classes, even transcending national boundaries (MARX, 1867/2007). Following Marx, Weber carries out a deeper analysis by explaining how social structures are shaped by individual actions and meanings. His theory of social action classifies behavior as traditional, emotional and rational and individuals engage in competitive and cooperative actions in line with social norms and values. Weber also defines the concept of understanding. This concept involves individuals empathizing with the values and culture of others which encourages cooperation even in competitive environments. Herein, defined rules, roles, and hierarchy are essential to social harmony (WEBER, 1922/2019).

From another perspective, Spencer approaches society with Darwinian principles by putting forward the concept of Survival of the Fittest. He suggests that stronger individuals and groups prevail over weaker ones. Also according to him, competition is a natural and necessary part of the social progress (SPENCER, 1864/2017). However, he states that cooperation also plays an important role by helping individuals to reach common goals and establish a social order. Thus, while competition plays the primary role, cooperation serves as stabilizing factor (SPENCER, 1876/2013). Kropotkin also touches on competition by emphasizing the importance of cooperation. He suggests that cooperation and mutual aid are important for the survival and success and a critical factor for social stability (KROPOTKIN, 1902/2017).

By adding other dimensions, Gumplowicz sees individuals as agents whose thoughts and behaviors are shaped by their social environment, including historical and cultural factors. Therefore, competition and cooperation dynamics are built during social interactions. While focusing on family and land ownership in inter-group relations, he also presents grouping as the basis of all social phenomena by stating that any change in a group requires a certain inter-group relation. According to him, minority groups are subjected to dominant ones and these dominant groups tend to protect their own position and increase their power and territory by using subjected ones in the most profitable way. As a result, classes and sub-classes emerge in society, some of which arise from unity and some from separation. These processes are the source of ideas, emotions and morality and interactions between them causes social events and processes (GUMPLOWICZ, 1899/1975).

Another social scientist, Sumner, also defines social processes, focusing on the habits of groups. According to him, habits are shaped by the guidance of the most powerful members of the group and followed by others. Then, social processes are determined by the individuals repeating their efforts to meet their needs. Habits and traditions resulting from these processes are vital for the survival of individuals and societies. Sumner calls all these phenomena as folkways, which are custom-made solutions to solve common problems. Additionally, folkways construct the roles, professions, social classes, religious beliefs and sects. Thus, social groups, we-groups and they-groups, become the most important agents of social development, while each believing in their own superiority with ethnocentric attitudes (SUMNER, 1906/2007).

Small also agrees that individual economic interests direct social behavior and social life is the process of developing and satisfying these interests. According to him, individuals and groups compete for economic dominance, while cooperating for common economic benefits. The interaction of groups in line with their own interests constitutes social processes. Herein, social process has various forms in terms of spiritual environment or milieu, contacts, differentiation, groups, conflict, and social situation. Whatever the form, the basis is always the different interests of the people who form the groups in relation to each other (SMALL, 1905/2008). Meanwhile, Ross considers social interactions, personal competition and cooperation processes as fundamental elements in terms of the development of social structures, as well. While determining instincts, instinct-based interests, race and geographical conditions as social forces, he systematically reviews social processes by drawing attention to four basic forms of individual level interactions such as association, domination, exploitation and opposition (ROSS, 1930).

Vold also defines the existence of the individual by relating it to the group. According to him, group identities and sense of self are formed and maintained through participation in group activities. Through these activities, individuals also internalize group ideals. In addition to identity and grouping issues, Vold also highlights that competition, occurring when groups have a common interest, shapes social development and groups are the tools that individuals use to reach their needs and interests in the most effective ways. As new interests emerge in the environment, new groups are formed and old groups weaken or disappear. Furthermore, when groups are not kept away from each other's territory, conflict arises. For this reason, groups are always in a defensive position and the basis of this position is to prevent displacement. In cases where this threat of displacement arises, competition arises between nations, races, religions, economic systems, labor unions or any type of organization. He also states that as a result of competition, one of the groups may completely disappear or the group members may start to leave the group. Another result is the reconciliation. However, reconciliation does not occur between the strong and weak groups. The weak are subjugated and integrated into the group that wins the conflict in a subordinate capacity (VOLD, 1937/1997).

Considering issue of identity, Bagehot argues that identity and adherence to social norms within structured institutions are important for maintaining social order. Individuals must have a clear identity in order to conform to social rules. Clarified identity contributes to the stability of the social order. Thus, this view also emphasizes the importance of cooperation within the social framework. It ensures the maintenance of social harmony even in the face of competition (BAGEHOT, 1872/2010).

Meanwhile, Tönnies examines society from the perspective of groupings and the formation of society in two different ways. While society is shaped by rational will, conscious choice and a specific purpose, community is formed by natural will which are involuntary situations arising from natural relations. In addition, he establishes the concepts of community and society on separate sets of forces. While he explains the forces that form community as instincts, emotions and habits, society is shaped by negotiation and conscious choice that are dominant over these forces. As a result, community is highly integrated while society is segmental. Tönnies' socio-biological approach will eventually be called human ecology (TÖNNIES, 1887/2011).

Durkheim analyzes social cooperation by evaluating the individual within the framework of solidarity, as well. According to him, society is held together by shared beliefs and values (mechanical solidarity) or the mutual dependence of specialized roles (organic solidarity), maintaining social harmony. Moreover, norms and institutions have an important role in these processes. Durkheim also attributes the emergence of social institutions to his concept by describing the purpose of the law as satisfying collective feelings. In societies, where organic solidarity is the case, laws become the restorers of rights and provides the coexistence of different and interconnected groups and a functioning social system (DURKHEIM, 1893/2013).

Moreover, Simmel brings a psychological perspective to social dynamics by describing society as a complex network of interactions between individual minds struggling for existence. According to him, as a result of the interactions, dynamic relationships emerge. These relationships constitute the unions, and the unions constitute the society. In addition, each individual in these unions has their own role and characteristics. However, they are also reproduced by the group they belong to. Furthermore, groups that offer individuals different positions from each other have a characteristic that bears the traces of individuality and at the same time is beyond individuality. Finally, social relations between groups occur in the context of superiority and inferiority (SIMMEL, 1903/1950).

He also suggests that competition and cooperation are forms of social interactions. According to him, competition is a type of indirect cooperation and occurs for accessing to resources and status. As a result, rules and norms shape individuals and groups in line with them. This process can strengthen social harmony. In addition, even if needs and behaviors remain constant, social forms such as institutions and organizations change according to changing economic, social and technological conditions. A reflection of these changes is the new social groups formed by elite groups that cross borders. Furthermore, he defines urban formation as a fiction that arises from the individual's relationship with the group (super individual) while trying to protect their own individuality. At this point, he deals with the agreement that individuals make with the society in terms of the psychology of individuals. The metropolis creates the conditions for this process. The rapid and uninterrupted occurrence of stimuli reorients the psychology of the inhabitants. In addition, the metropolis exhibits a unique quality with the amount of personal freedom it offers to individuals. It gives this freedom to objective conditions that arise from the nature of society, over which individuals have very little control. The reason for these objective conditions is that the city exists independently of the individual. Moreover, the division of labor also transforms the survival struggle into competition.

Individuals specialize in order to guarantee their existence. Therefore, the money economy becomes very important because of connecting all the elements of metropolitan life by providing exchange and consumption. Thus, money organizes complex economic and social relations, enabling individuals to engage in resource competition on an objective and standardized basis and encouraging cooperation as a common value system (SIMMEL, 1900/2004).

Simmel (SIMMEL; WOLFF, 1950) also touches upon the concept of border by defining it as a sociological phenomenon rather than a spatial phenomenon. While the border separates a social group from the outside world, it also ensures the internal unity. This makes the social order more concrete and dense. As a result, social configurations within different borders differ from each other. Within this framework, he lists four other spatial formations resulting from social interactions as organized space from rational, political and economic organization, territorial control from local social domination, fixed places as a result of social bonds and empty spaces as the result of neutrality, protection or potential appropriation. Moreover, Simmel also focuses on movement, which is related to socio-spatial features. The individuals are potential travelers and their movements are shaped by the specific socio-spatial features of the place (SIMMEL, 1908/2009).

Focusing on the city life, Park and Burgess define cities as arenas where competition and cooperation between individuals and groups form social structures. In their studies, they emphasize how these structures and patterns emerge in urban life by examining the dynamics of the interactions of individuals and groups by following the tradition established by Small. They consider the individual as an element that interacts and forms society, just like Simmel does. Interests, sentiments, and attitudes are examined as social forces. Park and Burgess, who consider inter-group relations as social processes, first examine the degree of individuals' inclusion in the group through isolation, social contact, and social interaction. They also focus on the subjects of competition and cooperation while listing social forces as competition, conflict, accommodation, and assimilation. They consider these concepts as social processes rather than individual ones. Conflict is competition that is consciously and socially elevated and has an effect on the economic equilibrium. It determines the political order, while accommodation affects social organization.

Assimilation, in addition, is related to personality and the cultural heritage (PARK AND BURGESS, 1925/2019).

According to them, when a new immigrant comes to the city and encounters the existing social and economic order, he makes a choice. The individual who finds himself in competition will either integrate into the existing system or create an alternative area for himself. In the economic field, newcomers compete with the existing working classes in order to find a job. Migrants who work in factories, markets, construction sites or daily jobs try to make room for themselves by working for lower wages. This situation leads to a reaction from the established worker groups. Thus, the individual's adaptation process to the city becomes a competitive relationship with different social groups in the city as well as an effort to find a job. There is also competition in social life. While immigrants try to settle in certain neighborhoods of the city, they come face to face with groups already living in these areas. In this encounter, established groups may perceive the newcomers as a threat to their own social order. This perception may bring with it exclusionary attitudes. Thus, the newcomer's effort to adapt to the city becomes difficult and social separation deepens. In addition, immigrants compete with each other. Different immigrant groups compete for the same resources. At this point, ties of fellow countrymen, ethnic identities or religious affiliations are decisive in creating supportive social networks. Some may remain isolated by remaining outside these networks.

However, over time, the individual begins to better understand the rules and social dynamics that are new to him. Initial competition and conflicts give way to compromise. While established groups accept newcomers over time, immigrants adapt by developing their own social strategies. The adaptation process varies according to the social groups the individual is in. Some immigrants prefer assimilation to the established culture in order to be accepted more easily. These individuals give up their old habits and adapt to urban norms. However, this process may also conflict with the individual's efforts to preserve their own cultural identity. On the other hand, some groups construct alternative areas of existence through their own social networks. Fellow countrymen associations, cultural solidarity centers and ethnic neighborhoods help individuals exist within a group and preserve their identities. However, this situation can also squeeze the individual into certain communities and make it difficult for them to integrate into the wider urban society. At this point, the individual will either integrate with his/her new environment and move away from his/her past or will remain within his/her own group and will not be able to go beyond certain boundaries. This decision varies according to the individual's economic opportunities, level of education and social relations.

Thus, one of the most important factors determining the individual's future in the city is social mobility. In order to rise in the city, gain economic opportunities and reach better living conditions, the individual must have certain advantages. In this context, education is an important element. The level of education obtained can determine the individual's position in the social hierarchy. However, access to educational opportunities is also linked to the opportunities of the social group the individual is in. The process is more difficult for individuals belonging to marginal groups. Social networks also play a decisive role in the individual's urban mobility. Individuals can find jobs, obtain housing and receive social support through these networks. As a result, while some individuals and groups rise over time and become part of the middle or upper classes, the city continues to remain a field of struggle for others. The city becomes a space that reproduces the boundaries between social classes as well as providing opportunities for individuals.

Sorokin also mentions that populations have hierarchical orders. According to him, the permanent feature of any organized society is being divided into overlapping classes. They can be stratified based on economic criteria, politically based on authority and power or occupational difference. Thus, he considers the possibility of many concrete forms of stratification and sees them as sociologically important, drawing attention to two different phenomena. The rise or fall of a group as a whole and the increase or decrease in stratification within a group. Horizontal and vertical mobility underlie these. While horizontal mobility refers to the transition from one social layer at the same level to another, vertical mobility refers to the movement of individuals from one social stratum to another higher or lower in the hierarchy. Thus, Sorokin suggests that societies will be separated according to differences in the intensity and generality of social mobility. While mobility is high in societies where the boundaries between groups are permeable, the opposite is true in societies where groups are strictly separated. He also states that tolerance increases and intellectual life becomes easier in societies where mobility is high, while social isolation and mental problems increase in the opposite cases (SOROKIN, 1927).

2.1.3 Globalizing Forces and Decolonial Counter-currents (Late 20th–21st Centuries)

Bourdieu's concepts of habitus and capital also touch on the role of social competition and cooperation processes in spatial segregation. According to him, while habitus (BOURDIEU, 1990) determines the ways individuals think, feel and act that stem from their social positions and past experiences, the cultural capital (BOURDIEU, 1986) explains how education, language, art and cultural practices shape the social positions of individuals. Moreover, cultural capital provides a competitive advantage to individuals that also determines the positioning of social groups. Thus, groups with more capital strengthen spatial segregation by providing access to more advantageous areas and develop internal cooperation mechanisms. As a result, urban space becomes an area where social competition and in-group cooperation practices are embodied. Putnam further develops the concept of social capital by underlining that communities with high levels of social capital are more inclined to cooperate in solving common problems. On the contrary, communities with low levels of social capital have more competition and face social fragmentation (PUTNAM, 2000).

Additionally, Gramsci examines the dominance of the cultural and ideological sphere by the dominant class under the concept of cultural hegemony. He explains that competition is carried out in the field of ideas of social groups beyond the economic sphere and social change is an action that must be encouraged through cooperation between the lower classes against the hegemony of the dominant elite (GRAMSCI, 1971). Elias also examines power dynamics as well as social processes. As societies become more complex, individuals' internalization of social norms leads to more organized and cooperative behaviors. He also emphasizes that competition and cooperation are integral parts of the social development processes. In these processes, individuals strive to establish balance between competitive differences and the need for social harmony (ELIAS, 1978). Dahrendorf also focuses on the shaping of social relations by power and authority. According to him, society is inherently in conflict. Social division is the result of competition to access scarce resources. He confirms that competition and cooperation lead to social change and development (DAHRENDORF, 1959). In line with these, Foucault examines the shaping of individuals' behaviors through social norms and discourses. Power is productive as well as oppressive. Thus, individuals adapt when they are exposed to power relations. While the power applied through institutions regulates the dynamics of competition and competition, it also regulates social norms. In this way, social harmony is achieved (FOUCAULT, 1980). In addition, according to Habermas, rational communication creates a discussion environment free from oppression between individuals. This communication ensures that social relations are based on cooperation. This cooperation brings about mutual understanding and compromise, as opposed to competitive power struggles (HABERMAS, 1987).

Related with the power dynamics, focusing on the concepts of urban exclusion and spatial stigmatization, Wacquant argues that spatial segregation stems not only from economic inequalities but also from social control mechanisms. As a result of competition, some groups are positioned in advantaged areas, while disadvantaged groups are concentrated in marginal neighborhoods. In addition, these areas are stigmatized with negative social images. Thus, spatial competition is not limited to physical areas, but also continues in a symbolic dimension. While stigmatized spaces restrict the social mobility of individuals, they also provoke marginalized groups to try to overcome exclusion by forming solidarity networks (WACQUANT, 2008).

With a different approach, Hillier and Hanson examine the interaction of social behavior, cooperation and competition with spatial configurations. Thus, they connect social processes to spatial design. By establishing this connection with the concept of integration, they measure the accessibility of an urban area and individuals settled in this area to other areas and individuals. Therefore, areas with high integration encourage interaction between individuals and cooperation. However, by examining the relationship between social dynamics and spatial discrimination, they state that physical barriers and divisions in urban environments can prevent cooperation and cause social isolation. Another important factor in their theory is visibility. Areas with high visibility encourage more social interaction and cooperation. At the same time, social behaviors can be organized thanks to the easier observation of interactions. They also consider groups consisting of individuals by stating that solidarity, like their predecessors, causes social groups. They also accept the existence of spatial groups that are located close to each other in space and have common identity elements. Furthermore, they also draw attention to the existence of transpatial groups, which are individuals who, although spatially distant, are united under a common identity element at the super-ordinate level according to the situations they encounter. Individuals and groups move through space with varying amounts of aggregation or separation among each other and within the group (HILLIER AND HANSON, 1984).

Quijano's concept of colonialism offers an important perspective for understanding the historical roots of social competition in the Latin American context. According to Quijano, modernity is a process in which racial identities are positioned as the determining element of social hierarchy, beyond the discourse of progress suggested by the Western perspective. The economic and cultural legacy of the colonial period forces social competition to continuously produce existing inequalities. Based on this, colonialism is a system of competition shaped by identity, culture and space. However, in the face of this system, marginalized communities participate in alternative knowledge and space production processes by developing solidarity networks (QUIJANO, 2000). Cusicanqui's decolonial approach also speaks of the intertwining of spatial competition and solidarity. He defines cities as areas that simultaneously contain conflict and opposing elements. According to her, marginal and indigenous communities struggle to protect their identities against colonial spatial orders. This struggle, which also includes alternative urbanization practices, emphasizes the existence of solidarity beyond spatial competition (CUSICANQUI, 2012).

Mignolo and Santos, on the other hand, discuss the connection between competition and cooperation with the processes of knowledge production (MIGNOLO, 2011; SANTOS, 2014). Mignolo's concept of epistemic separation explains the global dominance of colonial knowledge systems and how they marginalize local forms of knowledge. The production and control of knowledge is one of the important tools used in competition between social groups. Western-centered knowledge systems determine the orientations of economic and political competition as well as the possibilities of solidarity. Santos supports this discussion with the concept of invisible knowledge. Within the framework of the concept, alternative forms of knowledge are systematically devalued, in other words, made invisible. The importance of alternative knowledge systems is that they form the basis of solidarity struggles against existing inequalities. As a result, the process of knowledge production is one of the most important dynamics of social competition and cooperation. Furthermore, Fanon’s works, through the window of colonialism, reveal the psychological dimension of social competition. According to him, colonial systems shape the identities of individuals and force them to compete within themselves. Individuals struggle with internal contradictions as well as external conditions. Thus, spatial segregation is directly linked to issues of identity and belonging. While racial and cultural hierarchies determine the conditions of competition for individuals, they also shape the internal solidarity mechanisms of groups. According to him, the process of spatial segregation reproduces competition and solidarity at the individual and social level (FANON, 1961).

Brazil’s intellectual tradition adds details to the issue by focusing on how competition and cooperation have shaped its own social and political atmosphere. In his work, Buarque de Holanda argues that the Portuguese patrimonialism fostered a cordial man whose personalism enables solidarity. According to him, this patrimonialism also supports nepotistic competition within social networks. These affective ties have also structured the entire system from rural landholding patterns to the formation of civic institutions. This structuring embedded cooperation in everyday relations while reproducing exclusionary hierarchies (BUARQUE DE HOLANDA, 1936). Ribeiro deepens this cultural analysis by pointing to miscegenation of Brazil’s Indigenous, African, and European populations in both conflict and alliance processes that continued centuries. According to him, resulting identity has been formed by mutual exchanges of language, ritual, and material culture, while ethnic groups competes for political and economic domination. In addition, he emphasizes the collective efforts to preserve indigenous knowledge as a cooperation which is a vital strategy for cultural survival amid colonial competition (RIBEIRO, 1995). Franco’s work also uncovers patterns of cooperation and competition in Brazilian society. She shows that enslaved and freed Africans constructed networks of mutual aid to contest the dynamics of the plantation economy, while competing even among themselves for scarce privileges and space. These alliances, anticipating later forms of urban *quilombola* resistance, are examples of subordinate groups that can mobilize cooperation under extreme competition (FRANCO, 1983).

Paz de Oliveira also analyses social movements to show how grassroots cooperation can contest elites even amid internal competition for leadership and resources in the late 20th century. Focusing on participatory budgeting and the Landless Workers Movement, he shows how strategic cooperation across class and regional divisions are crucial to advancing land reform, urban housing rights, and democratization (PAZ DE OLIVEIRA, 1999). Murilo de Carvalho also focuses on the issue of citizenship by examining electoral competition and civic cooperation. He argues that struggles over voting rights, party formation, and public education illustrate a dialectic between competition over political offices and resources and cooperation in building participatory institutions. Carvalho's longitudinal perspective underlines that every expansion of right to participate depended on coalitions of social groups negotiating territorial claims within the republic (CARVALHO, 2001).

Considering the urban scale, Santos criticizes the global capital's competitive logic that fracture local cooperation with his concept of the space of the citizen. He argues that when residents transform the city from a commodity circuit into a site of collective empowerment when they organize around shared needs, such as access to housing, transportation, and public services. His analyses of peripheral neighborhoods in São Paulo and Rio de Janeiro show that territorial cooperation among grassroots associations are useful strategies to resist marginalization (SANTOS, 1994).

From a Turkish perspective, Gökalp also defines intra-city cooperation and competition through the concept of asabiyyah in the transition from the Ottoman Empire to the Republic. According to him, neighborhood and tradesmen guild organizations were areas of both cooperation based on common cultural identity and competition for status and market share (GÖKALP, 1918). İnalcık's studies on the Ottoman economy also show that guilds both limited competition and created social capital within the neighborhood through monopolistic marketing rights and member solidarity in city centers. The bazaars and inns controlled by these structures constitute early examples of urban centralization and territoriality (İNALCIK, 1994). Genç, on the other hand, draws attention to the ongoing struggles between the state and the guilds in the Ottoman Empire for taxes, privileges and market access. According to him, the competition between different groups of tradesmen and merchants caused the spatial separation of the urban fabric. In the resulting pattern, the strong guilds settled in the central districts, while the weak groups clustered on the periphery (GENÇ, 1991). Berkes, on the other hand, emphasizes that the associations, cooperatives and professional organizations that emerged during the modernization process in Turkey organized both cooperation among citizens and ideological and class competition (BERKES, 1964).

Contemporary Turkish scholars likewise pictures the shaping effects of group-based competition and cooperation of urban territoriality and centrality. Keyder analyzes Istanbul as an arena for competition and cooperation between global and local capitalist groups reflected by the segmentary markets from informal bazaars to corporate real estate developments. As a result, spatial segregation occurs as advantaged capital groups consolidate high-value central zones and precarious vendors and small-scale traders are pushed to peripheral areas (KEYDER, 1999). Dikeç, on the other hand, focuses on participatory budgeting campaigns and social mobilizations as examples of intra-group cooperation that challenge the competitive logic of neo-liberal urban redevelopment. He presents the cooperation between the residents, activists, and NGOs and their collective action to reclaim territory including public parks, squares, and housing, under the pressures of the spatial marginalization imposed by real-estate finance capital and state planning (DİKEÇ, 2015).

In the context of globalization, the dynamics of competition and cooperation have become increasingly complex, creating a complex web of interactions between individuals, organizations, and nations. In this context, Florida underlines the new forms of competition and cooperation that emerged between cities and regions. This competition, which includes talent investment and innovation, is an obstacle to global cooperation (FLORIDA, 2005). Beck also states that emerging risks and uncertainties in globalization process require international cooperation. However, he emphasizes that the competition of nations and companies prevents effective solidarity because of the tension between global cooperation and national interests (BECK, 1992). On the other hand, globalization has created a new form of global governance characterized by decentralized and networked power structures. According to Hardt and Negri, globalization not only increases competition but also offers opportunities for new forms of global cooperation (HARDT; NEGRI, 2000).

Giddens examines the effects of this phenomenon on social structures and individual identities with dynamics that transcend borders, while also emphasizing how local and global cooperation shapes it. According to him, the interconnectedness of global systems adds new dimensions to existing dynamics. Local institutions are reshaped by global effects. However, global integration and international companies create an elite class that holds significant power. In addition, another transbordering group is formed on professional networks (GIDDENS, 1990). According to Castells, the social interactions of the network society affect the dynamics. Social, economic and political relations are transforming. He argued that power is concentrated in global networks in the fields of capital, information and technology, and this situation changes the competition and cooperation dynamics (CASTELLS, 1996). Bauman, on the other hand, argues that the transience of new social relations, competition for resources intensifies, and as a result, feelings of uncertainty and insecurity are strengthened. Moreover, globalization also allows marginal groups to establish connections across borders. This offers opportunities for new forms of solidarity (BAUMAN, 2000).

Moreover, Stiglitz focuses on the effects of globalization management on inequality and social justice. According to him, this new phenomenon could encourage cooperation and common welfare, but due to the way it is implemented, it increases competition between nations and societies by deepening existing inequalities (STIGLITZ, 2002). Further, Zizek focuses on the ideological effects of the issue and argues that the process masks deep social and economic problems. In this new order, cooperation is present but superficial (ZIZEK, 2008). Milanovic, in addition, focuses on the effects on income distribution. He states that international cooperation is necessary to eliminate increasing inequalities (MILANOVIC, 2016). Sandel also agrees that the phenomenon has negative effects on social values. Market oriented competition weakens social trust and reduces cooperation (SANDEL, 2012).

According to Harvey, who draws on Simmel’s views, money allows for the spatial separation of buying, selling, and other long-distance interactions, eliminating the absolute qualities of place and thus facilitating the concentration of social power in space. Like Simmel, Harvey focuses on the buying and selling of commodities including labor power by highlighting that capitalism requires this. Money and time economy are critical to profitability. Thus, spatial concentration is effective in reducing the cost of a movement that requires a certain amount of time (HARVEY, 1982/2007). In addition, according to him (HARVEY, 2001) labor is directed to places where enterprises are clustered. Thus, agglomeration economies occur. In this context, he concludes that urban agglomerations are also places built by capital in line with its own interests. They are characterized by economic relations between firms. Cultural processes also reinforce these flows. As a result, dominant classes and the alliances formed by these classes can give an identity to certain regions. These specialized economic regions with new identities create an uneven geographical development. While developing regions have larger markets, local tax bases, physical and social infrastructure and attract new activities and investments, other regions are deprived of this. As a result, wealth, power and influence are unequally distributed in geography. The existence of limits to continuous concentration and the structure of market relations also bring spatial dispersion over time. Capital moves to less developed regions with low-income standards and high unemployment rates. Another factor contributing to this process is the developments in transportation and communication technologies. These developments reduce the cost of time and spatial movement. As a result, production patterns begin to change and transform on geography. Thus, dominant groups and group coalitions are not only in competition, but that this competition takes place on geographical space.

Following this, Sassen developed the concept of global cities. She shows that the transformations in the world economy also cause transformations in urban place. According to the theory, global cities are economic centers where the world economy is managed and services are provided. In addition, these centers have attracted migration. As a result of this situation, a new cheap labor force pattern has emerged with the increase in export-oriented services and the industrial sector. Furthermore, the increase in high-income and technical jobs, the shrinkage of middle-income jobs and the significant increase in low-income jobs occurred as a result of global capitalism, which is trying to secure the labor supply. In order to secure this labor supply, policies have been developed by states. Before this period, cities were grouped with hierarchies that included first, second and third levels at the national level and this time, they are grouped with international hierarchies according to Sassen's world cities hypothesis. Major cities are considered as production, finance or coordination centers of the world economy within the framework of international relations. Sassen also determines the distribution of duties in the hierarchy as core, semi-peripheral and peripheral countries and names the cities of these places in the same way. Through this hierarchy, she presents a new global spatial order based on global money, information and human flow (SASSEN, 1991).

Sassen emphasizes that globalization also allows for new collaborations in intensely competitive areas. New social movements are shaped by the effect of globalization. Cities are the main arenas where the contradictions of globalization are experienced (SASSEN, 2001). Harvey also focuses on the changes that occur as a result of social characteristics within these spatial structures. Capital concentration creates advantaged and disadvantaged groups. At the same time, competition between these groups intensifies (HARVEY, 2005). Harvey and Sassen draw attention to the inequalities of wealth, power and influence created by capital moving in the global network in regions and cities. Economic power is effective in the distribution of resources and opportunities.

2.1.4 Dialectical Dynamics of Competition, Cooperation, and Spatial Power in Urban Segregation

Based on the above mentioned insights, it is seen that social competition and cooperation are mutually constitutive dynamics that determine spatial and social structures. From Ibn Khaldun's asabiyya (1377) and Machiavelli’s alliances (1532) to Spencer’s survival of the fittest (1864) and Weber’s theory of social action (1922), many theorists with various backgrounds emphasize that individuals and groups struggle for scarce resources such as economic opportunities, political power, and symbolic status, while at the same time interdependent to secure collective benefits and maintain social order. This dialectic of competition and cooperation can also be observed in different forms of socio-spatial restructuring, such as assimilation patterns and the formation of alternative ethnic neighborhoods (PARK AND BURGESS, 1925), struggles over guild privileges and patronage networks (İNALCIK, 1996; GÖKALP, 1918), or civil associations and participatory budgets (PAZ DE OLIVEIRA, 2009; DIKEÇ, 2007).

In this interaction, territoriality and centrality function as both disciplinary mechanisms and strategic resources. Early thinkers such as Bodin and Hobbes

(BODIN, 1967; HOBBES, 1651) emphasize the need for authority and contract to regulate the innate aggressiveness of individuals, paving the way for the production of different forms of spatial access through legal, institutional, and design principles later develop by urbanists such as Park, Burgess, Hillier, and Hanson (PARK AND BURGESS, 1925; HILLIER AND HANSON, 1984). Harvey and Sassen extend these insights to a global scale (HARVEY, 2005; SASSEN, 1991). They show that the logic of concentration of capital creates centers of accumulation and global cities where flows of information and finance converge, while peripheral regions are left with a lack of infrastructure, stigmatized identities, and limited mobility.

Inequality and spatial segregation are expected outcomes of these processes. Bourdieu and Putnam emphasize that the unequal distribution of economic, cultural and social capital (BOURDIEU, 1986; PUTNAM, 2000) leads to spatial clustering that increases cooperation within groups but intensifies competition between groups. Wacquant, Quijano and Cusicanqui show how economic exclusion is reinforced by symbolic stigmatization and colonial legacies (WACQUANT, 2008; QUIJANO, 2000; CUSICANQUI, 2012), transforming urban peripheries into areas of social abandonment. However, grassroots movements based on solidarity, whether quilombo networks (FRANCO, 1983), indigenous knowledge collectives (RIBEIRO, 1995), or neighborhood associations (SANTOS, 2001), have the potential to develop counter-strategies and transform urban space through mutual aid, knowledge resistance, and participatory governance.

All these perspectives lead us to a common conclusion. Spatial segregation is not simply a by-product of market dynamics or public policies, but also the spatial formation of ongoing social struggles around power, identity, and resources. While advantaged groups construct legal, symbolic, or infrastructural boundaries that protect their privilege through invisible epistemologies (MIGNOLO, 2011; SANTOS, 2006), cultural hegemony (GRAMSCI, 1971), or networked capital control (CASTELLS, 1996), disadvantaged groups construct alternative spaces of inclusion for themselves by developing cooperative strategies such as solidarity economies, community cooperatives, and social movements against these boundaries.

In conclusion, the theoretical background presented in this section defines the city as a dynamic space where capital and authority are concentrated in centers for which competition is made, where cooperation is realized, and where spatial formations that are the product of a survival strategy are produced. Inequality and discrimination are not accidental problems but structural consequences of human nature. Moreover, these dynamics do not only operate in the local context, but are also positioned on a global scale. Therefore, understanding urban segregation is only possible by focusing on the interoperable logic of grouping, competition, cooperation, spatial control, and centralization that are the product of human nature.

2.2 Socio-psychological Theories

This section examines how evolutionary perspectives (Table 5) and socio-psychological (Table 6) approaches have explained the issue from the earliest theoretical formulations to the present. Drawing on fundamental concepts such as grouping tendencies, social competition, cooperation, territoriality, centrality, social inequality, the insights underline the influence of innate motivations and learned behaviors on urban segregation dynamics.

In addition, these theoretical frameworks have fed into a wide range of sociological observations recorded from different perspectives over time, providing multidimensional explanations for phenomena such as social stratification and urban segregation. Integrating perspectives from the biological origins to the interplay of social, cultural, and economic factors, this section highlights the impact of social competition and cooperation on understanding the ongoing construction and restructuring of social hierarchies in diverse urban contexts.

2.2.1 The Evolutionary Foundations of Urban Segregation: Social Competition, Cooperation, and the Cultural Construction of Territoriality

Rooted in the origins of evolutionary thought, the theory of natural selection considers competition as a fundamental force in the evolution of all organisms. Carried out for limited resources that will meet basic needs, it directs the survival processes of each individuals. During the process, those who adapt best to their environment have a higher probability of success. This competition occurs in two main ways, between the same and different species. Intra-specific competition refers to the competition between members of the same species for resources, while inter-specific competition refers to the competition of species to use different resources or to occupy certain ecological niches. The theory of natural selection takes into account social dynamics in which cooperation also plays an important role as well as competition (DARWIN, 1859/2009).

Table 5- Evolutionary theories

Concepts	Key theories	Implications for Urban Dynamics
Groupings	Cultural Group Selection (Richerson; Boyd, 2005); Evolutionary Sociology (Sanderson, 2001)	Groups with cohesive cultural norms out compete others; urban cultures crystallize into enduring enclaves that mobilize cooperation and defense.
Social Competition	Natural Selection (Darwin, 1859/2009); Evolutionary Game Theory (Smith, 1982; Axelrod; Hamilton, 1981)	Rivalry over resources mirrors survival of the fittest; strategies like Tit-for-Tat explain why competitive defense of territory arises in repeated interactions.
Social Cooperation	Kin Selection and Reciprocal Altruism (Hamilton, 1964; Trivers, 1971); Evolutionary Social Psychology (Tooby; Cosmides, 1992)	Social networks produce mutual aid; evolutionary drives toward cooperation yield collective institutions that buffer inequality.
Centrality	Central Place Foraging Theory (Orians; Pearson, 1979); Optimal Foraging Theory (MacArthur; Pianka, 1966)	Resource density and accessibility peak in centers; competition for and cooperation around these centers shape commuting patterns, service provision, and real-estate hierarchies.
Territoriality	Cumulative Culture (Henrich, 2016); Cultural Transmission (Boyd; Richerson, 1985)	Shared cultural practices codify territorial claims; generations transmit spatial boundaries and defense mechanisms, embedding territoriality into the city's cultural memory.
Social Inequality	Cultural Evolution (Boyd; Richerson, 1985); Evolutionary Sociology (Sanderson, 2001)	Inherited cultural institutions favor dominant groups; groups with adaptive cultural repertoires maintain spatial privileges, while others adapt by forming resilient enclaves.
Urban Segregation	Cultural Neuroscience (Kitayama; Park, 2010; Triandis, 1995; Haidt, 2012); Cultural Group Selection (Richerson; Boyd, 2005)	Neurocognitive biases toward in-group loyalty and out-group suspicion reinforce spatial clustering; culturally selected cooperative norms and institutions crystallize into segregated urban fabrics.

Source: Author, 2025.

Considering this, kin selection states that the success of an individual is also related to the success of their relatives. Thus, even in competitive environments, it is inevitable for individuals to cooperate among related individuals for their own success

(HAMILTON, 1964). Moreover, Trivers' theory of reciprocal altruism expands the idea of cooperation beyond kinship. According to the theory, individuals cooperate with unrelated individuals in the expectation of mutual benefit. At this point, cooperation is driven by repeated interactions and the expectation of future reciprocity. Thence, with reciprocal altruism, social structures can mitigate competition, especially among humans, who are social species (TRIVERS, 1971).

Although natural selection theory does not focus on strategic behaviors developed by populations, it provides a basic understanding of the traits that increase the probability of survival. Building on this, evolutionary game theory (SMITH, 1982) focuses on the strategies developed by populations in the processes of social competition and cooperation. Modeling interactions as strategic games shows that the success of a particular strategy depends on other strategies. The Tit-for-Tat strategy (AXELROD; HAMILTON, 1981), in which an individual cooperates on the first move and then imitates the previous move of the opponent, has been shown to encourage cooperation in repeated interactions.

Moreover, Smith's evolutionary game theory (1973) also examines the relationship between altruistic behaviors and mechanisms such as kin selection and reciprocal altruism. The success of these strategies also depends on their frequency in the population. In addition, cooperation strategies are successful when they are rare due to protection from exploitation. Becoming common, decreases their effectiveness. This theoretical basis is useful for explaining the long-term dynamics of competition and cooperation from biological, social and economic perspectives.

Drawing another analogy from the nature, foraging-like behaviors, which are strategies that organisms use to maximize resource acquisition while minimizing effort and risk, can also be observed within social and spatial landscape. Within the spatial framework, Optimal Foraging Theory (MACARTHUR; PIANKA, 1966) and Central Place Foraging Theory (ORIANS; PEARSON, 1979) offer models to elucidate human behavior in cities. Optimal Foraging Theory posits that organisms, including humans, strive to maximize resource acquisition while minimizing energy expenditure and risk.

Moreover, evolutionary social psychology applies the evolutionary principles to the human social behavior. Specifically, it emphasizes the shaping effects of natural selection on cooperative and competitive dynamics. In this framework, ranging from altruism to coalition formation, many social behaviors are interpreted as adaptive strategies that evolved to solve recurrent challenges in ancestral environments (TOOBY; COSMIDES, 1992). Here, cooperation is not seen as an anomaly in evolutionary logic, rather, it is a context-dependent strategy that increases individual and group fitness. Additionally, individuals engage in cooperative behaviors to access vital resources, such as food, protection, information, and mating opportunities, that would be more difficult to secure independently. These interactions are often stabilized through mechanisms such as reciprocal altruism, kin selection, reputation management, and the enforcement of social norms to enhance long-term benefits. Evolutionary social psychology also points to the importance of inter-group competition in the evolution of cooperation and proposes that in environments where groups compete over scarce resources, territory, or influence, the ones with more effective internal cooperation are more likely to prevail.

Evolutionary sociology integrates insights from evolutionary biology, evolutionary psychology, and sociological theory to explain the origins, structure, and transformation of social behavior and institutions. It posits that human social systems are not arbitrary constructions but are shaped by universal evolutionary pressures that have historically favored behavioral patterns and institutional arrangements conducive to group cohesion and survival (SANDERSON, 2001). Within this framework, social institutions such as the family, religion, legal systems, and governance structures are understood as emergent adaptations that facilitate cooperation, regulate behavior, and mitigate conflict in complex social environments. These institutions evolve over time in response to ecological, demographic, and inter-group selection pressures, serving to organize collective life and enhance social stability. Their persistence and elaboration are linked to their efficacy in reducing internal friction, coordinating shared goals, and reproducing social order (FEHR; GACHTER, 2000).

Meanwhile, cultural evolution theories focus on how cultural practices, beliefs, and institutions evolve over time through processes of variation, selection, and inheritance. According to these theories, competition and cooperation are influenced not only by genetic factors but also by cultural factors. Key concepts in cultural evolution include Cultural Transmission, Cultural Group Selection, and Cumulative Culture (BOYD; RICHERSON, 1985). Cultural transmission refers to the process by which knowledge, beliefs, norms, and behavioral practices are passed across generations and among individuals through social learning. This transmission underlies the stability and variation of cultural traits within and between populations. Cultural Group Selection posits that groups characterized by advantageous cultural traits, those promoting cooperation, out compete others in inter-group dynamics. The selection pressures operate not only at the individual level but also at the level of social groups, favoring those that can mobilize cooperation more effectively (RICHERSON; BOYD, 2005). Cumulative Culture, in addition, refers to the cultural knowledge and technological practices that accumulate over generations. It leads to the development of increasingly sophisticated tools, norms, institutions, and social strategies. According to Henrich (2016), such cumulative processes enable the emergence of complex social institutions and refined cooperative behaviors that significantly enhance the adaptive success of cultural groups. Moreover, cooperative norms and institutions, rules, shared values, and enforcement mechanisms that foster collaboration, are instrumental in increasing internal group cohesion. Groups with stable and effective cooperative infrastructures are better positioned to manage internal conflicts, pool resources efficiently, and adapt to environmental and social challenges. As a result, they demonstrate higher rates of survival, expansion, and influence compared to less cohesive or disorganized groups.

Another discipline covering the issue, cultural neuroscience, explores how cultural values, practices, and environments shape neural mechanisms that influence social behavior (KITAYAMA; PARK, 2010). Research shows that individuals from collectivist cultures tend to prioritize group harmony and cooperation, while those from individualist cultures emphasize autonomy, competition, and personal gain (TRIANDIS, 1995). Additionally, moral evaluations, which also play a key role in guiding cooperation and competition, are shaped by culturally specific moral foundations (HAIDT, 2012). At this point, cultural context influences how individuals perceive and respond to in-group versus out-group members, reinforcing distinct patterns of social cohesion and boundary maintenance.

Based on the information above, urban segregation, which is often considered a problem, can also be interpreted as a natural organization based on the evolutionary roots of human behavior. According to the theory of natural selection, competition over limited resources is the most fundamental dynamic of life (DARWIN, 1859/2009). Cities, with their high population density and limited resources, are contemporary spaces of this evolutionary struggle. Competition around resources such as housing, employment, centrality and infrastructure causes social stratification in urban spaces. However, the evolutionary perspective also accepts cooperation as a central strategy. For example, while the theory of kin selection (HAMILTON, 1964) argues that the success of an individual is related to the success of his relatives, Trivers' theory on reciprocity (1971) also shows that cooperation develops within individuals due to the expectation of mutual benefits. In this context, it makes evolutionary sense for humans to establish complex social structures to reduce competition and regulate resource sharing.

Evolutionary game theory (SMITH, 1982), which examines the strategic dimensions of these approaches, models the interactions between individuals and groups and analyzes which strategies are successful in the long term. While strategies applied in repeated interactions (AXELROD; HAMILTON, 1981) allow for the building of trust and the maintenance of cooperation, the proliferation of cooperation strategies makes them vulnerable to exploitation. Thus, this situation causes groups to withdraw, protect their boundaries, and act with distance in their relations with out-groups. This dynamic reveals a spatial logic of urban segregation.

Evolutionary social psychology, on the other hand, argues that social behaviors such as in-group solidarity and wariness against out-groups are adaptive responses shaped by natural selection (TOOBY; COSMIDES, 1992). Here, cooperation is considered as a strategy developed in response to competition. Especially in environments where competition between groups is intense, those with stronger internal cooperation are seen to be more successful. Therefore, the spatial clustering of ethnic, class or cultural groups in cities is the product of the groups' efforts to secure their own internal functioning and access to resources in addition to exclusion.

Evolutionary sociology (SANDERSON, 2001) attempts to explain the origins of social order by combining these biological and psychological processes with sociological institutions and norms. Institutions are not only expressions of cultural structures but also of evolutionarily shaped cooperative strategies. Over time, these institutions evolve under environmental and demographic pressures to become structures that reduce inter-group conflict and promote internal harmony. At this point, behavioral models based on justice, reciprocity, and norms (FEHR; GACHTER, 2000) reinforce urban segregation by enabling individuals to continue to cooperate.

Meanwhile, cultural evolution theories explain how cultural practices and institutions evolve beyond genetic inheritance through transmission across generations (BOYD; RICHERSON, 1985; HENRICH, 2016). Concepts such as cultural group selection and cumulative culture show that social groups are subject to selection pressures not only genetically but also culturally. Groups with norms and institutions that encourage cooperation have been more durable, harmonious, and effective throughout history (RICHERSON; BOYD, 2005). These norms are also reflected in space. Institutionalized forms of cooperation, social capital, and cooperation networks are concentrated in certain areas within the city and increase the relative success of these areas. Cumulative culture, on the other hand, enables the development of complex social institutions through the accumulation of knowledge, technology, and norms transmitted from generation to generation. These institutions enable groups to become more resilient to environmental and social changes.

Centrality is a measure of resource density and accessibility, as in the theories of Optimal Foraging (MACARTHUR; PIANKA, 1966) and Central Place Foraging (ORIANS; PEARSON, 1979). Based on this, it is consistent with these theories that groups close to city centers have easier access to both economic and social capital. While competitive groups build strong networks to maintain their positions in these centers, cooperative networks provide solidarity and mutual support. The spatial reflection of this is that high centrality fosters hierarchical inequalities and ignores peripheral areas in terms of both resources and actors.

Finally, cultural neuroscience (KITAYAMA; PARK, 2010) examines how individuals are affected by their cultural environment at a neurological level. According to the discipline, in collectivist cultures, cooperation and group harmony are emphasized, while in individualist cultures, competition and individual interests are emphasized (TRIANDIS, 1995). Moral judgments are also based on cultural foundations and affect individuals' decisions about whom to help or avoid (HAIDT, 2012). This is directly reflected in spatial behaviors such as where to live, who to be neighbors with, and which areas to avoid.

In conclusion, urban segregation is not just a problem of injustice or planning, but an evolutionary strategy that comes from the depths of human nature. Evolutionary dynamics such as competition and cooperation, in-group solidarity and out-group differentiation also find their counterparts in space. The structural inequalities of the city are also an extension of the strategies of individuals and groups to survive and access resources. In this context, it is necessary to think of segregation not only as a problem, but as an evolutionarily shaped form of organization inherent in social life.

2.2.2 Spatial Manifestations of Competition and Cooperation Dynamics through Socio-Psychological Theories

Socio-psychological theories are also important in understanding individual and group dynamics as well as their spatial reflections (Table 6). One of these, Field Theory (LEWIN, 1947), frames a person's behavior as a function of both their individual characteristics and the environment in which they live. According to the theory, the social environment, as a psychological field, influences individual thoughts, feelings, and actions. Behavior is the result of interactions between the person and the environment and alterations in a social environment can impact an individual's behavior.

Thus, it is important to consider the social context when studying human behavior and group processes. According to the theory, a group is also viewed as a dynamic social field. This field is shaped by various individuals, each with their own psychological and social forces. Within this field, there are driving forces that lead to particular group behaviors and outcomes. These forces include individual motivations, shared goals, norms, leadership, communication patterns, and the group's history and context. These driving forces finally influence the group's state.

Symbolic Interactionism Theory, in addition, evaluates the interactions of individuals and their effects on social reality. It emphasizes the importance and effects of symbols, language and communication on social identity and group dynamics (MEAD, 1934). The theory suggests that individuals create meaning through their interactions with others and the self is developed in the process of this communication. At the same time, this social interaction constructs reality (BLUMER, 1969). As a result of the process, objects, events and behaviors gain meaning and can be interpreted in different ways by different groups. In this case, approaches to competition and cooperation differ.

Table 6- Socio-psychological theories

Concepts	Key Theories	Implications for Urban Dynamics
Groupings	Social Identity and Self-Categorization (Tajfel; Turner, 1979; Turner, 1985)	Group boundaries drive the formation of ethnic, class or cultural enclaves; strong group identity clusters similar individuals in discrete urban neighborhoods.
Social Competition	Realistic Conflict (Sherif, 1966); Frustration–Aggression (Dollard et al., 1939)	Competition over scarce resources fuels inter-group hostility; territories become competitive field, reinforcing spatial polarization.
Social Cooperation	Contact Theory (Allport, 1954); Attribution Theory (Heider, 1958; Kelley; Michela, 1980)	Structured inter-group contact under equal-status conditions fosters trust and shared norms; positive attributions to cooperative motives strengthen associations and cross-group ties.
Centrality	Network Theory (Wasserman; Faust, 1994); Systems Theory (Bertalanffy, 1968)	Groups or territories with better connectivity accumulate more resources and influence; peripheral areas remain under-served.
Territoriality	Proxemics (Hall, 1966); Territoriality Model (Altman, 1975); Defensive Space (Newman, 1972; Stokols, 1987)	Space claims (fenced houses, gated communities) express identity and security; boundaries can either facilitate inclusive interaction or deepen exclusion.
Social Inequality	Equity Theory (Adams, 1965); Social Dominance (Sidanius; Pratto, 1999)	Perceived unfair distribution of services triggers withdrawal or mobilization; advantaged groups use ideology and policy to maintain privilege.
Urban Segregation	Field Theory (Lewin, 1947); Symbolic Interactionism (Mead, 1934; Blumer, 1969)	The city as a psychological field channels social forces into distinct zones; symbolic markers both reflect and reinforce the us vs. them logic of segregated districts.

Source: Author, 2025.

Attribution Theory, on the other hand, explains the behaviors of individuals and the causes of events in terms of internal and external factors. According to the theory, attributions affect how individuals respond to competition. When an individual, who experiences failure, attributes external factors such as bad luck, they feel the desire to compete again. Attribution to internal factors such as personal inadequacy leads to a loss of motivation, on the other hand (HEIDER, 1958). However, another factor that affects cooperation is the individuals' perceptions of others' reasons to cooperate. Thinking that cooperation is done for mutual benefit increases positive responses. Further, perceiving that cooperation is a strategic maneuver can create distance between individuals (KELLEY; MICHELA, 1980).

Another approach that examines the interaction of human activities, social practices, and cultural tools comes from Cultural-Historical Activity Theory. According to it, competition and cooperation interact with historical and cultural contexts and social practices and cultural tools shape these dynamics. In addition, competing goals and conflicting values create conflicts. The theory, which examines the emergence of conflicts and their effects on competitive or cooperative behavior, suggests that cooperation plays an important role in communities achieving common goals (ENGESTRÖM, 1987).

Allport's Contact Theory, adds on by suggesting that inter-group contact alleviates prejudice. Empathy, understanding, and positive attitudes develop between individuals from different groups through this contact. Factors such as equal status, common goals, cooperation, and support from institutions and authorities are important in establishing successful contact between groups. These factors have the potential to challenge stereotypes, nurture empathy, and diminish prejudice, ultimately culminating in social harmony. However, the conditions in which contact occurs have a certain effect on the results. Bringing together diverse groups without addressing power disparities or promoting equal status may not succeed in cultivating harmonious feelings (ALLPORT, 1954).

Moreover, John Dollard and Leonard Doob's Frustration-Aggression Hypothesis suggests that frustration leads to aggression. In addition, individuals who are prevented from achieving their goals may transform aggression into competitive behaviors against those they see as obstacles. Moreover, individuals may compete more aggressively in areas where they have more control. These competitive behaviors naturally prevents cooperation (DOLLARD et al., 1939). On the other hand, cooperation can help to resolve conflicts by addressing frustrations. Realistic Conflict Theory (SHERIF, 1966) also determines that competition between groups for limited resources such as jobs, land, or political power leads to conflict. However, this conflict is effective in determining group identities. When group members realize that resources are scarce, they engage in a competition in which one side loses. This situation brings with it in-group harmony and inter-group hostility. This hostility can manifest as discrimination, aggression, and even violence. Finally, the theory suggest that one way to increase cooperation is to ensure that groups unite around super-ordinate goals.

Meanwhile, Systems theory perceives competition and cooperation dynamics as components within a single system. It examines the feedback loops between all components as a result of a change in one part within the system. According to the theory, social systems try to achieve a dynamic balance by transforming themselves in line with environmental factors. The interaction between competition and cooperation is one of the important factors affecting this balance. As a result of the dynamic relationship between individuals and groups, competitive or cooperative behaviors that can affect the entire system can occur (BERTALANFFY, 1968).

Furthermore, according to Social Comparison Theory, individuals compare their own abilities, successes, and ideas with others. At this point, self-evaluations can increase competition or cooperation. When the comparison is upward, those who are better off than themselves are the subjects of this comparison. As a result, they can provide motivation, but also be subject to negative emotions such as jealousy. On the contrary, in downward comparisons, individuals increase their self-esteem. However, they can also become complacent (FESTINGER, 1954). While these comparisons can provide constructive cooperation in the search for development, they can also cause destructive competition that looks down on others. However, individuals compare themselves more with those in the same situation. Similarities in ability, ideas, or status can lead to a tendency to act together.

According to Tajfel and Turner’s Social Identity Theory, I and we identities are important in determining social relationships. Individuals classify themselves and others according to in-group and out-group memberships. They also gain a sense of identity and self-worth through these group memberships. The grouping also has an effect on social competition and cooperation. Individuals favor members of their own groups and develop strong social bonds and collective action among each other. On the other hand, they develop negative attitudes and behaviors towards out-group members. This out-group discrimination leads to inter-group prejudice, competition and even conflict. In addition, individuals compare and evaluate their own groups with others in order to improve their status and identity. While positive comparisons strengthen self-esteem, if the comparison results negatively, groups try to improve their position through competition. As a result, the cooperation gets stronger among its members while competition increases between groups (TAJFEL; TURNER, 1979).

Thereupon, Turner developed the Self-categorization Theory (TURNER, 1985). According to him, individuals place themselves in the abstract layers of subordinate, group and super-ordinate according to their self-perception, closeness to group norms and behaviors. This placement occurs as a result of individuals defining themselves by the situations they encounter. In this process, individuals encounter depersonalization, social stereotyping, cohesion, ethnocentrism, and the formation of social norms while adopting a group identity. This adaptation increases the chance of survival because it offers more cooperation. Conversely, a strong group identity can damage social integration by exacerbating inter-group conflicts and discrimination.

Moreover, according to Adams's Equity Theory, perceptions of equality and inequality affect the dynamics of competition and cooperation. Individuals evaluate their relationships according to the inputs of the process such as effort, time and resources and the outputs such as rewards and recognition. This evaluation affects whether the relationships are competitive or cooperative. While the perception of what is achieved as a result of the relationship between individuals as fair encourages cooperation, the feeling of injustice increases competitive behavior. Individuals may compete more intensely or withdraw completely to improve their situation as a result of the feeling of inequality (ADAMS, 1965).

In parallel, Expectancy Theory suggests that individuals' behaviors are determined by expectations of results and the values of the results. Individuals compete if they believe that their efforts will result in valuable rewards. Similarly, they adopt this strategy in cases where they believe that cooperation will bring gain. Thus, competition and cooperation are affected by the expectation of positive results. The intensity of these dynamics is also directly proportional to the amount of expected gain (VROOM, 1964).

Another perspective is offered by Social Learning Theory. Individuals internalize behavioral patterns through observation, imitation, and modeling within a social context. This enables the transfer and even reinforcement of competitive or cooperative behaviors. The individual who observes the behaviors and results of others decides on the type of relationship. Behaviors that are rewarded are repeated by individuals, while those that are punished have the opposite result (BANDURA, 1977).

Network Theory, on the other hand, focuses on the impact of social networks and relationships on these dynamics. Individuals are connected to each other within social networks, and these ties affect the behaviors of individuals. The ties between individuals and groups can encourage cooperative behaviors as well as create the ground for a competitive environment. However, central individuals with a high number of connections can also affect the behaviors of others by encouraging competitive or cooperative norms (WASSERMAN; FAUST, 1994).

Social Role Theory adds another dimension to the relationships between individuals and groups. Social expectations and roles affect the behavior of individuals. Social roles come with expectations and norms that guide the behavior of individuals. Individuals engage in competition and cooperation dynamics depending on the roles they occupy. For example, traditional gender roles may encourage competition in men and cooperation in women. When individuals are both cooperative and competitive team members, conflicts arise. The result of these conflicts determines how individuals will act (EAGLY; WOOD, 2012).

The Theory of Planned Behavior suggests that individuals' perceptions affect their decisions about behavior. If individuals feel they have control over the outcome, they are more likely to take action. Subjective norms and the perceived expectations of others also shape behavior, and when they are consistent with the expectations of their social group, individuals tend to take action. As a result, perceptions determine whether individuals will engage in competitive or cooperative behavior (AJZEN, 1991).

Considering social hierarchies, Social Dominance Theory examines the relationships of individuals with the hierarchy they are a part of. Societies are organized into hierarchies based on categories such as race, gender, and class. Individuals and groups compete to occupy dominant positions within these hierarchies. Dominant groups, on the other hand, do not hesitate to use social, political, and economic power to maintain their dominance. In this direction, they continue the cultural ideologies that maintain social hierarchies. However, individuals and groups that share a common status within the hierarchy are in solidarity. Within this solidarity, individuals both try to strengthen their positions within the group and serve the competition between groups (SIDANIUS; PRATTO, 1999). Power and ideology are quite effective on social relations. Moral Foundations Theory investigates how different moral values affect social behavior. Although they vary between different cultures, various moral foundations such as justice, loyalty, authority, and sanctity determine the behavior of individuals. Competition and cooperation dynamics are also affected in this direction. Different foundations lead to the emergence of different patterns (HAIDT; GRAHAM, 2007).

During the dynamics mentioned above, individuals and groups claim, control, and defend space as an expression of identity, security, and power. Thus, from a spatial perspective, territoriality is deeply embedded in cultural norms, individual behavior, and group dynamics. Hall's concept of proxemics elucidates how interpersonal distances, ranging from intimate to public spaces, reflect underlying needs for privacy and social order (HALL, 1966). These spatial preferences are not arbitrary. They are culturally mediated behaviors that reveal much about how people organize and protect their personal and communal domains.

Altman further enriches this understanding with his Territoriality Model, which differentiates among primary, secondary, and public territories. Primary territories, such as one's home, are intimately linked with personal identity. Secondary territories such as workplaces or schools, serve functional purposes. Finally, public territories are areas which are governed by social norms and accessible to all (ALTMAN, 1975). This framework emphasizes that territorial behavior is dynamic and context-dependent. Furthermore, territoriality evolves alongside changing social interactions.

Social Identity Theory (TAJFEL; TURNER, 1979) also touches upon this phenomenon by explaining how group membership influences territorial claims. According to the theory, groups establish clear spatial boundaries to reinforce in-group cohesion and to demarcate themselves from out-groups. This boundary-making serves not only as a symbol of collective identity but also as a mechanism to legitimize social hierarchies and access to resources.

Environmental psychology contributes further insights through the notion of defensive space. STOKOLS (1987) and NEWMAN (1972) argue that delineating personal and communal spaces helps individuals cope with environmental stress and enhances feelings of security. Newman’s Defensive Space Theory, shows how clear boundaries, visibility, and controlled access can either promote inclusive social interactions or intensify exclusion and isolation. Collectively, these socio-psychological theories underscore that territoriality is not only physical demarcation but also a dynamic process shaped by cultural, cognitive, and emotional factors.

Drawing on the above theories, urban segregation is once again seen as the spatial configuration of social competition and cooperation dynamics. The effort to secure scarce urban resources (housing, employment, infrastructure) as mentioned earlier, creates competitive pressures at multiple scales, as can be seen. In Lewin's Field Theory, the city itself functions as a psychological field in which individuals and groups negotiate pushes and pulls. In this field, competition for central locations or first-class services reflects the driving forces of the field, while spatial inequalities are reinforced (LEWIN, 1947). When powerful groups monopolize central nodes, peripheral areas are left with weaker institutions and fewer opportunities, producing entrenched patterns of segregation.

In urban areas, territoriality is more than physical boundaries. Here, Symbolic Interactionism shows how street names, local landmarks, and social rituals produce shared meanings that separate us from them (MEAD, 1934; BLUMER, 1969). These spatial symbols strengthen in-group cohesion but also create psychological barriers, making out-groups less welcome and intensifying discrimination.

Centrality, on the other hand, provides both resources and status. Network theory (WASSERMAN; FAUST, 1994) suggests that individuals and groups in highly connected positions in social and infrastructural networks can use ties to access jobs, information, and political influence. As central actors strengthen their positions through social learning and role expectations (BANDURA, 1977; EAGLY; WOOD, 2012), peripheral actors see their mobility and opportunities constrained and spatial inequality deepened.

Inequality both drives and is reinforced by these processes. Attribution Theory (HEIDER, 1958; KELLEY; MICHELA, 1980) shows that when marginalized groups attribute failure to systemic barriers rather than personal shortcomings, they may withdraw from competitive urban areas and consolidate in segregated areas. Conversely, groups that interpret adversities as external injustices mobilize collective action, sometimes leading to the gentrification or displacement of others. This is another form of territorial competition.

Finally, these intertwined dynamics result in urban segregation. Realistic Conflict Theory (SHERIF, 1966) explains that competition over resources at the neighborhood level produces out-group hostility and in-group solidarity, while Allport's Contact Theory (1954) warns that mere proximity without equal status and institutional support can exacerbate rather than alleviate prejudice. Thus, segregation results not only from economic stratification but also from the fundamental, evolved interplay of competition for centrality, cooperation within regions, and the reproduction of inequality through both individual cognition and collective institutions. In summary, urban segregation is seen, not as an anomaly of policy failures but as an emergent spatial logic of human social behavior. Segregation is shaped by evolved tendencies toward competition, moderated by cooperation, structured by territorial practices, and patterned by centralization and inequality. Understanding segregation in these terms highlights leverage points for intervention.

2.3 The interplay of social competition and cooperation in shaping urban segregation

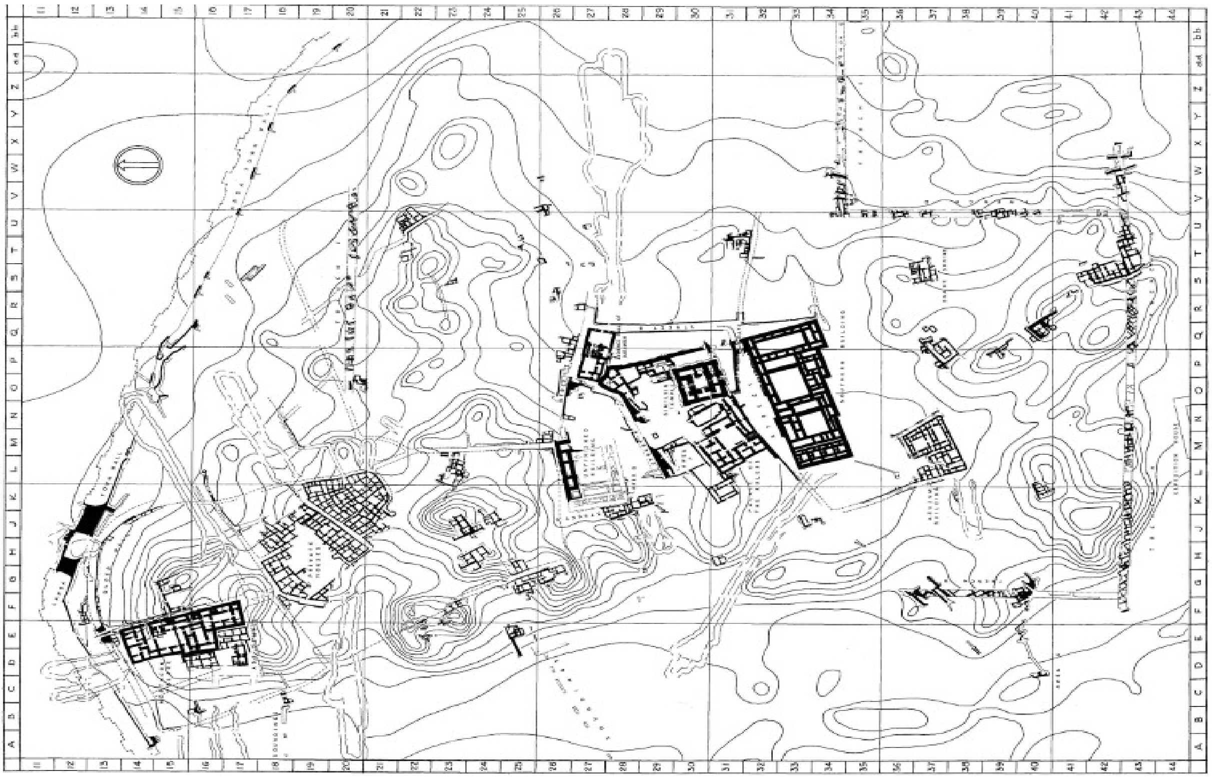
This chapter analyzes patterns of urban segregation from the earliest civilizations to modern metropolises, presenting how the spatial and social organization of cities has been shaped in historical and contemporary contexts. In each case, spatial divisions reflect the dominant social, cultural, political, and economic structures of their time. In addition, the monopolization of critical resources and the strategic control of urban areas by individuals and groups are common features. This situation also plays a decisive role in the maintenance of existing hierarchies. From the examination, it is understood that cooperation among social groups strengthens position in the social hierarchy, while competition deepens, even structuralize, social stratification. These patterns also emphasize the inevitability, continuity, and universality of social competition, cooperation, territorial claims, and centrality among individuals and groups struggling for survival. They also point to the fact that social inequality and urban segregation are not accidental but a natural consequence of the dynamics mentioned.

2.3.1 Historical Trajectories: From Ancient Civilizations to the Industrial Revolution

Although phenomena considered in the study are likely to have existed in early settlements, the absence of archaeological evidence prevents a comprehensive analysis. However, settlements such as Çatalhöyük and Jericho, which had dense and compact settlement patterns for their eras, show a high level of social stratification. Moreover, the close proximity of the inhabitants must have led to social conflict, especially when the expansion was limited by a perimeter wall, as in the case of Jericho. In addition, the construction of a fortification system must have required collective labor and organization. Thus, both internal cooperation and social distinctions between communities within and outside the settlement must have been reinforced. Despite these, Jericho and Çatalhöyük did not develop into a larger, integrated settlement system or a regional center. Although densely populated for the time, both examples remained isolated, and did not provide a transition to later urban forms (NISSEN, 1988). As a result, the lack of data prevents a precise understanding of the social structures of early settlements. This highlights the importance of written documents in the reconstruction of urban social organization. For this reason, this section begins with the periods when written sources exist.

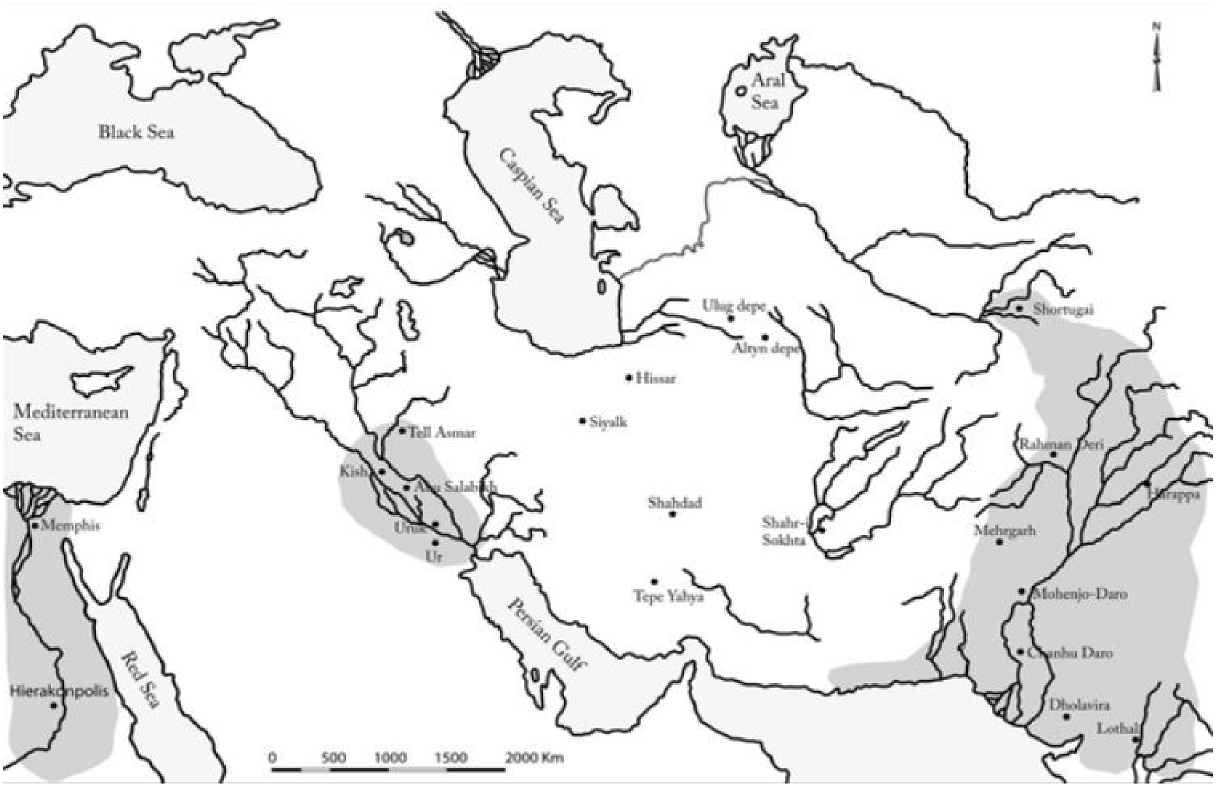
From around 5000 BC, Ancient Sumerian city-states such as Uruk and Ur and Akkadian settlements such as Esnunna (Figure 1) illustrate links between segregation, power dynamics and resource control (ADAMS, 1966; POSTGATE, 1992). For example, early urban centers, structured around a centralized temple complex, also acted as center for economic and political power (NISSEN, 1988). Through this, the ruling priest-kings exerted control over agricultural production, trade, and labor. This control reinforced a spatial hierarchy that privileged the elites while marginalizing the lower classes (POSTGATE, 1992). The temple precincts and their surroundings housed priests, scribes, and administrators who managed the city’s wealth. Meanwhile, artisans and laborers were relegated to peripheral areas with limited access to essential resources (VAN DE MIEROOP, 2016). Over time, competing elite groups, including officials, merchants, and intellectuals, sought control over strategic urban zones and this deepened social divisions. These patterns reflect broader power dynamics of Sumerian society. Physical separation and resource monopolization were instrumental in maintaining social hierarchies.

Figure 1 – Example of the formation of power dynamics in space



Obs. The ancient core of Esnunna where the terrain reaches its highest elevation. The central area hosts monumental structures and surrounded by a city wall along the northern boundary circa 2300–1800 BC. Source: Delougaz, Hill and Lloyd, 1967, as cited in Postgate, 1992.

Figure 2 – Early urban civilizations with parallel socio-spatial formation



Source: Wright, 2010.

In the Indus Valley (Figure 2), segregation in Mohenjo-Daro and Harappa (circa 2600 BC) was evident through distinct neighborhoods. They varied in terms of architectural quality, sanitation, and resource access (KENOYER, 1998). With its sophisticated drainage and water management systems, the urban grid indicates an organized but stratified society. Containing large structures such as the Great Bath and granaries, the Citadel area housed administrative elites and religious figures. On the other hand, lower-status laborers and traders occupied more crowded, less-developed sectors of the city (WRIGHT, 2010). The division of space based on status and function underscores the early formation of urban inequality, shaped by access to infrastructure and governance.

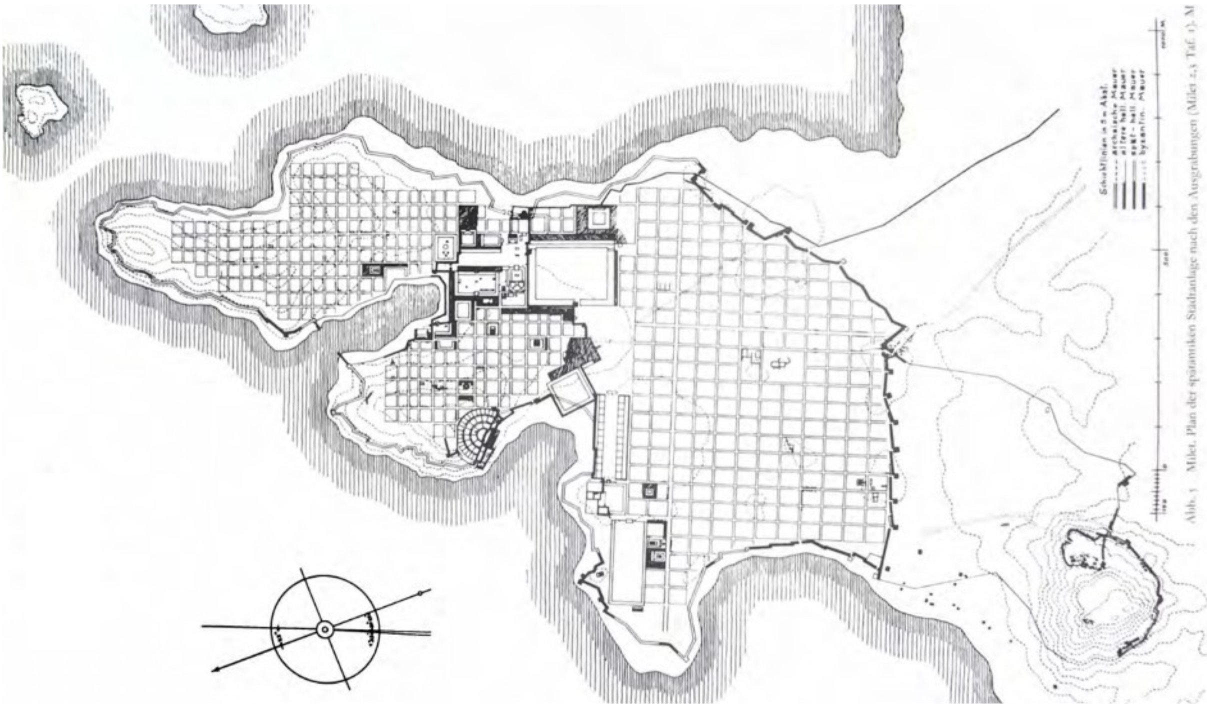
In ancient China, A parallel example can be observed in the Forbidden City model that emerged during the early dynastic periods around 2000 BC. The model became institutionalized during the Ming and Qing dynasties (ELMAN, 2000). This urban structure symbolized the rigid separation between the ruling elite and common citizens. The emperor, his court, and high-ranking officials resided within the innermost palatial areas. These areas were heavily guarded and inaccessible to the general public (FEUERWERKER, 1995). On the other hand, surroundings were assigned based on occupational hierarchies, with scholars, merchants, and craftsmen occupying different levels of privilege. While reinforcing social stratification, this spatial organization, a system where proximity to the center correlated with political and economic power, became a blueprint for urban planning in other Chinese cities (CHANG, 1977).

Beyond these, evidence of spatial segregation is also prominent in pre-Hispanic Mesoamerican cities such as Teotihuacan and Tenochtitlán. In Teotihuacan (circa 100 BC–550 AD), distinct residential compounds housed different social classes and ethnic groups. The ruling elite occupied grand palaces near the Pyramid of the Moon and Pyramid of the Sun. In contrary, artisans and lower-class laborers lived in densely packed areas on the periphery (ADAMS, 1966). This picture also reflects economic roles and political hierarchies, reinforcing disparities in access to urban resources and political influence. Similarly, in the Aztec capital of Tenochtitlán (circa 1325–1521 AD), segregation was institutionalized through the strict division of neighborhood units, which were organized along ethnic and occupational lines. The central Templo Mayor zone was reserved for religious, military, and noble elites, while commoners lived in more peripheral zones, often with limited access to the central market and key infrastructure (ADAMS, 1966). Canals and causeways reinforced these divisions by controlling mobility within the city, ensuring that access to wealth and power remained concentrated among the ruling classes.

This pattern was also evident in ancient Greece and Rome, where spatial organization reflected and reinforced social hierarchies (Figure 3). In Athens, non-citizens, including resident foreigners, slaves, and other marginalized groups, were driven out to peripheral areas. As a result, their access to political, economic, and social institutions were limited (HANSON, 1997). Despite, these groups played crucial roles in the economy, this exclusion heightened social tensions as they were politically marginalized. The physical separation of these populations highlighted the rigid boundary between citizens having full participation in the polis and those who didn't have such privileges.

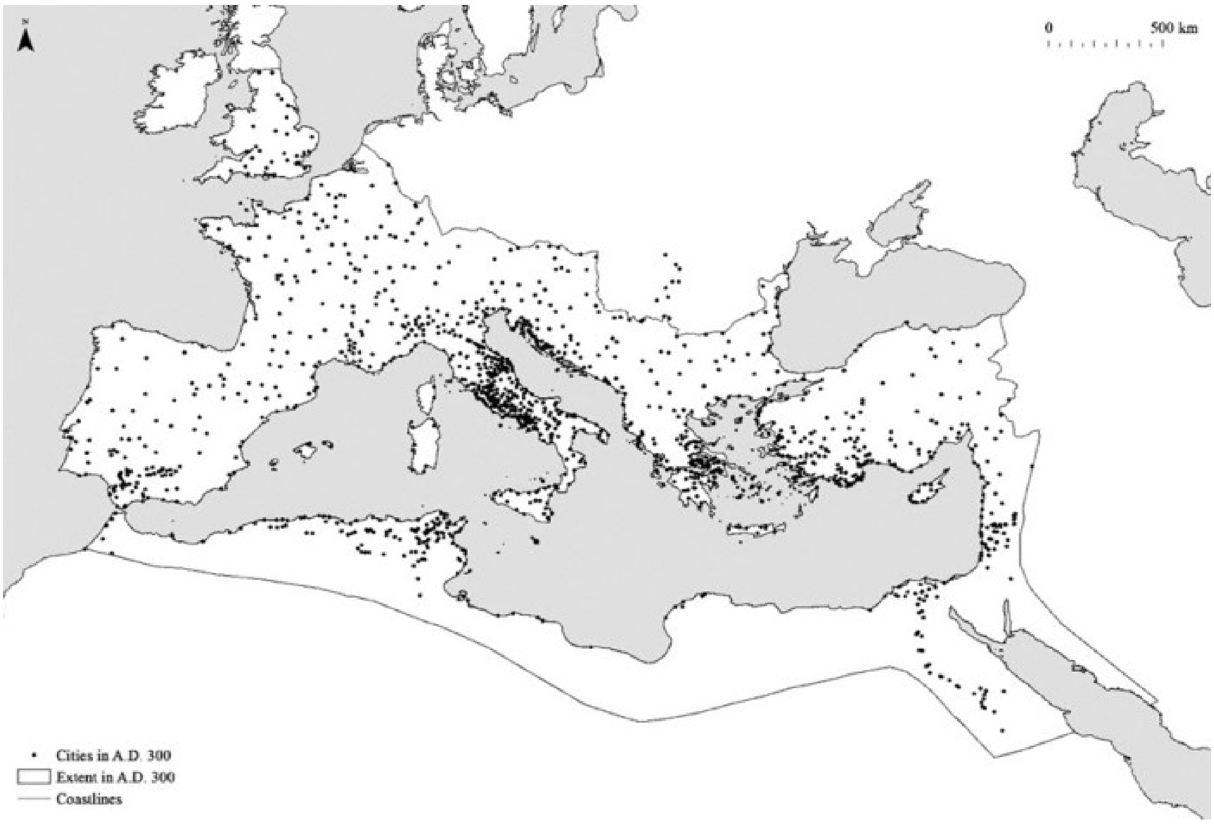
In the Roman Empire (Figure 4), which established a wide network of cities including Rome, Alexandria, Antioch, Ephesus and many others around 300 AD, a similar division existed between classes with spatial segregation institutionalizing their unequal status (HANSON, 1997; WIEDEMANN, 1992). Upper classes occupied elite districts with access to political and economic power, while the others were concentrated in overcrowded, lower-status areas. As enslaved individuals were physically and socially isolated from free citizens, divides were further exacerbated, often housed in segregated quarters or confined to large estates and labor-intensive environments. The emergence of multi-story apartment complexes for lower-class dwellers contrasted with the luxurious residents of the elite, highlighting the spatial reflections of economic disparity (PETERS, 1991). In addition to controlling advantaged urban spaces, elites also had exclusive access to services such as private bathhouses, forums, and entertainment venues (HORSLEY, 1992). The controlled cooperation among dominant groups, as seen in political alliances, further solidified their privileged position. Furthermore, this situation also restricted mobility for lower classes. In these urban centers, the dual forces of competition and cooperation shaped spatial arrangements. While elites competed among themselves for power and prestige, they simultaneously collaborated to maintain their collective dominance. Thus, urban segregation in antiquity was not only a matter of physical separation. It was an expression of the pursuit of power and survival, as well.

Figure 3 – Example of social hierarchy reflected in space



Obs. Miletus, attributed to Hippodamus, had a grid-based urban plan with intersecting streets and distinct zones for political, commercial and residential functions. This layout, with its civil and economic core containing central spaces such as the agora and temples, became the model for later Greco-Roman urban planning. Source: Hanson, 1997.

Figure 4 – Widening of socio-spatial patterns through a city network



Source: Hanson, 1997.

These dynamics continued to shape urban development in later historical periods, as growing cities became arenas for competition over resources, land, and influence. The capital of the Abbasid Caliphate in 762, Baghdad, exemplifies how rapid urban expansion fueled competition among merchants, scholars, and political factions (HOLDEN, 2004). Initially, its circular design was intended to facilitate administrative efficiency and commercial activity. In addition, the city's strategic location along the Tigris River made it a crucial trade hub, attracting diverse populations seeking economic opportunities and intellectual prestige. As various factions sought to secure their standing within the empire’s power structure, the struggle for control over land, commercial spaces, and political influence became intense. Symbolizing the joint political and religious authority the palace and the Great Mosque settled at the city’s core. Markets, bureaucratic institutions, and elite residences surrounded this central area. This reinforced spatial segregation based on status and function. As a result of this layout, economic prosperity and cultural exchange were fostered but also deeper social divisions were reflected. Administrative elites and scholars resided in privileged quarters, while artisans, traders, and laborers occupied peripheral districts (CRESWELL, 1989).

A similar pattern emerged in Cairo while it was an important political, economic, and religious center during the Fatimid Caliphate in 969. The city witnessed strong competition between administrative elites, merchants, and religious authorities (ALBAYATI, 1994). The spatial organization of Cairo reflected power struggles, with distinct zones demarcated for commercial, residential, and religious purposes. The ruling elite controlled the central palatial complex and key religious institutions, while merchants dominated the trade districts. As a consequence lower-status groups were relegated to the outskirts.

Considering these historical examples, it is also seen that the coexistence of competition and cooperation among ruling factions, traders, and intellectuals shaped the city's development, ensuring both stability and controlled access to resources. The urban segregation was driven by strategic efforts to monopolize economic and political power, demonstrating the enduring link between spatial organization and social hierarchy.

Furthermore, cities like Córdoba, Damascus, and Istanbul also exemplify how political, religious, and economic powers shape urban growth. During the Umayyad

Caliphate, Córdoba emerged as a major cultural and political center with competition between dynastic factions and religious communities. These dynamics played a decisive role in shaping the city's development. As rival groups sought to consolidate power, they invested in monumental architecture and urban expansion, leading to the construction of grand mosques, palaces, and public infrastructure. For example, the Great Mosque of Córdoba (Figure 5), initially built under Abd al-Rahman I, symbolizing dominance over the region. At the same time, academic and cultural collaborations between scholars with different religious background brought intellectual prestige to the city. The flourishing of institutions such as madrasas and libraries, including the renowned library of Al-Hakam II, positioned Córdoba as a leading center of knowledge in medieval Europe (MOLINA, 2007).

Similarly, during the Umayyad and later empires, Damascus was shaped by competition for political and economic power as an administrative and commercial center. It witnessed continuous struggles between ruling elites, military factions, and trade guilds (BURNS, 2019). As a result, this competition influenced the spatial organization with different commercial, religious, and residential districts. The Umayyads aimed to consolidate their authority also in Damascus with the construction of the Great Mosque of Damascus. It was an architectural statement of their power and legitimacy. At the same time, cross-regional academic collaborations in medicine, astronomy, and philosophy, enhanced the city's influence as a trans-regional intellectual center. The integration of knowledge systems underscored the cooperative dimension of urban development.

Istanbul, also, became a stage of intense political and religious competition during its transition from Byzantium to the Ottoman Empire. The conquest of Constantinople in 1453 by Mehmed II marked a shift in political power. This shift also caused an urban transformation. To assert their dominance with large-scale architectural projects, The Ottomans redefined a new identity. For instance, the Hagia Sophia, a Christian cathedral (Figure 6), conversed into an imperial mosque as a representation of the new ruling order. Additionally, the construction of mosques, bridges, and markets reinforced the new authority while fostering economic and social integration (FREELY, 1996). As a result, Istanbul became a melting pot of cultures, where cooperation between different social groups contributed to its transformation into a global metropolis.

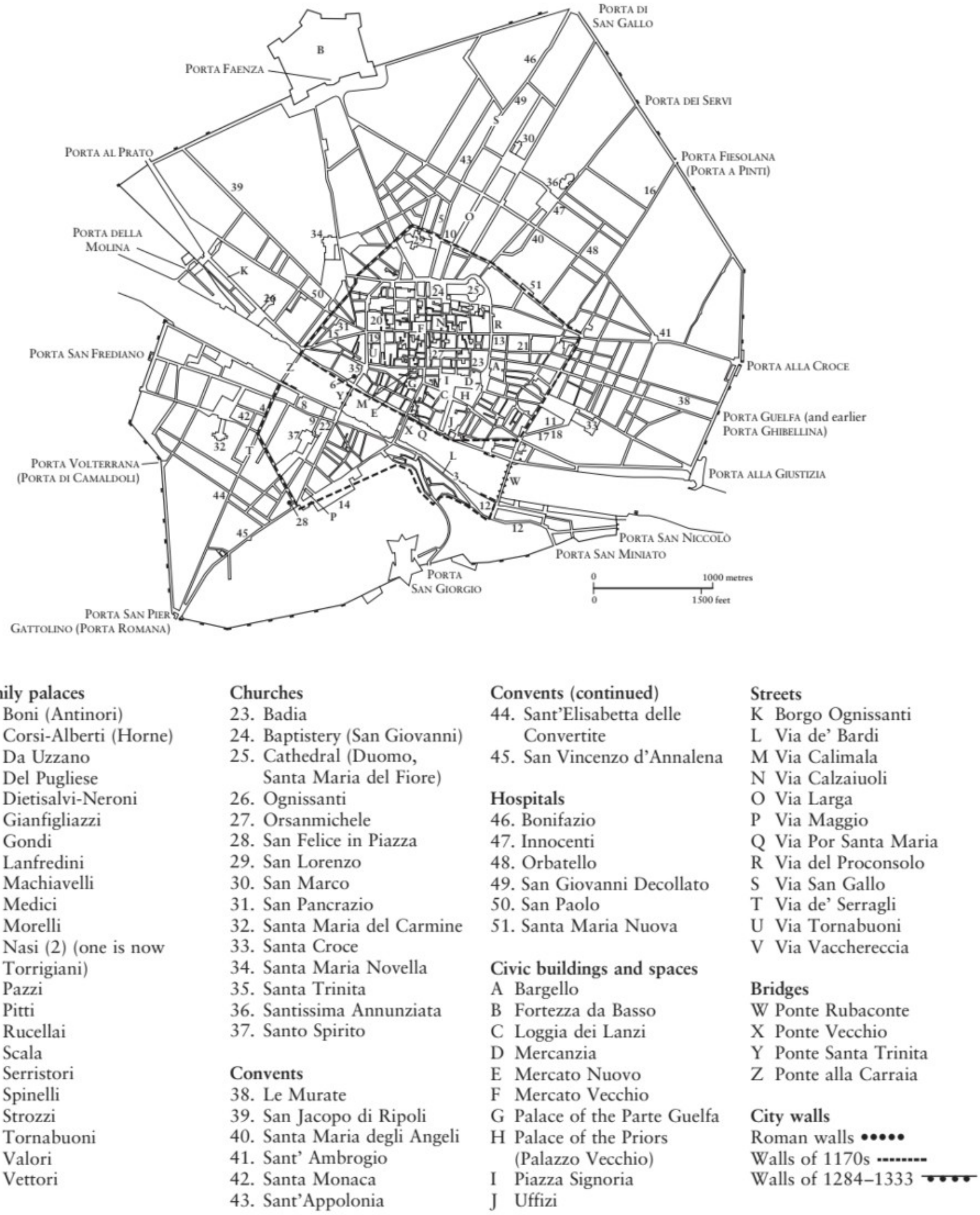
Figure 5 – Example of spatial reconfiguration and dominance

Obs. As seen from the south facade, there are two different construction layers, from the Islamic and Christian periods. The transformation of the building is a reflection of the spatial and symbolic domination after the reconquest. Source: Molina, 2007.

Figure 6 – Another example of spatial reconfiguration and dominance

Obs. The addition of minarets and the covering of Christian mosaics exemplify the spatial and symbolic reconfiguration to assert new religious and political authority. Source: Metropolitan Museum of Art, 2012.

Figure 7 – Architectural markers of power and negotiation in the urban fabric



Obs. The map illustrates the spatial distribution of monumental buildings in Florence. These structures not only symbolize power but also reflect ongoing processes of competition and collaboration among ruling elites, religious institutions, and emerging social groups. This interplay produces an urban fabric where power is negotiated through both physical form and social practice. Source: Najemy, 2006.

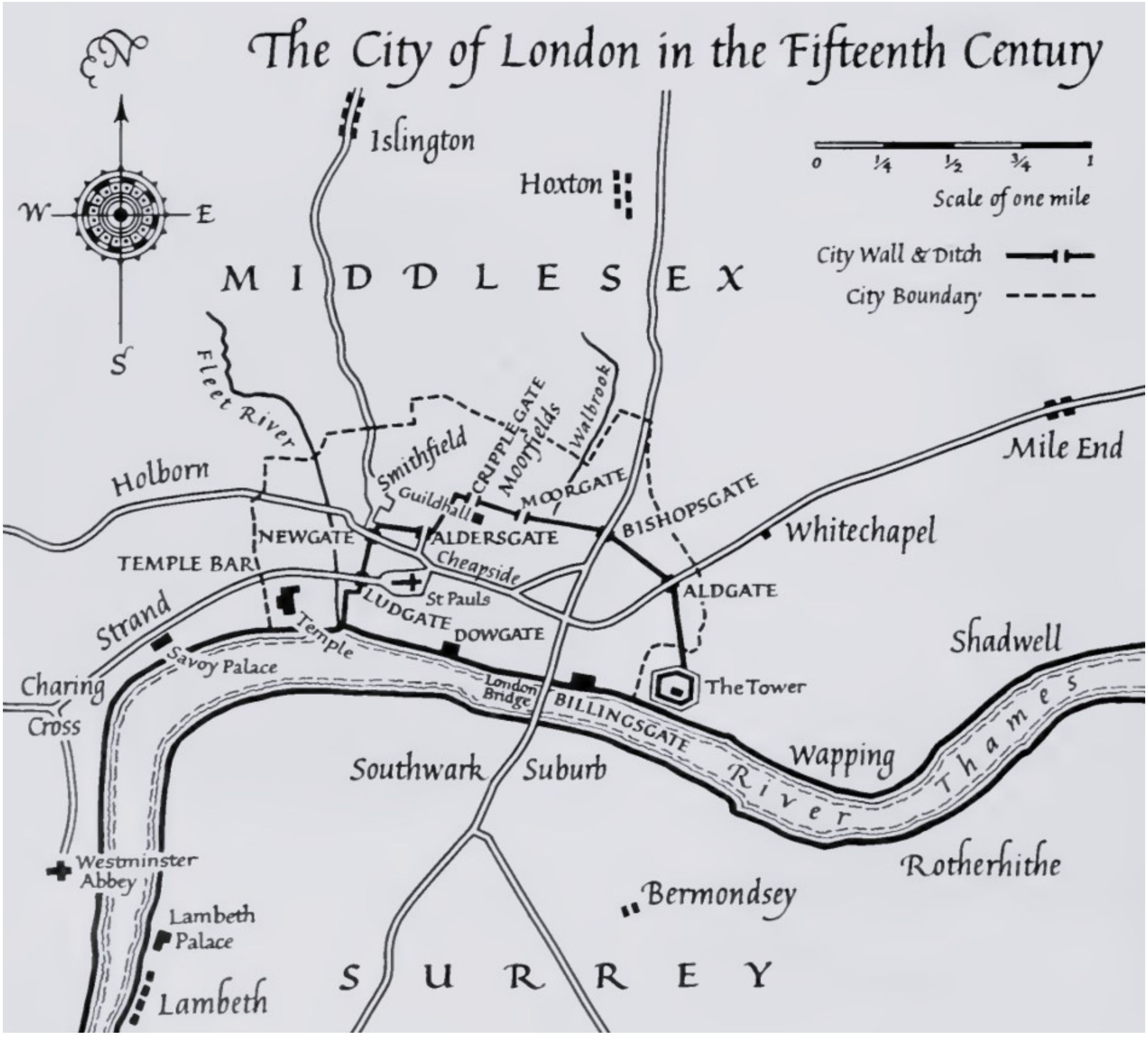
These examples illustrate the urban development is not only a reflection of political control. Additionally, it is also a result of the continuous interplay between competition and collaboration. Monumental architecture, spatial segregation, and knowledge production are all tools for ruling powers to shape the urban fabric.

Similar dynamics can be observed in Medieval European cities such as Florence (Figure 7), Paris, London, and Venice. In Florence, the guild system was central to economic, social and political organization of the city. Those of artisans, merchants, artistic and literary associations, guilds regulated trade by setting quality standards, pricing structures, and labor practices maintaining control and stability within the local economy.

Moreover, they influenced civic politics by holding key public offices and participating in decision-making processes that shaped policies. Thus, these economic and political power contributed to the spatial organization of the city. Specific guilds and social groups established their own territorial domains with distinct neighborhoods. For instance, artisans and merchants clustered in designated quarters to facilitate their economic activities and social interactions. This created identifiable enclaves by the crafts and trades practiced. In contrast, the elites, including banking families such as the Medici, occupied central zones. This provided them strategic advantages by offering proximity to major trade routes, administrative centers, and cultural venues. These advantages further reinforced their dominant status. As a result, the guild system in Florence was not only an occupational organization but also a complex social institution that played an important role in shaping urban morphology and reinforcing socio-political hierarchies. As detailed by De Grazia (1994) and Najemy (2006), spatial segregation resulting from guild-based territorial control exemplifies the combination of economic, cultural and political forces to produce a lasting urban order.

In Paris, between the 12th and 14th centuries, Jewish communities emerged as a result of social exclusion imposed by the dominant Christian society. Jews were compelled to settle in specific, marginalized quarters of the city as a result of legal restrictions and pervasive discrimination. However, this situation encouraged the development of highly organized social networks that were vital to economic survival and cultural preservation by establishing institutions such as synagogues, schools, and charitable organizations. They served as centers for religious practice, education, and mutual aid reinforcing a shared identity and internal solidarity. Economically, the situation led many Jewish groups to specialize in particular areas like money lending, textile production, and commerce. These formed markets sustained their livelihoods and contributed to the broader urban economy. This adaptive response demonstrates that enforced segregation as a tool for marginalization, can foster internal cooperation and resilience (HOLLANDER, 1997).

Figura 8 – Socio-spatial hierarchy and economic centrality in the urban scene



Obs. In the 15th century, London showcased a clear socio-spatial hierarchy. The city was confined within its ancient Roman walls, with the River Thames serving as a major transport and trade route. The core of economic and political activity was concentrated around the commercial district near Cheapside. Source: Hibbert, 1969.

In London (Figure 8), the medieval guild system also represented the competitive and cooperative dimensions of urban life. Striving to protect economic interests and assert professional dominance, rivalries among different trades caused the formation of distinct residential and commercial enclaves. These spatial divisions reinforced existing social stratifications by clustering wealthier artisans and merchants in well-maintained neighborhoods. On the other hand, lower-income workers were restricted in modest quarters. At the same time, the guild structures served as solidarity networks. By organized cooperative associations to provide mutual support, guild members pooled resources, and negotiated collectively with authorities and external markets. This dual dynamic of competition and cooperation strengthened collective bargaining power and created an urban fabric that was both competitive and collaborative (HIBBERT, 1969; HARBEN, 1985; THOMPSON, 1991).

In the 16th century's Venice, spatial segregation was also systematically implemented. This practice targeted to control the diverse population. The authorities imposed legal measures to confine Jews, Turks, and certain Christian sects to restricted areas known as ghettos. This institutionalized segregation reinforced existing social divisions by ensuring that the marginalized communities remained physically and socially separated from the dominant mercantile and political classes. By restricting their movement, housing, and economic activities, the authorities maintained order on one hand. On the other hand, they also controlled inter-group interactions in one of Europe's most dynamic commercial centers (DA MOSTO, 1987).

Additionally, this type of segregation had implications for the cultural and social development of these communities. Because of being isolated, these groups developed distinct collective identities and internal support networks allowing them to navigate the challenges of marginalization while preserving their cultural heritage. In conclusion, Venice's model of segregation is an example of shaping the urban fabric through legal and administrative practices and balancing the imperatives of economic growth with the demands of social control.

Similarly, Moscow and Lisbon starting from the 16th century reflect comparable patterns of competitive growth and localized cooperation. These dynamics are driven by political governance and economic forces. In Moscow (LIEVEN, 2006), autocratic rule of Tsar Ivan IV and his successors caused rapid urban expansion. The emergence of both geographically and socially segregated zones mirrored the deepening economic and ethnic disparities of the time. The centralized power structure restricted mobility and controlled land allocation. This led differentiated residential areas. While Nobles and the Tsar's court occupied the city center, near the Kremlin, lower-class citizens relocated to peripheral areas as part of state-building policies. Under the autocratic rule, the spatial arrangements not only reflected the strict social hierarchy but also reinforced it (MIKLASHEVSKY, 1994). Urban policies of this period was not only about political control but also about fostering economic productivity. Infrastructures like roads, markets, and trade routes further separated social groups by class and occupation.

In the 16th century, Portugal’s expansionist maritime trade and its role as a center for the European spice trade marked a period of geopolitical prominence. The growing economy led to the establishment of distinct urban districts reflecting the effects of competition for resources and cultural exchange in Lisbon. Wealthy elites consisted of merchants, nobles, and the aristocracy clustered in the city's well-developed central districts, where the royal court, religious institutions, and trade routes were concentrated. In contrast, the others were confined to the outskirts of Lisbon. These areas were less serviced by the infrastructure of the urban core. The rapid development of such territorial segregation also paralleled political reforms under King João III. The reforms reinforced social stratification and increased distinctions between the ruling elite and the common people. Moreover, due to its maritime reach, Lisbon’s diverse international population created pockets of cooperation and competition. A network of guilds, commercial associations, and cultural institutions helped to cultivate a sense of shared purpose within the segregated districts although such cooperation often served to maintain the privileges of the elite (SERRÃO, 2002). The city became both an arena for competitive growth and a system of localized cooperation, where on one hand mercantile powers developed and distinct social groups continued to exist economically, on the other hand.

As a result, the historical development of cities reveals an enduring interplay between social competition, cooperation, and spatial organization by producing some advantaged and disadvantaged groups within urban environments. From ancient Mesopotamian settlements to medieval European cities urban space has been shaped by the struggles between groups seeking access to resources, economic and political power. This ongoing contest has reinforced both physical and social segregation, with privileged groups consolidating control over the most strategically significant urban spaces while others were pushed to the periphery.

Territoriality, the claim and defense of urban space by competing social groups, is a central theme in this historical process. Within this theme, as both a spatial and symbolic factor, centrality also plays an important role in determining access to power and resources. As seen, in many cities, central districts became centers of political authority, economic wealth, and cultural prestige. This reinforced the dominance of elite groups over others. In contrast, disadvantaged populations were often relegated to peripheral or less desirable areas. This directed location solidified their exclusion from urban benefits.

Despite the absence of evidence, in early settlements such as Çatalhöyük and Jericho, spatial organization suggests that social stratification already existed. Furthermore, as settlements evolved, ancient cities institutionalized these hierarchies through architecture, infrastructure, and social organization. In Mesopotamian settlements, central temples, administrative complexes, and palaces occupied the most strategic areas, while lower-status individuals and laboring classes lived in distant quarters. As religious and political authority merged to maintain control over both material and symbolic resources, the sacred centrality helped them to obtain the dominance.

Greek and Roman cities exhibited similar patterns, with spatial arrangements reflecting class divisions. In Athens, citizenship determined access to key urban spaces. This legal tool excluded marginalized groups from political and economic centrality. In Rome, similarly, while the elite class maintained privileged access to central districts, lower-class citizens were often confined to dense apartment blocks in marginalized areas. Social competition over urban space led to clear physical demarcations, creating zones of privilege and exclusion.

Furthermore, during the medieval and Islamic periods, cities such as Baghdad, Cairo, Córdoba, and Damascus also reinforced urban hierarchies through territorial organization. Competition and cooperation among merchants, scholars, and ruling elites shaped the layout. Economic and religious centers located in privileged areas and the other communities were often restricted to specific quarters. However, despite the marginalization, cooperation within certain social networks enabled disadvantaged groups to maintain economic resilience and cultural identity.

Istanbul, from Byzantine to Ottoman rule, pictures how urban centrality was contested and redefined by political dominance. The architectural imposition of mosques, palaces, and administrative centers symbolized the victory of the new elite. This imposition consolidated the control over the valuable zones while restraining non-Muslim communities to designated neighborhoods.

In European cities, similar patterns emerged through legal and economic mechanisms. Florence's guild system structured economic and social life. This system allowed some families and professional associations to gain power and dominate prime urban locations and other groups. In addition, Paris and London showcased the spatial exclusion of specific social groups and lower-class populations. By being confined to specific neighborhoods, social and economic stratification were reinforced. Furthermore, Venice's institutionalized spatial exclusion of certain groups exemplifies intentional spatial segregation as a tool for social competition in the background of urban governance.

The cases of Moscow and Lisbon further demonstrate how territorial competition shaped urban growth and even maintained social hierarchies into the future. Reflecting deep social divisions reinforced by state policies, Moscow's rapid expansion under autocratic rule led to distinct zones based on class and ethnicity. Lisbon's maritime trade networks created new social hierarchies, where merchant elites occupied strategic locations while laboring classes and marginalized groups were pushed to the outskirts.

It is inevitable to see that urban segregation has functioned as both a consequence and a mechanism of social competition and cooperation throughout history. Here, territoriality and centrality remain as strategic factors in determining access to power and resources. As dominant groups secure prime locations, disadvantaged groups are systematically displaced or contained. Within internal networks and between groups with similar goals cooperation has also played a role. However, it rarely transcended broader social divisions as urban structures continue to reflect and reinforce existing inequalities.

Additionally, cities are active arenas where struggles over territoriality, hierarchy, and centrality among social groups shape physical form and social relations. The long-term trajectory of urban development demonstrates that competition and cooperation are inseparable forces in the lives of individuals and groups and in city-building. These dynamics continually redefine spatial and social structures across the time and civilizations.

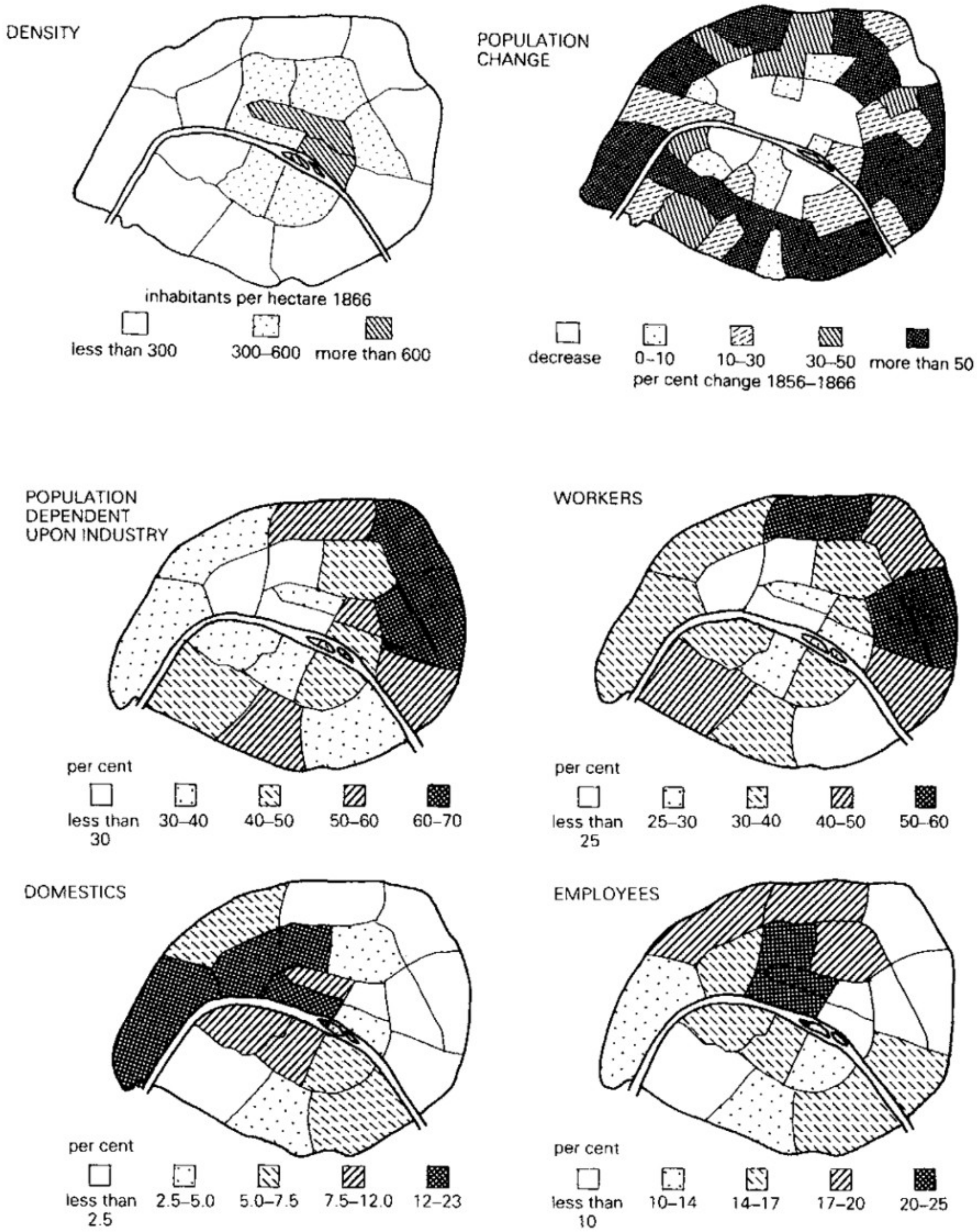
Industrialization in the 19th and 20th centuries restructured the cities. During the rapid urbanization process, social stratification was reinforced and spatial segregation was deepened (HARVEY, 1985). Cities such as Manchester, the center of the revolution in England, reflects these transformations. As industries expanded, waves of rural migrants and immigrants flooded the city in search of employment. This created a divide between industrialists and the working class. The struggle for housing and jobs resulted in the emergence of densely populated working-class neighborhoods. These neighborhoods were characterized by overcrowded and unsanitary living conditions and located near factories. In contrast, the economic elite occupied the spacious, well-maintained districts in suburban or central areas with better infrastructure and amenities (RODGER, 1993; SCOTT, 2001). Moreover, industrialists used their economic power to further reinforce these divisions by shaping urban policies and housing developments that preserved their privileged access to urban resources (CHADWICK, 1842).

On the other hand, communities in working-class also developed cooperative strategies and mechanisms such as charities, mutual aid societies and trade unions to reduce economic and social inequalities (HOBSBAWM, 1964). Within these, trade unions played a central role in defending workers' rights by leading improved wages, reduced working hours and better living conditions (THOMPSON, 1963). In addition, organized labor movements put pressure on industrialists and politicians and created a sense of solidarity among the working class. These actions also strengthened these groups bargaining power in urban society (MORRIS, 2005).

Cultural and political organizations also helped marginalized communities establish some autonomy in segregated areas. Cooperative housing initiatives, educational programs, and health services aimed to overcome the troubles created by official policies, demonstrating the power of social cooperation as a counterweight to competitive exclusion. However, these efforts were often met with resistance by elite groups and government officials who sought to maintain existing urban hierarchies through zoning laws, policing, and economic policies (SENNETT, 1994).

In Paris (Figure 9), too, industrialization and rapid population growth in the 19th century created working-class neighborhoods. The expansion of factories and the influx of workers intensified social and spatial divisions as wealthy classes sought to avoid overcrowded and impoverished areas (HARVEY, 2003).

Figure 9 – The impact of industrial growth on socio-spatial structure



Source: Harvey, 2006.

Baron Haussmann's mid-19th-century redesign of Paris exemplifies the interplay between competition and cooperation in shaping urban space. Haussmann's projects modernized infrastructure and improved sanitation, while also serving the interests of the bourgeoisie by moving low-income communities to the outskirts of the city (JORDAN, 1995).

This competitive process also involved strategic cooperation between the state, urban planners, and economic elites. These groups aligned their interests to reinforce social hierarchies through spatial organization (PINOL, 2003). The restructuring of Paris' boulevards and the development of large public spaces facilitated economic activity and improved mobility, while excluding working-class populations by making central areas unaffordable. For these reasons, Paris is a rare example of urban development reflecting the dual process. While dominant groups cooperated to shape urban space in their favor, competition for access to valuable resources deepened the social stratification.

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Chicago was also transformed into a highly segregated urban landscape, where competition for employment and housing intensified social and spatial divisions (BURGESS, 1925). The city's rapid economic expansion attracted large waves of immigrants from Southern and Eastern Europe, who settled in ethnically diverse areas as they sought work in factories, cattle markets, and construction (BODNAR, 1985). This influx heightened the competition in the labor market. As a result, the immigrants often faced hostility from native-born workers and earlier immigrant populations (ZUNZ, 1982). Housing shortages and discriminatory practices reinforced ethnic segregation. Thus, different communities concentrated in specific neighborhoods such as Little Italy, Pilsen, and the Polish Triangle (PHILPOTT, 1978). In contrast, wealthier social classes moved to more affluent districts or emerging suburban areas. This further exacerbated spatial divisions (MAYER; WADE, 1969).

Despite the competitive appearance, various forms of social cooperation also emerged as immigrant communities sought to improve their living conditions and establish their place in the city. To provide resources, employment opportunities, and social support networks, mutual aid societies, religious institutions, and technical organizations played an important role (TILLY, 1990). Especially, ethnic charities and mutual aid societies helped working-class immigrants to cope with economic hardship and discrimination by fostering resilience and solidarity in segregated neighborhoods (COHEN, 1990). As a result, Chicago's ethnic segregation pattern, shaped by both social competition and cooperation mechanisms, became a defining feature of its urban fabric persisting into the twentieth century by influencing the city's subsequent racial and economic segregation (DRAKE; CAYTON, 1945). In conclusion, the dynamics observed in the Chicago case illustrate the reinforcing effect of competition over urban resources on divisions, as well as its provocative effect on cooperative strategies aimed at collective progress.

Similar to previous rapidly industrializing cities, New York City experienced significant segregation in the late 19th and early 20th centuries, as well. The city's crowded apartment neighborhoods, especially in Lower Manhattan, became battlegrounds for resources such as housing, jobs, and political influence. Moreover, these areas often led to violent conflict between different immigrant groups (RIIS, 1890). Irish, Italian, Jewish, and later Eastern European communities competed for space and opportunities, reinforcing ethnic enclaves and social divisions (BODNAR, 1985).

Cooperation also emerged here parallel to competition to improve the conditions of immigrant groups. Reform movements such as the settlement house movement, aimed to provide education and social services to working-class immigrants by promoting solidarity among ethnic groups (ADDAMS, 1910). Furthermore, religious institutions played a significant role in providing assistance to poor populations and advocating for workers' rights and housing reforms (STANSELL, 1987). The mutual effects of both competition and cooperation in New York's immigrant neighborhoods picture the broader urban dynamics of the industrial era. On one hand, economic pressures and ethnic rivalries deepened segregation. On the other hand, grassroots initiatives and reform movements helped to mitigate some of the harshest effects. As a result, both dynamics caused an evolution of social fabric.

Berlin also faced densely populated working-class neighborhoods. As labor demand increased, waves of immigrants and competition for housing and employment increased (BLACKBOURN, 2003). In the process, relatively wealthy individuals were gradually settled in well-planned areas, while workers were confined to overcrowded apartments in areas such as Wedding and Neukölln (BENEVOLO, 1993). Cooperation, including housing associations and social reform movements, emerged, as well. Workers' housing cooperatives aimed to improve affordability and living standards, while especially state-led urban reforms aimed to address health and infrastructure problems (HAUBERMANN; SIEBEL, 1987).

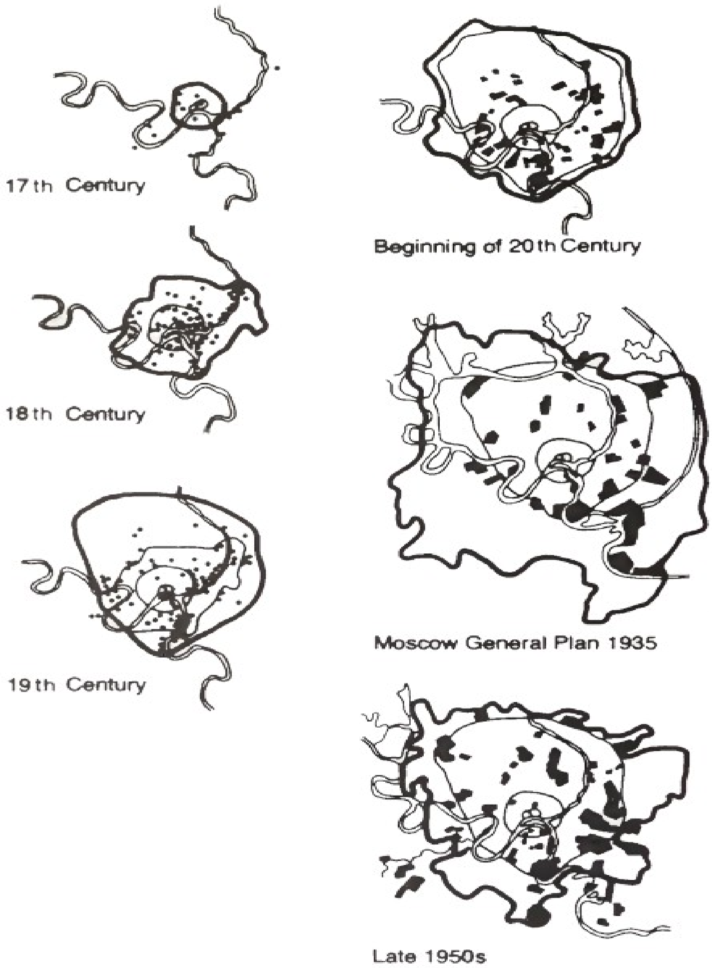
The transformation of Tokyo during Japan’s industrialization and opening to the West led to the formation of neighborhoods reflecting social stratification, as well (Figure 10). Wealthier residents and elites settled in newly developed areas such as Marunouchi and Yamanote, while lower-income groups remained concentrated in older districts like Shitamachi without an option other that traditional wooden housing in high populated areas (SORENSEN, 2002). As industrial expansion and migration fueled urban congestion, resources such as housing, sanitation, and employment became scarce (JINNAI, 1995). In response, the government and local organizations initiated cooperative efforts to address social inequalities. Furthermore, after the Great Kanto Earthquake in 1923 large-scale redevelopment projects reshaped Tokyo’s urban hierarchy by reinforcing distinctions between privileged and marginalized areas even if some reforms aimed at improving working-class conditions (SEIDENSTICKER, 1991).

The rapid industrialization of Moscow also led to pronounced social and spatial divisions with overcrowded working-class districts (Figure 11) on the outskirts, such as the Zamoskvorechye and Presnya. These areas were characterized by poor housing conditions and limited infrastructure reflecting economic disparity (BATER, 1980). Meanwhile, political and industrial elites occupied well-planned central districts, causing reinforced urban segregation patterns. In addition, tensions between social classes exacerbated, as competition for employment and housing intensified as a result of migration from rural areas (GATRELL, 1999).

Figure 10 – Reflection of social stratification

Source: Sorensen, 2005.

Figure 12 – Class-Based Spatial Segregation



Source: Bater, 1980.

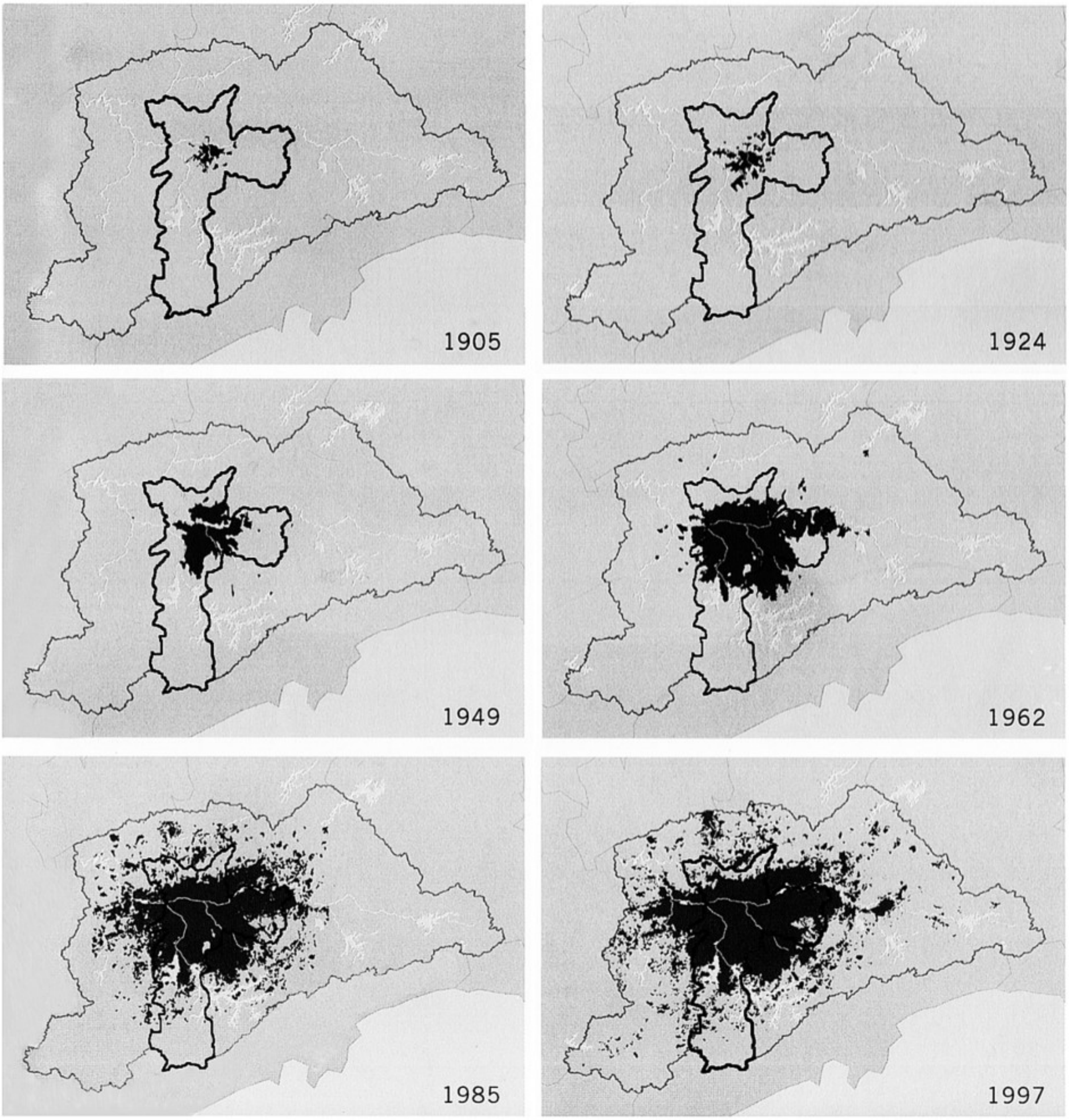
In response, cooperative strategies such as worker associations, revolutionary movements, and state-driven housing reforms naturally emerged. The Soviet period further reshaped Moscow's spatial hierarchy. Despite still being stratified, large-scale urban planning projects aimed to integrate workers into centrally controlled residential zones (KIRK, 1980). Still, demonstrating the interplay of competition and cooperation in shaping urban space, social and economic inequalities persisted.

As the Ottoman Empire sought to modernize its economy and infrastructure, Istanbul in the late 19th and early 20th centuries faced increased migration from rural areas, leading to the growth of working-class neighborhoods. While these groups settled especially on the periphery (ÖKTEM, 2011), bureaucrats and merchants resided in wealthy districts such as Pera (Beyoğlu) and the ones along the Bosphorus, reinforcing spatial segregation (KEYDER, 1999).

Because of ongoing competition, particularly between Muslim and non-Muslim communities tensions were increased as legal and economic policies affected urban distribution. While non-Muslim communities occupied important commercial and port areas of the city based on their inheritance from the past, nationalist policies in the early Republican period reconfigurated not just the entire country but also Istanbul's demography through forced displacements and economic restrictions. (MILLS, 2010). At the same time, cooperation and social solidarity were evident in the initiatives of foundations that provided housing, education, and infrastructure to disadvantaged groups. Moreover, labor movements and municipal reforms that emerged over time aimed to improve conditions for the growing working class, even as social hierarchies remained settled.

São Paulo also witnessed deep social and spatial segregation in parallel (Figure 12). As coffee exports fueled economic growth, the settlement experienced intense competition for jobs and housing, as it received a large influx of immigrants from Europe, Japan, and later rural Brazil (BONDUKI; ROLNIK, 1982). The working class was pushed into marginal and precarious housing, while the wealthy groups settled in central and western areas such as Jardins and Higienópolis under better conditions. The resulting picture was one of fragmented social inequality (HOLSTON, 2008). After the abolition of slavery in 1888, racial and class-based discrimination intensified as Afro-Brazilians, with highly limited access to economic opportunities, were disproportionately confined to favelas and informal settlements (ROLNIK, 1997). Meanwhile, European immigrants, despite initial difficulties, had relatively better access to housing and jobs, reflecting structural inequalities in the labor market.

Figure 12 – Density and central dominance in the growth of settlements



Obs. The expansion of Metropolitan São Paulo (1905-1997). The bold line represents the boundaries of the municipality of São Paulo, while the lighter line marks the extent of the broader metropolitan region. Source: Adapted from Meyer, Grostein, and Biderman (2004), cited in Holston (2008).

In response to these inequalities, cooperative strategies emerged, including labor unions, mutual aid societies, and housing cooperatives, which aimed to improve living conditions for the working class (SINGER, 1973). However, state-led urban interventions, especially during the military regime (1964–1985), further reinforced segregation by prioritizing infrastructure for certain groups while neglecting marginalized communities. Over time, the construction of highways and gated communities deepened the social and physical divisions of the city in ways that continued in the years to come (CALDEIRA, 2000).

In summary, industrialization has fundamentally transformed cities by intensifying social competition and strengthening spatial hierarchies. The waves of migration accelerated by industrialization have intensified the struggle over employment, housing, and resources, leading to more pronounced socio-spatial segregation. In cities such as Manchester, Chicago, New York, Paris, Berlin, Tokyo, Moscow, Istanbul, and São Paulo, industrial growth has created areas of economic opportunity as well as deepening social stratification.

In this process, centrality has played a critical role in determining inequalities within the city. While economic and political elites control commercial centers, planned housing districts, and areas with developed infrastructure, the working class and disadvantaged groups have been pushed to the periphery or into overcrowded areas. Moreover, the physical organization of cities has also perpetuated economic inequalities. The Haussmann transformation of Paris, the discriminatory zoning policies in New York and Chicago, and the emergence of informal settlements in São Paulo and Istanbul are examples of this trend.

On the other hand, cooperation appears to have emerged as a counterforce to industrial-era inequalities. Workers organized through unions, mutual aid societies, and cooperative housing projects, while social reformers sought to alleviate extreme poverty by establishing charities and welfare programs. But many of the infrastructural and social policies implemented by the state and elites often reinforced existing social divisions, further excluding disadvantaged groups from urban centers.

2.3.2 Modern Urban Landscapes: From Post-Industrialization to Globalization

Post-industrial and global periods have a characteristic that continues with economic transitions and globalization transforming social dynamics and thus spatial segregation. The decline of the manufacturing industry and the rise of the service-oriented economy have intensified class-based segregation in post-industrial cities. In this process, economically disadvantaged communities have been marginalized. At the same time, knowledge-based industries have concentrated in urban centers.

While certain regions have attracted investment and become rich, disadvantaged neighborhoods have experienced a loss of resources. As a result, these neighborhoods have exhibited sharp differences in terms of education, health and employment. With globalization, the area itself has been reshaped. The increase in property values and the displacement of certain communities are the most obvious characteristics of this shaping. Thus, existing segregation shells have deepened. However, global migration has brought about new forms of segregation. Immigrant communities have clustered in suburbs. These neighborhoods are a reflection of competition and have encouraged cultural collaborations and social networks within themselves.

Brazil stands out as a striking example in this regard. Favelas, in particular, clearly demonstrate the interaction of these dynamics in urban segregation. In cities such as Rio de Janeiro (Figure 13) and São Paulo, these informal settlements, which lack infrastructure and economic investments and host marginalized communities, exemplify the spatial and social separation between disadvantaged and advantaged groups. These settlements, which are a reflection of these social dynamics, also increase competitive inequalities. However, the wealthy residents of these cities constantly compete for central areas (VILLAÇA, 2001; PEARLMAN, 2010).

Figure 13 – *Barrocos* as a survival strategy

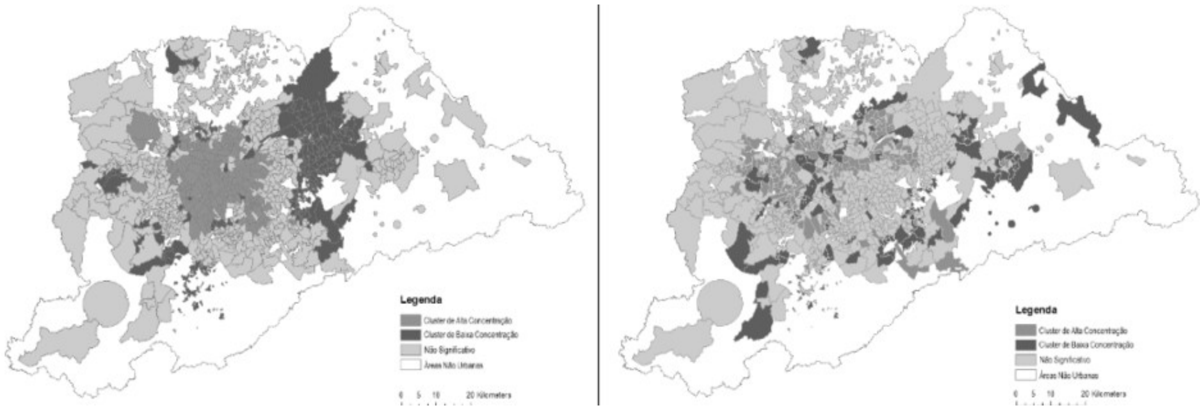
Source: Pearlman, 2010.

Despite its spatial segregation and socio-economic exclusion, the favela also represents a cooperative adaptation through self-organized spatial practices that reflect resistance. Over time, they develop into coherent territories exhibiting crucial features of centrality, flow continuity, and relational integration. These features indicate not merely survival under conditions of marginality, but the production of internal cooperation, shared territorial control, and collective identity formation. In this sense, the favela functions as both a product of competitive urban processes, where disadvantaged groups are displaced from formal, centralized urban areas, and a site of cooperative spatial reconfiguration, where residents generate new urban orders based on survival and cooperation (LOUREIRO, MEDEIROS, AND GUERREIRO, 2019). In addition, reflections of the segregation phenomenon are also observed in luxurious high-rise buildings. While high-income individuals live on the upper floors, low-income individuals live on the lower floors or in old buildings. Thus, vertical segregation, another reflection of social dynamics, is exhibited.

One reflection of segregation in Brazil, particularly in São Paulo (Figure 14), Fortaleza and Salvador, shows itself through income level, social class and race related to policies and regulations in the historical process (FRANÇA, 2020). The most striking feature of segregation, where there is a certain hierarchy between groups, is the sharp separation of whites of the middle and especially upper income groups from all other groups (Figure 14). This situation is associated with the reflections of social stratification with historical roots to the present day. Preteceille and Cardoso (2020), on the other hand, states that in São Paulo the upper income group tends to self-segregate within the possibilities they have, while the middle income group tends to move away from the low income group and choose places closer to the upper income groups. In their study comparing the cities of São Paulo, Rio and Paris, they state that although this type of segregation is seen in all cities, it is more severe in Brazilian cities. In addition, this segregation also has a direct effect on access to urban infrastructure and services. They relate the fact that segregation is less severe in Paris to public policies, especially housing policies.

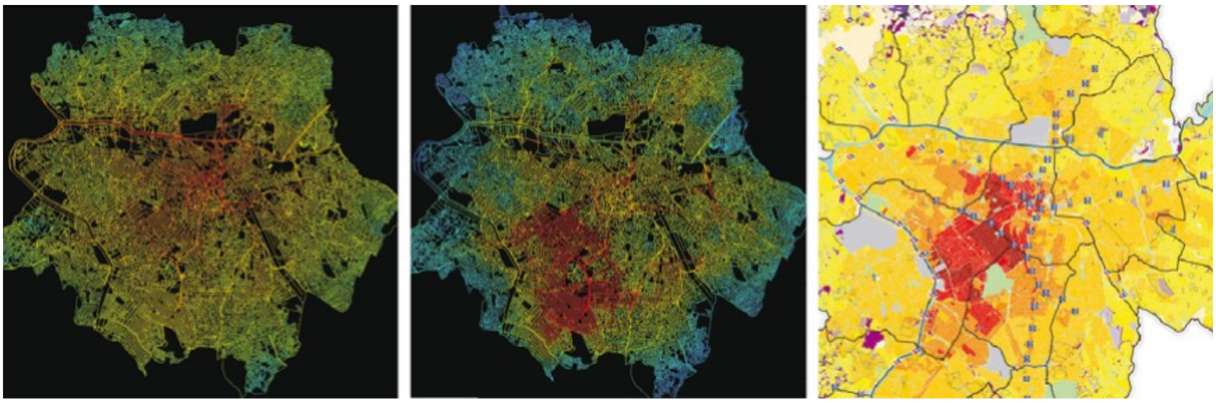
Rodriguez, Sakr and Griffits (2012), in their study of the historic center, its peripheral area and the southwest region of São Paulo City (Figure 15), also reveal the relationship between socio-economic characteristics and configurational characteristics. They argue that the lack of local and global interrelationships in the historic city center has resulted in some groups leaving the area, leading to physical deterioration, crime and increased poverty. They also relate the fact that the urban structure is made up of parts with different integration and choice values to the settlement of groups with different socio-economic characteristics in different areas. The concentration of buildings offering urban activities in the most accessible and intelligible areas is explained as a result of the settlement of the upper and middle income groups in these areas and the by-product movements of these groups. Naturally, these areas also have the highest land prices. In addition, this center is connected to the peripheral areas by streets with high value through movement, which increases its integration. This more integrated area offers better socio-economic conditions and a greater diversity of uses.

Figure 14 – Central concentration and peripheral fragmentation of social groups



Obs. In metropolitan São Paulo (2010) while the whites are clustered mostly (dark grey) in the central areas, where the land prices are high, blacks are located in fragmented relatively smaller clusters on the periphery. Source: Preteceille and Cardoso, 2020.

Figure 15 – Accessibility and economic valuation correlation in urban settings



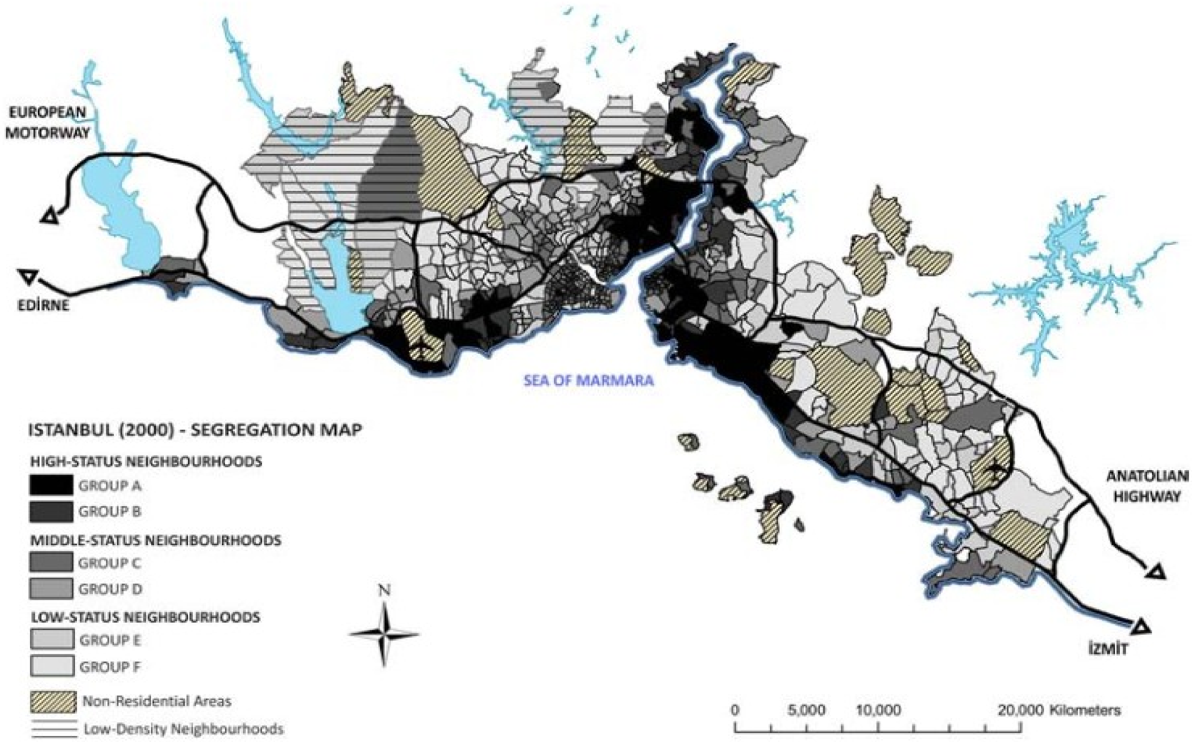
Obs. Red color shows the highest values in all maps. The land values increase (on the right) as the centrality value increases (on the left). Source: Rodriguez, Sakr and Griffits, 2012.

In addition, another study in Campinas (CUNHA; JIMENEZ, 2009) shows that inequality in resource access, educational attainment, and employment opportunities perpetuated by residential segregation creates a cycle of disadvantage. This particularly affects minority groups and those with limited income. The concentration of poverty within segregated neighborhoods restricts access to quality educational institutions and gainful employment. This impedes upward mobility. Furthermore, the disparities in access to healthcare services prevailing within segregated areas can engender elevated rates of chronic illnesses, limited accessibility to healthcare providers, and heightened vulnerability to environmental hazards.

In addition, indigenous populations in various Latin American cities, including Brazil, are marginalized and segregated. They often reside in neighborhoods that are physically and socially separated from the rest. This restricts access to basic services such as education, health, and housing. These restrictions deepen existing social divisions. Historical and structural factors such as land dispossession, discrimination, and unequal power dynamics perpetuate cycles of poverty and limit opportunities for social mobility. The continuing spatial and social marginalization of indigenous populations as a result of competition demonstrates that cooperative efforts are inadequate to eliminate deep-rooted inequalities (WORLD BANK, 2015). Cooperation among individuals against the segregation and discrimination mentioned is carried out through various movements that address housing, land rights, and police violence. Social movements are of vital importance to marginalized communities. In cities like São Paulo and Rio de Janeiro, where sharp divisions between rich and poor are formed, these social movements mobilize cooperation among individuals. through various actions. These movements are effective without achieving basic rights for low-income families (FRIENDLY, 2017).

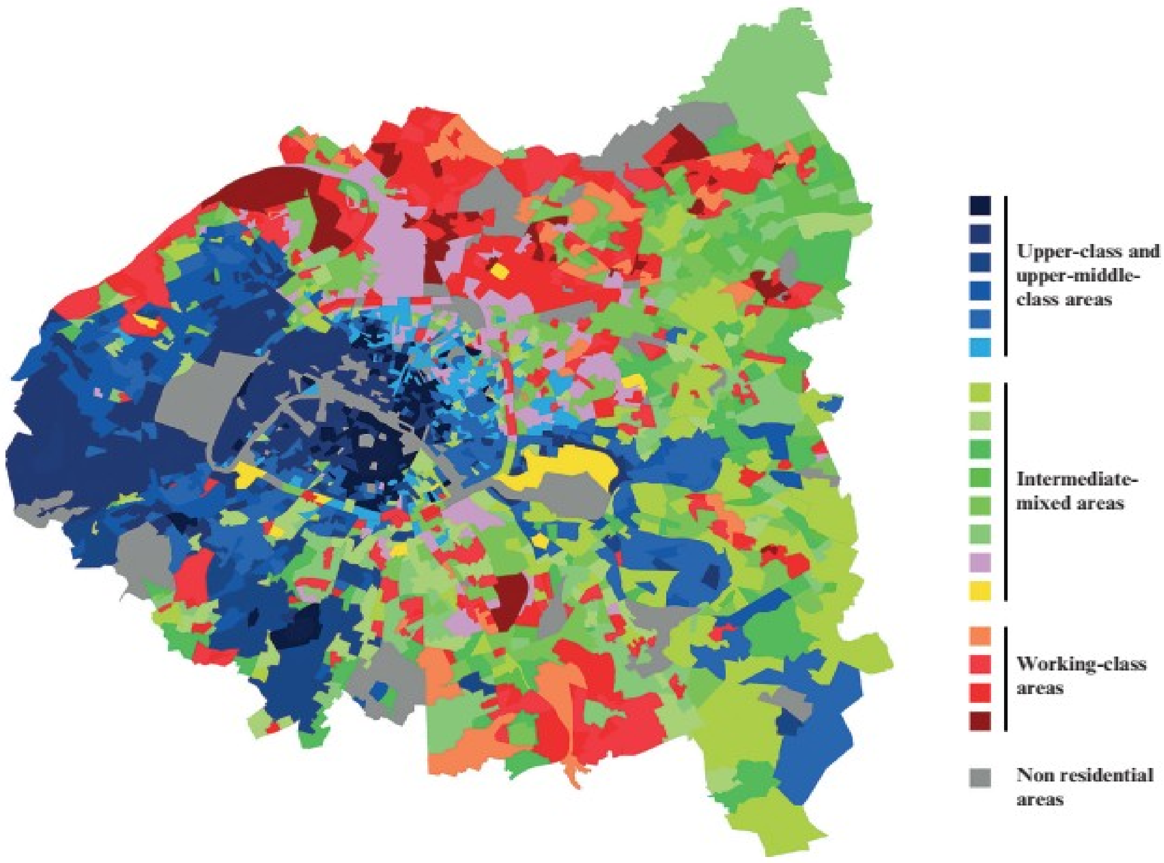
In Turkey, major cities such as Istanbul, Ankara, Izmir, Kayseri and Diyarbakir have also been undergoing rapid urban expansion and socioeconomic changes. In the process, while high social status groups are located mostly in the central or environmentally desirable areas, lower social stats groups pushed to the peripheries. Thus, these cities exhibit a typical spatial segregation pattern between different socio-economic status groups. In Istanbul (Figure 16), low-educated groups, as a sign of social status, are located in the peripheries, while high-educated ones are located in central and coastal areas. The groups with a university degree, which is an indicator of higher status, are located in crowded neighborhoods closer to the city center. These are the groups that are the most differentiated from others. Finance sector employees, professionals and employers are the second most differentiated groups.

Figure 16 – socioeconomic Stratification and urban segregation



Source: Ataç, 2017.

Figure 17 – Peripheral exclusion and structural marginalization



Source: Oberti, 2020.

On the other hand, in the low-status groups, illiterate women and manufacturing sector employees are located in the peripheries. Unlike other groups, these groups tend to cluster less. They are much more spread out throughout the system than other groups. While high-status groups are located in more qualified environments close to the city center, low-status groups exhibit the opposite settlement, creating a social network. This model of segregation between social status groups is also valid for other Turkish cities, regardless of their size. While city centers maintain their attractiveness for high-status groups, low-status groups are pushed to the periphery. Physical barriers make the separation between these groups more apparent. The quality of the residential environment is another indicator of segregation (ATAÇ, 2017).

In European cities, the social dynamics mentioned are also mobilized around immigration, housing competition, and gentrification. In London, neighborhoods that previously housed working-class communities have been reshaped as the city has become a global financial center. Residents of these neighborhoods have been pushed to the periphery as wealthier individuals and investors have chosen to locate in these areas . In addition, displaced individuals are collaborating with organizations advocating for affordable housing (ATKINSON AND BRIDGE, 2005; LEES, SLATER AND WYLY, 2008). In addition, a new model has emerged in which wealthier upper-income groups created by globalization are separated from traditional urban elites (ATKINSON AND KEI HO, 2020). Naturally, competition is also observed between these two groups. These new high-income groups shape urban policies, planning laws, and housing regulations with the power they possess. In this way, they reinforce their status within the new hierarchy or separate the high-status neighborhoods they settle in from the rest of the city.

The new roles of the suburbs in Paris also present important consequences for social dynamics and spatial segregation (Figure 17). These areas have become a character where social and ethnic discrimination is evident today, access to basic resources such as education, employment and health services is restricted and marginalized groups are isolated. These restrictions also increase social economic hardships and deepen the division between them and the more advantaged areas of the city. This segregation is due to the interactions of historical policies, economic inequalities and discriminatory practices. As a result, inequality in resource distribution, damage to social cohesion and stigmatization of residents are seen. Social tension and exclusion between groups are among the outcomes of the process (WACQUANT, 2008).

A more recent study (OBERTI, 2020), which examines the effects of exclusion and stigmatization on social, ethnic, racial and spatial segregation, is also important in terms of considering how individuals value their own identities. The fact that highly privileged groups concentrate on certain areas in urban space increases the visibility of the phenomenon. Upper middle class members, who think that social and academic success will be achieved through segregation, separate themselves from other groups. Group members who are excluded from these areas and schools feel their own identity values are less valuable. The groups that face this problem, called social downgrading, are the working class and immigrants. Individuals in the residential areas where these groups settle feel the sense of discrimination more.

Cities in Central and Eastern European countries such as Lithuania, Poland and Hungary also reflect patterns of competition and cooperation influenced by historical legacies. The transition from socialist to market economies resulted in limited interaction between different social groups despite spatial proximity. Discrimination inherited from the socialist era have deepened with neo-liberal market forces and restructured economies. This result shows that it is difficult to achieve social cohesion in urban spaces where past inequalities and current resource competition are effective together (KOVACS, 2020).

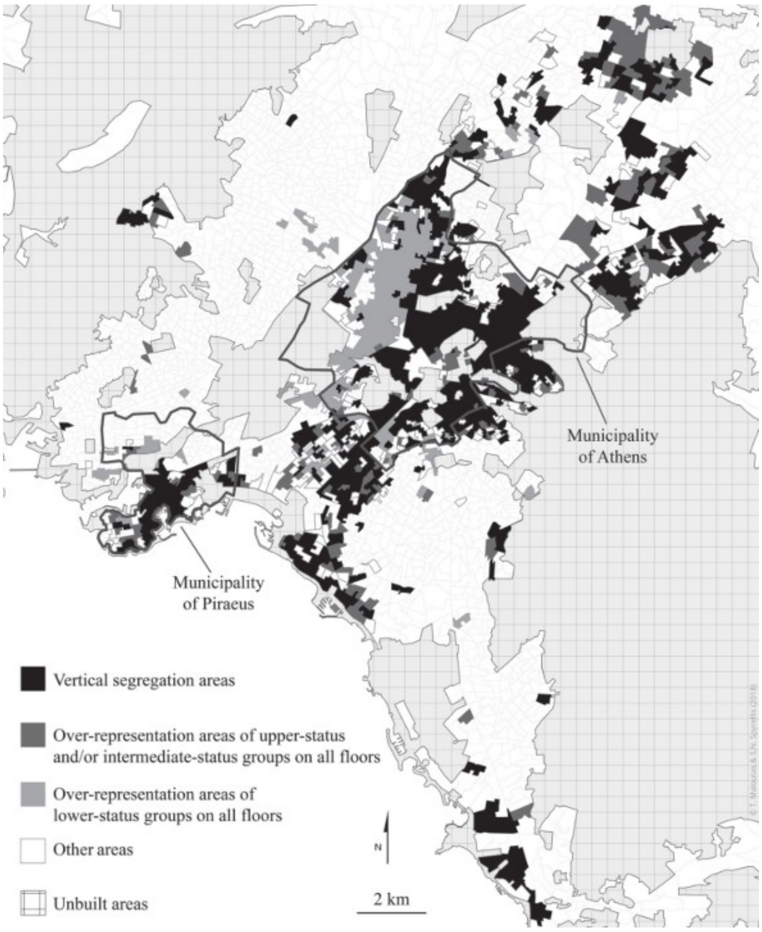
Another example from Europe, Vienna, reflects the interaction of competition and cooperation resulting from foreign immigrants. In the city, where guest workers come temporarily to do low-skilled jobs and become permanent over time, these dynamics are effective among ethnic groups. Competition and cooperation occur around targets of affordable housing and economic opportunities. As a result, spatial segregation patterns have emerged. Despite efforts such as incentive loans and social policies aimed at reducing economic differences between groups, competition continues to be intense. Social initiatives aimed at promoting social cohesion of different groups lead to discrimination due to economic inequalities. Lower-income individuals and groups tend to live in council housing, while others live in more desirable ones. Additionally, in cases where economic and social inequalities are reduced, more diverse patterns of segregation are seen (KOHLBACHER; REEGER, 2020).

The relationship between biological age and spatial segregation in Amsterdam is a striking example (BOTERMAN, 2020). According to the pattern, the most important finding is that the group of young adults is more separated from the others at the regional scale than the groups of middle-aged and children. This situation of young adults continues at the urban scale, although its severity decreases. However, the severity of segregation between age groups also varies according to the ethnic origin of these groups. The severity of segregation between age groups decreases in minority groups such as Turks and Moroccans, while it increases among those of Dutch origin. The study explains this situation with the severe separation between Dutch and other groups. An interesting finding here is the situation exhibited by the Caribbean-Dutch group at regional and urban scales. While young children are quite segregated, adults are much less segregated than any other group. Another important finding is the effect of income level on age segregation. Segregation between age groups increases in intensity as income increases. Being from different municipal areas within a metropolitan area also has an effect on segregation, especially for young people. In addition to revealing a specific segregation pattern, another important result of the study is that age segregation interacts with income and ethnicity, indicating that when age segregation decreases, segregation increases in these other factors.

Stockholm presents a different challenge in terms of social dynamics. The limited number of housing units developed since the 1990s has strained demographic integration. In this situation, where individuals have limited choice, mixed neighborhoods are created. Thus, the effects of housing policies on urban segregation are seen. Despite competitive pressures for limited resources, different demographic groups are forced to live together by the authorities (BRAMA; ANDERSSON, 2020). Athens (Figure 18) presents another dimension of the issue. Although different groups of individuals live in the same block, vertical segregation is observed within the same buildings. Individuals belonging to different social groups occupying different floors have varying levels of access and quality. Thus, deep social divisions are observed even in mixed neighborhoods. Competition for housing results in social stratification despite the physical integration forced by the authorities.

Segregation continues its existence with the dimensions of occupation, income, race and ownership status (MALOUTAS, 2020).

Figure 18 – Social stratification within shared structures



Source: Maloutas, 2020.

Figure 19 – Spatial exclusion and structural marginalization

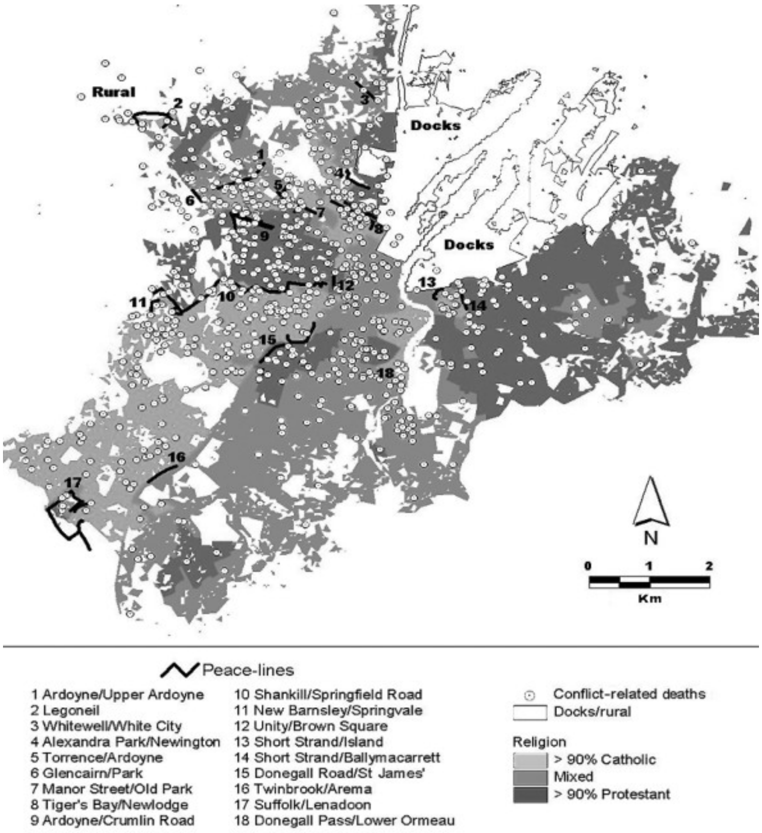
Source: FORTEPAN / Gyulai Gaál Krisztián,1976.

Romani settlements in Europe (Figure 19) provide more examples where these dynamics operate even more violently. These communities struggle with exclusion and are subject to segregation in European cities. The groups living in these settlements, which are generally located on the periphery of cities, have access to inadequate infrastructure and services as a result of historical competition. This situation also reinforces their social and spatial disconnection from the general urban fabric. The discrimination and stigmatization they are exposed to deepens their exclusion by continuing negative stereotypes. This deepening also negatively affects social cohesion. The obstacles to their access to education and employment opportunities further strengthen their social isolation (PICKER, 2017).

Another element of social dynamics is cultural ideologies (see figure 20). In cities such as Belfast, Derry/Londonderry and Armagh in Northern Ireland, tensions between Catholics and Protestants have led to the construction of physical barriers between groups (SHIRLOW; MURTAGH, 2006). Spatial separation also includes housing areas, schools and community facilities that serve different groups (MURTAGH, 2011). The solidarity within groups and competition between groups, which are the reasons for the segregated spaces, also limit interaction between groups and deepen the distances. As a result, social cohesion is hindered and cooperative efforts for mutual empathy become difficult (GAFFIKIN; MORRISSEY, 2011).

In the United States, the peak of racial segregation between the 1930s and 1960s provides a deep impact of social competition and cooperation on urban dynamics. Discriminatory policies systematically restricted housing and economic opportunities for certain populations. Thus, investments in these areas were suppressed and poverty was concentrated. This created a cycle of socioeconomic disadvantages and deepened social spatial stratification (MASSEY; DENTON, 1993; ROTHSTEIN, 2017). On the other hand, the struggle for equal rights and opportunities is the result of the solidarity of individuals opposing these discriminatory practices (Figure 21). These movements aim to balance the competitive environment and provide cooperation towards equality. Movements that aim to eliminate inequalities between groups have not achieved sufficient success in the face of historical and deep-rooted discrimination. Thus, the lasting effects of competition manifest themselves as spatial division (SUGRUE, 2008; SHARKEY, 2013).

Figure 20 – Cultural ideology and spatial segregation



Source: Shirlow and Murtagh, 2006.

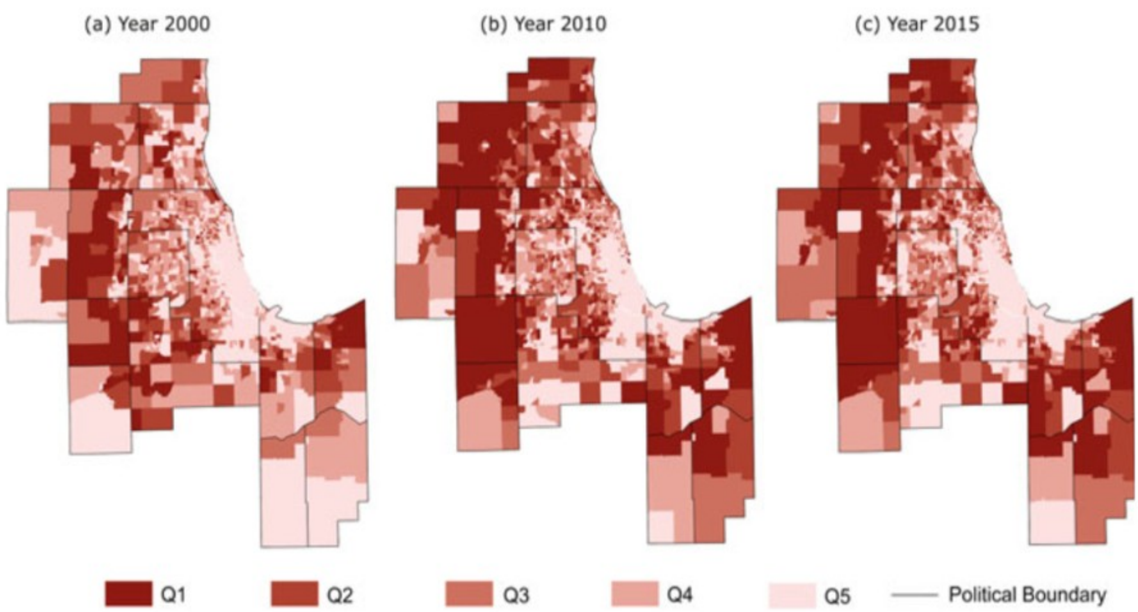
Figure 21 – Solidarity and resistance

Source: National Archives, 1963.

Competition for access to urban resources in cities such as Chicago, Cleveland, Detroit, Manhattan, Philadelphia and Pittsburgh is also observed among Italians, Poles and African Americans. Inter-group competition increases in-group solidarity and causes group members to concentrate in certain neighborhoods. As a result, a fragmented social and urban fabric has emerged. For example, in Chicago, the struggle for housing has led to sharp spatial divisions as each group establishes its own community. Despite the competitive pressures between groups, individuals also cooperate to establish and maintain their own community institutions. Ethnic ghettos have also emerged in Los Angeles and San Francisco. In Los Angeles, immigration and the accompanying competition have fostered urban segregation. Immigrant communities from Latin America and Asia have created neighborhoods that are cultural and economic centers. Immigrants lack access to adequate housing, employment, health, and education resources (PARK; BURGESS, 1925/2019).

New York City exhibits similar dynamics. Residential segregation plays a pivotal role in perpetuating disparities in the allocation of resources, opportunities, and social capital within urban settings. This phenomenon engenders differential access to essential resources such as education, healthcare, employment, public services, and infrastructural amenities for residents inhabiting segregated neighborhoods. These disparities, in turn, contribute to the exacerbation of socio-economic inequalities, ultimately constraining life prospects within urban spheres (GLAZER; MOYNIHAN, 1963).

Figure 22 – Urban restructuring and racialized displacement



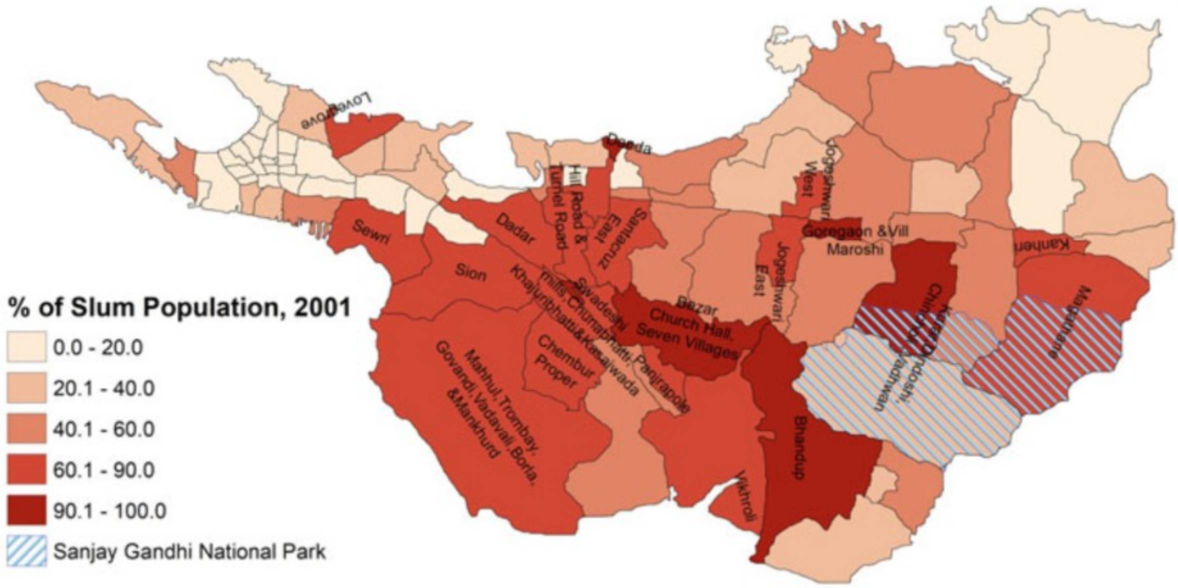
Source: Smith et al., 2021.

In addition to the social and spatial segregation between groups seen in Chicago (Figure 22), residents form strong networks. Businesses, schools, and cultural institutions that meet their common needs are part of these networks. At the same time, neighborhoods where African Americans have historically settled are being replaced by other groups with higher incomes. This situation causes increases in property values and rents, thus displacing the former group. In this process, local groups act together against gentrification interventions (SMITH et al., 2021). Another dimension of the issue in New York is vertical segregation. Segregation manifests itself clearly between luxury skyscrapers and older apartment buildings. While upper-income individuals have access to the upper floors of high-class residential towers, lower-income residents are generally able to find space in older buildings and public housing projects. Thus, individuals and groups at the upper levels of the social hierarchy have access to private areas and services, while others face disadvantages.

In addition to the examples above, household segregation in the United States also demonstrates the extent of income inequality. Segregation patterns in the 20th century show that households with and without children experience social cohesion problems in the same neighborhood. Although the segregation between families experiencing cohesion problems has eased over time, spatial segregation patterns between high- and low-income families are still observed. In these patterns, the segregated are low-income families. Thus, although one dimension of segregation has eased, the economic dimension continues to show itself. While signs of improvement are seen in the segregation of household types, economic factors continue to feed spatial segregation. This situation reveals the complex interrelationships of competition and solidarity dynamics and their reflections on space. In another American city, Atlanta, suburban expansion since the 1960s demonstrates the clear relationship between poverty and access to central areas. While middle-income groups have settled in the central areas as a result of urban renewal, low-income groups have been excluded from these areas. As a result, these groups have been pushed into less accessible and under-served areas. As a result of the competition for central areas, the disadvantaged position of low-income residents within the Hierarchy, who have access to limited public transportation and inadequate urban services, has also been reinforced (OWENS, 2020).

In addition, Jargovsky (2020) examined the US census data and Gini and Dissimilarity indexes for white, black and Hispanic groups in twenty US metropolitan areas. The study revealed that although the severity of racial discrimination, which was a practice applied in the past, has decreased, it is still the main determinant of income segregation today. Whites in the upper income group separate themselves from blacks and Hispanics, and even from whites in the lower income group. The pattern is shaped by the relationship between these whites, who are located in more qualified housing areas, have more access to urban services and resources, and educational and employment opportunities, and others. Hispanics, and especially African Americans, are economically isolated in the low-quality housing areas in which they are concentrated. This inequality is due to the interaction of economic segregation and racial segregation. Over time, racial segregation has given way to social class-based segregation.

Figure 23 – Informality as spatial manifestations of social hierarchies



Source: Shaban and Aboli, 2021.

In cities like Mumbai (Figure 23), Dhaka and Karachi in South Asia, urban growth and segregation outcomes are also encountered. The segregation between the upper and lower income groups in Mumbai is a striking example (WIT, 2017; SHABAN; ABOLI, 2021). In informal settlements, overcrowding increases the intensity of competition and insufficient resources lead to substandard conditions. However, in addition to the intense struggle for urban space and resources, the informal economy has been built as a result of solidarity in the Dharavi Slum city. This cooperation is vital for the dense populations pushed into these areas. Mumbai is also a city where vertical segregation is observed. There are also significant differences between the luxurious skyscrapers located in the south of the settlement and the older and densely populated neighborhoods of the city. As seen in the previous examples, luxurious apartments on the higher floors appeal to individuals in the upper income group, while lower income groups are pushed into older buildings or the aforementioned informal settlements. As a result of the competition, the riskier group benefits from improved living conditions, while the less affluent residents face barriers. This situation is a result of the existing caste system and also a result that crystallizes the social hierarchy. The hierarchical structure prevents social integration while also defining the dynamics of the urban area and preventing the upward movement of certain communities. Mumbai is another example of how historical and structural factors affect today's spatial and social dynamics.

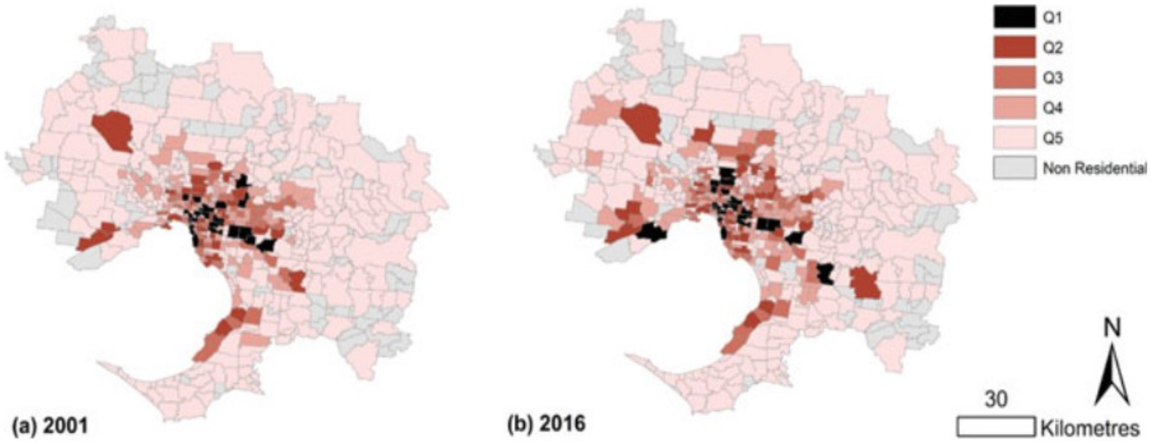
Similarly, Dhaka, the capital of Bangladesh, is also facing segregation problems determined by social dynamics as a result of rapid urban growth. Population growth is confining a large population in the low-income group to overcrowded informal settlements such as Korail. As a result of social competition, residents who choose to live in these areas also cannot access urban resources such as adequate housing and sanitation. In contrast, residents of informal settlements have established cooperation networks to improve their living conditions and access more resources. In Karachi, the largest city in Pakistan, land competition between individuals and groups has also directed low-income communities to informal settlements at risk of environmental disasters. These groups, formed by disadvantaged individuals, cooperate to develop defense systems and disaster preparedness plans to increase their chances of survival against competition.

In the African continent, Lagos, the largest city in Nigeria, hosts intense competition for urban resources. As a result, the settlement is sharply divided between wealthy areas such as Victoria Island and Ikoyi and informal settlements such as Makoko. Individuals and groups in informal settlements face dangerous conditions. They also lack basic services. Despite this, local leaders and residents cooperate for basic needs such as schools and health services. This cooperation also strengthens community solidarity. Nairobi, on the other hand, bears the traces of segregation policies inherited from colonial times. While divisions based on spiritual and ethnic groups are a result of a phenomenon, they also lead to inequalities in access to resources. As a result, social integration has been hindered and deep economic and social stratification has been created. In South Africa, the regime that lasted between 1948 and 1994 deepened racial divisions in the cities of Johannesburg (BALLARD; HAMANN, 2021), Durban and Cape Town. The local African population was forcibly settled in poorly infrastructural settlements on the periphery of urban centers. This created huge inequalities in access to education, health, and employment opportunities. Despite the solidarity within the ruling group, disadvantaged individuals also brought about the end of the regime through solidarity within the group and across borders. Despite this, the existing spatial, economic, and social segregation is difficult to eliminate. Today, social movements still focus on issues such as land rights and access to services.

Urban policies implemented in Australia over the last fifty years have also deepened inequalities between different socio-economic groups (Figure 24) in cities such as Melbourne (SYDES; WICKES, 2021). In single-center Australian cities, the centers are naturally the most physically and economically developed areas. While individuals in the upper income group dominate these areas, low-income groups are pushed to the periphery of the city. This situation, as seen in previous examples in different geographies, limits the employment opportunities and access to urban resources of individuals in the low income group. At the same time, the situation of displacement restricts the mobility of individuals, causing them to live in lower-paid jobs and poorer housing conditions. This segregation is also a result of competition for important urban land and urban resources.

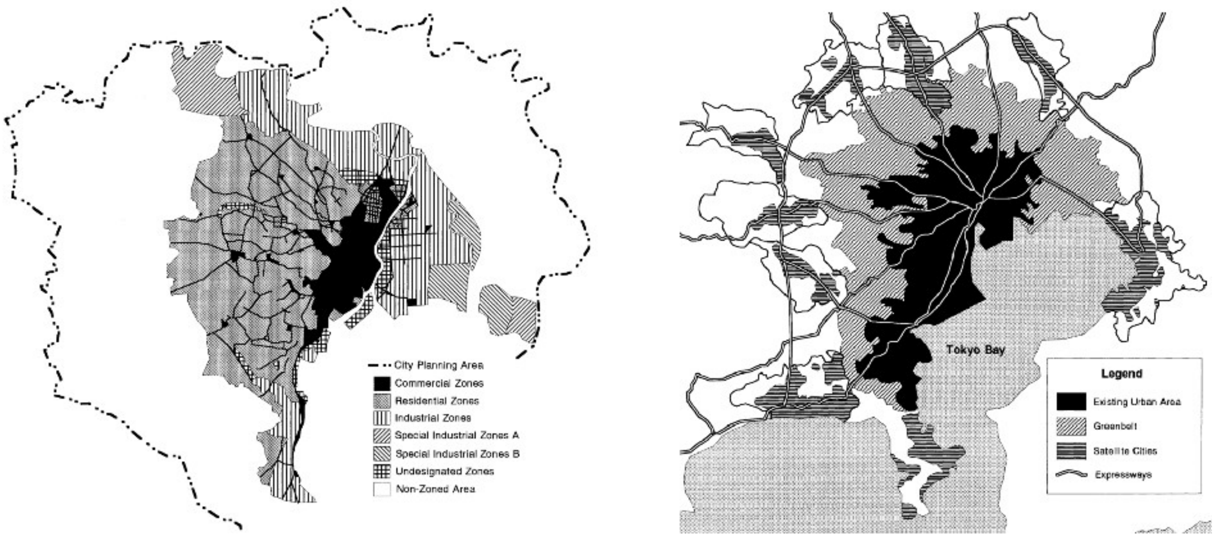
In post-reform China, Shanghai, Guangzhou and Shenzhen exhibit significant spatial segregation, with rural migrants mostly concentrated in suburbs as a result of migration flows (LI; GOU, 2020). Urban villages where migrants settle provide affordable housing and social networks necessary for their survival. On the other hand, urban villages pose problems of social isolation and perpetuating poor economic conditions. Rapid migration and economic changes deepen these inequalities. In Beijing, the distribution of urban services is organized according to different functions. While commercial facilities compete for central areas, public service facilities exhibit a more homogeneous distribution, reflecting a cooperation-oriented structure. As a result, the integration differences between commercial and public facilities increase the challenges of service equality. In Hong Kong, Forrest, Tong and Wang (2020) document that segregation is vertical in Hong Kong, as in the cities of Greater Asia. The study, which generally reveals the situation caused by price stratification in private housing structures, targets the middle-income group, but also contributes to making inferences for other income groups.

Figure 24 – Peripheral displacement and resource inequality



Source: Sydes and Wickes, 2021.

Figure 25 – Spatial stratification and urban reorganization



Source: Sorensen, 2002.

Tokyo's transformation also reflects the shifting balance between historical continuity and modern urban planning imperatives (Figure 25). In 1925, the city reflected the social and economic divisions of the past. The low city (Shitamachi), historically home to ordinary people and merchants, was largely designated as a commercial district, strengthening its role as the heart of economic activity. East of the Sumida River, industrial zoning reflected the increasing importance of manufacturing, while the high city (Yamanote), long associated with the upper classes, became home to residential use with commercial corridors following the main roads. By 1958, however, the city's uncontrolled growth was being brought under control. Industrial expansion was directed to satellite settlements surrounding the metropolis. In the process, Tokyo's urban fabric transformed from a socially stratified, district-based city to a metropolis struggling with rapid urbanization. A spatial delimitation and a regional planning-oriented approach paved the way for the city to become a dynamically growing global center. However, rapid economic growth and the integration of the city with the global economy have revealed new segregation patterns. While rising real estate prices have concentrated the upper-income group in regions such as Minato, outer regions such as Adachi have become living spaces for low-income residents, elderly individuals and migrant workers. As a result, the competition experienced in this city, where population density and therefore competition became even stronger (SORENSEN, 2002).

In conclusion, as cities continued to evolve, social dynamics extended beyond settlements, shaping and being shaped by regional, national, and global networks. The expansion of trade routes, colonial enterprises, industrialization, and the rise of global capitalism further institutionalized socio-spatial segregation within and between cities. Economic cores emerged, concentrating financial and political power in specific urban hubs, while peripheral regions were relegated to roles of resource extraction, labor supply, or subservient economic functions.

At the same time, patterns of spatial exclusion persist within urban areas, as gentrification, privatization, and infrastructural developments reinforce segregation. Marginalized groups continue to face displacement and exclusion, echoing the historical mechanisms through which disadvantaged populations were pushed to the peripheries of ancient and medieval cities. Now, competition and cooperation manifest globally, as access to global resources, strategic territories, and political influence defines international relations. Just as medieval guilds or colonial empires structured economic and social hierarchies within cities, international institutions and transnational corporations play a similar role in shaping global inequalities.

Ultimately, cities are not isolated entities but components of a broader historical process. The dynamics that once played out between neighborhoods and social classes now occur between regions, states, and multinational actors, demonstrating that territoriality, centrality, and spatial organization remain crucial tools in shaping power and inequality across both urban and global scales.

3 METHOD

This section explains the methodological framework adopted in this study by situating it within the broader literature. It aims to explain the logic of the chosen approach and how it contributes to understanding the socio-spatial processes at the heart of the issue under consideration.

Methods for measuring urban segregation can be grouped under the branches of non-spatial (DUNCAN; DUNCAN, 1955; MASSEY; DENTON, 1988), spatial (TOBLER, 1970; MORRILL, 1991), configurational (HILLIER; HANSON, 1984; HILLIER, 1999) and machine learning analyses. The first one of these, non-spatial methods, focus on the characteristics of social groups without taking their physical locations into account. On the other hand, spatial analyses add this dimension by including the distances of groups to each other into the process. Another new dimension is added by configurational analyses. They examine the effects of road networks on the movements of individuals and calculate spatial integration, allowing inferences to be made on the relationships between both individuals and social groups. Finally, machine learning methods focus on the complex relationships between social groups and enable the interpretation of the phenomenon of segregation based on the different characteristics between these groups.

Non-spatial methods calculate social segregation with various indices. One of these, Dissimilarity Index (DUNCAN; DUNCAN, 1955), is widely used for residential areas where segregation is most pronounced. Five algorithms with different goals, including evenness, exposure, clustering, centralization, and concentration, offer different perspectives (MASSEY; DENTON, 1988). Evenness measures the unequal distribution of social groups and their shared space, but it can yield inaccurate results in certain cases. Exposure examines potential contact between different groups, considering interaction and isolation tendencies. In addition, clustering assesses the proximity of minority groups, indicating concentration or dispersion within the city and centralization focuses on the proximity of groups to urban centers, picturing distribution patterns. Finally, concentration measures the degree of segregation by comparing group distribution in various areas but may have limitations, particularly for smaller minority groups. However, despite providing useful outputs from different perspectives, this index does not capture details about social dynamics and structures because it only compares group compositions. Thus, for a comprehensive understanding, it is necessary to add a new dimension to the measurement of interactions between groups (REARDON; O'SULLIVAN, 2004).

Although measuring the physical distance between individuals and groups has some problems such as the modifiable areal unit problem (OPENSHAW, 1984) and scale sensitivity, studies aiming to integrate spatial elements into non-spatial indexes have also been conducted. For example, the spatial proximity index (WHITE, 1983) focuses on this problem when calculating residential segregation. This index takes into account the average distances between groups by weighting the group population sizes. This helps to detect clustering between certain groups located at close distances to each other. In addition, it helps to evaluate the relationships between groups by detecting the relationships at the group boundaries. In addition, developments in non-spatial indices that allow comparisons of multiple characteristics of groups simultaneously and the use of census tracts have made it possible to examine different dimensions of the subject (REARDON; O’SULLIVAN, 2004). In addition, the use of tract size and population density has enabled the index to be used at a variety of scales (MORRILL, 1991).

Another way to overcome the limitations of the Dissimilarity Index is to develop alternative indices. The Neighborhood Sorting (JARGOWSKY, 1996) and the Spatial Gini Indices (REARDON, 1998) are examples of these efforts. The Neighborhood Sorting Index calculates income segregation by taking into account individual and neighborhood average incomes. Over time, this index has adopted spatial factors such as local population densities, allowing for more comprehensive inferences. However, alternative versions of the index have become more comprehensive over time by also using income rankings.

Meanwhile, initially a non-spatial index (GINI, 1912), the Gini has also evolved over time to evaluate neighborhoods in terms of per capita income. Thus, the index has gained the ability to detect income inequality by spatial differences within a given geographic area. At the same time, both of these indices are capable of measuring the centralization of groups with different incomes. Thus, they can also shed light on the spatial dimension of income segregation.

As seen, the purpose of the transition from non-spatial to spatial indices is to provide an interpretation of how different social groups are located in different areas of urban settlements and the relationship between them (SCHELLING, 1971;

MASSEY; DENTON, 1993). They determine the degree of spatial separation between groups. As a result of the calculations, high values indicate more separation and less social interaction, while low values indicate the opposite. At the same time, considering the population densities in certain areas allows comments to be made about the potential interaction that may occur between groups.

Another measurement method frequently used in spatial segregation is the Location Quotient (LQ). This method measures the concentration of a certain group on a geographical area by calculating the ratio of the desired population to the entire population in a certain area. Although this method was initially a non-spatial measurement method, it has been spatialized over time with the geographical weighting of the reference group. Thus, the calculation of the spatial concentration or isolation of desired groups became possible (HAGGETT, 1965; PLANE; ROGERSON, 1994).

The Rule-Based typology is another approach that is capable to categorize areas with criteria such as ethnic background, income level, occupation, education level or household type or with predetermined rules (BAILEY; LIVINGSTON, 2007). Thus, this method allows the identification of spatial patterns or group clustering and segregation within a certain region. However, the method addresses complex social and spatial patterns in an overly simplistic way due to its focus on static classifications (ROBINSON, 2000).

Spatial autocorrelation statistics such as Local Moran's I (ANSELIN, 1995) and Getis-Ord local G (GETIS; ORD, 1992) are also widely used in analyzing spatial clustering of social groups. Local Moran's I measures local spatial autocorrelation by considering whether the desired variable shows similar or dissimilar values in neighboring areas. Thus, it takes into account both the characteristics of the group and its relations with the space. It provides statistical data for spatial clustering by defining hot and cold spots.

However, this method also has disadvantages. It requires defined neighborhood relations and cannot effectively measure the sizes of clusters quantitatively. Getis-Ord local G calculates the Z-scores of each area and, then, uses the difference of a group's value from the average values in neighboring areas to determine the clustering. This method determines hot and cold spots to understand spatial clustering, however, uses a fixed spatial scale and is not precise enough to detect small-scale clusters.

Local Indicators of Spatial Association (LISA) is another tool used to identify and evaluate local spatial auto-correlation patterns within a data set and a local extension of global spatial autocorrelation measures such as Moran's I and focuses on localized spatial relationships (ANSELIN, 1995). It detects areas where similar values are clustered together and areas where different values are close to each other. Its ability to detect specific areas of interest rather than a general statistic makes it useful for spatial analyses. However, there are some disadvantages (BOOTS; TIEFELSDORF, 2000). LISA is sensitive to the choice of spatial weights, which can negatively affect the results. In addition, it can be mistaken in detecting spatial patterns, especially in small samples. Finally, interpreting is more difficult compared to global measures such as Moran's I due to the complexity of local spatial relationships.

Moreover, population density-based clusterings such as Nearest Neighbor Analysis, K-Means Clustering, Kernel Density Estimation, Hierarchical Clustering, DBSCAN (Density-Based Spatial Clustering of Applications with Noise) and Spatial Point Pattern Analysis calculate the spatial concentration of the desired group within a defined area. Thus, they provide information on the concentration or separation of social groups within the geographical area in question (CLARK; EVANS, 1954; MACQUEEN, 1967; SILVERMAN, 1986; RIPLEY, 1977; ESTER et al., 1996). Although data on the density and spatial distribution of groups are provided, they are insufficient in obtaining data on group characteristics, their relationships with each other. Additionally, the precision of the results varies according to the scale of the chosen variables, and these variables require to be standardized or normalized before calculations.

At this point, there are two problems to be considered in analyses performed on units with certain geographical boundaries. In cases of spatial auto-correlation where neighboring units have similar values, even if a certain pattern is detected, this pattern may not be meaningful. This situation, called the Checkerboard Problem, may lead to the failure to capture existing meaningful patterns and to incorrect results. Therefore, the results obtained should be checked with social contexts (OPENSHAW, 1984; CLIFF; ORD, 1981).

The Modifiable Area Unit Problem (MAUP) is a problem arising from the scale of the geographical areas used in the analysis (OPENSHAW; TAYLOR, 1979). According to the census tract, neighborhood, district or municipality scale, analyses made on the same subject may give different results. In other words, when the same data set is grouped in different ways, different patterns emerge. Due to these two problems, obstacles may be encountered in interpreting the relationships between the groups.

Considering the configurational features of the urban fabric, an approach used in the analysis of the relationship between social groups is Space Syntax (HILLIER; HANSON, 1984; HILLIER, 1999; HILLIER; LIDA, 2005). This method focuses on the relationship between socio-spatial integration and segregation, thus, provides information on the social segregation phenomenon. According to the theory underlying the approach, the severance of spatial connectivity between areas is also effective on social segregation. Additionally, as the value of spatial connectivity increases, integration also increases. The basic tool used for calculations is the Axial Map, which consists of the longest and uninterrupted lines connecting areas in the settlement, and the Segment Map produced from it. As a result of the calculation, an integration value is assigned to each line that forms the entire network. The values of these lines provide information on the status of integration of the spaces. Thus, interpretations can be made on the movements of resident individuals and the relationships between groups. Those that are highly integrated allow for high levels of interaction between individuals and groups, while those with weak connections and limited access act as barriers.

One of the important advantages of this approach is scalability, thus, comparability. It allows analysis from the building scale to neighborhoods, from an entire city to regions. Variables that can be calculated over the road network are grouped under three categories, namely metric, topological and geometric. While metric variables consider the distance between two spaces to calculate integration, choice focuses on the ease of movement between these spaces according to the degree of connection and their preference by individuals. Topological variables, in addition, are interested in the paths with the lowest number of turns between these spaces. The number of turns is effective on the optimum efficiency of movement.

Finally, geometric variables are related to the angle changes on the path. It calculates the angular relationships between different paths.

In space syntax, the NAIN serves as the primary measure of spatial centrality. It reflects how integrated a street segment is to all others in the entire network. High NAIN values indicates better access to the labor market, services, and institutional infrastructure. In contrast, low NAIN scores are characteristic of peripheral, disconnected areas, where isolation exacerbates socio-economic marginalization (HILLIER, 1996; HILLIER, YANG AND TURNER, 2012). Within the logic of this study, NAIN thus operates as a proxy for the structural advantages that centrality affords in urban competition.

Moreover, the maximum segment length corresponds to large-scale infrastructural corridors. While such segments may increase mobility in the entire area, they may also function as barriers to local connectivity as they create physical separations that fragment territories and limit access (TURNER, 2007; MEDEIROS, 2013). Thus, the spatial fragmentation can serve as a mechanism of social exclusion when disadvantaged groups are disconnected from infrastructural corridors that service more advantaged territories. In contrast, the minimum segment length reflects the shortest navigable segments and are associated with dense, fine-grained environments. In affluent areas, this fine grain supports walkability, commercial diversity, and civic interaction (HILLIER, 1996; MEDEIROS, 2013). On the other hand, in lower-income zones, it may reflect unplanned or organic urban expansion in the absence of formal planning (LOUREIRO, MEDEIROS, AND GUERREIRO, 2019). Thus, the presence of short segments can signify both advantageous and disadvantageous urban conditions, depending on the socio-political context. Furthermore, the total number of segments within each territory serves as a measure of internal street density and micro-level accessibility. A higher count typically indicates diversified movement and intra-territorial access. Contrary, territories with low segment counts may exhibit spatial discontinuities and reduced permeability (HILLIER, 1996; MEDEIROS, 2013). This may reflect peripheral expansion, topographical constraints, or infrastructural neglect. These conditions very likely limit the ability of individuals to access urban resources and reinforce patterns of socio-spatial inequality. In this framework, centrality metrics are not merely technical descriptors of road networks. They are interpreted as spatial expressions of group-based strategies in the competition for urban resources.

Finally, machine learning approaches such as Decision Tree, Random Forests, Support Vector Machines and Neural Networks are modeling methods that offer powerful frameworks for modeling the complex, non-linear processes underlying urban socio-spatial segregation. These models are increasingly utilized in urban studies to classify, predict, and explore the interrelations between multiple socio-economic variables and spatial patterns (BATTY, 2018; MILLER; GOODCHILD, 2015). In decision trees, a tree-like model is created where each node is based on different features or variables and constitutes a decision point. It is an effective method for detecting the most significant factors that points to a distinction between groups (BREIMAN et al., 1984). The tree is the result of the interactions between various factors and presents the contribution of these interactions to the problem. However, the possibility of providing false insights due to over-fitting is among its disadvantages. At the same time, data corruption may cause inconsistent results due to the method's sensitivity. Finally, the capacity to detect excessively complex relationships may be limited. Thus, only one decision tree may be insufficient to explain the dynamics that cause urban segregation.

Random Forests, which solve the problems of over-fitting and limitations in the prediction capacity of the decision tree method, is another machine learning approach. Instead of a single decision tree, it combines multiple decision trees, each trained on a specific subset of the data. Following this, this approach combines all predictions over a series of decision trees to produce a final prediction (BREIMAN, 2001). Thus, random forests seems as a suitable choice for classifying specific geographic areas as segregated or non-segregated based on various variables. They are robust to distortions caused by data inconsistencies, therefore, suitable for real world data sets that contain irregularities and imperfections. However, the inherent complexity arising from the ensemble approach complicates model management and interpretation. Especially in scenarios with extensive data sets or many component trees, problems such as computational difficulties, computational resources, and time spent can be encountered. To overcome such difficulties, the hyper-parameters must be optimally configured.

Support vector machines are another tool used in classification and regression tasks. They organize the categorization of data points into separate classes in the classification of geographic areas based on the characteristics of various variables (CORTES; VAPNIK, 1995). They are capable of determining the optimal hyperplane strategically positioned to maximize the margin between different classes. By maximizing the margin, they have the capacity to generalize even to unseen data and the ability to produce accurate predictions. However, they can use both linear and non-linear data. Despite their versatility and robustness, they also have certain limitations. Extensive datasets significantly increase their computational intensity and their performance is compromised if there is excessive imbalance in the dataset. At the same time, the hyper-parameter tuning process is time-consuming. Finally, the interpretability of the models and making simple explanations are more difficult compared to decision trees.

Neural network models, another machine learning approach, are capable of handling non-linear and complex data models, as well. This makes it a powerful tool in urban analyses due to the ability of capturing multi-faceted relationships affected by a large number of factors. It is also capable of modeling temporal dependencies with two different architectures, recurrent neural networks and long short-term memory networks, and predicting future models based on historical data. Furthermore, the model has the ability to autonomously collect and distill relevant features in scenarios containing high-dimensional data, reducing dimensionality problems and improving the modeling process. Deep learning, a subset, uses multi-layered architectures for complex tasks and effectively reveals hierarchical representations in the data. However, this tool also has various shortcomings. First of all, it brings significant demands in terms of computation. They need high-performance computing infrastructure. When dealing with extensive data sets or complex model architectures, their training processes are quite time-consuming. Their inherent complexity prevents understanding the model’s decision-making rationale. In addition, the risk of over-fitting is higher for data sets containing limited examples. Much more advanced architectural design and hyper-parameter settings require deep knowledge of machine learning. The difficulty of using the method by non-experts in this field makes it less accessible (MCCULLOCH; PITTS, 1943; GOODFELLOW, BENGIO; COURVILLE, 2016).

Table 7- Indicators used for Metropolitan São Paulo

Concept	Grouped Indicators	Meaning and Relation
Grouping	Area; Population; Demographic density; Total, Private and collective households; Average residents numbers	Defines the spatial and demographic composition. Enables identification of areas with shared profiles, forming the basis for group-level analysis and inter-municipal clustering.
Social Competition	Gross Domestic Product (GDP); Formal employment; Nominal average salary; Total companies and organizations; Scientific and technical activities	Indicates levels of economic capital, production, and formal labor market presence. Proxies for competition over economic resources. Points to differentiated municipal access to accumulation and institutional power.
Social Cooperation	Human health and social services; International, educational, arts, culture, sport, and recreational organizations; People hospitalized per residence	Measures the presence social infrastructure. They serve as proxies for communal capacity, collective welfare, and institutionalized cooperation between residents.
Centrality	Demographic density; GDP; Formal employment; Access to education and health institutions; Scientific and technical organizations	Reflects urban centrality through density, economic and institutional presence. Central areas serve as cores of activity and resource flow, reinforcing their importance in spatial hierarchy and network integration.
Territoriality	Permanent private households with or without connection to the water and sewage general network; Area	Relates to infrastructural embeddedness. They represent the degree of infrastructural incorporation, autonomy, and spatial consolidation, key to understand marginalization and enclave formation.
Social Inequality	Skin color/ethnic categories (White, Black, Brown, Yellow, Indigenous); Gender ratio; Life expectancy; Income indicators; Sewage access	Highlights systemic disparities. Racialized, gendered, and infrastructural inequalities are central to the reproduction of socio-spatial hierarchies and exclusionary mechanisms.
Urban Segregation	Education level; Life expectancy; Household types; Dependency ratios (child, elderly, total); Healthcare expenditure per inhabitant	Encapsulates the spatial stratification of opportunities and amenities. They show cumulative disadvantage and unequal access to public goods and services, contributing to socio-territorial fragmentation.

Source: Author, 2025.

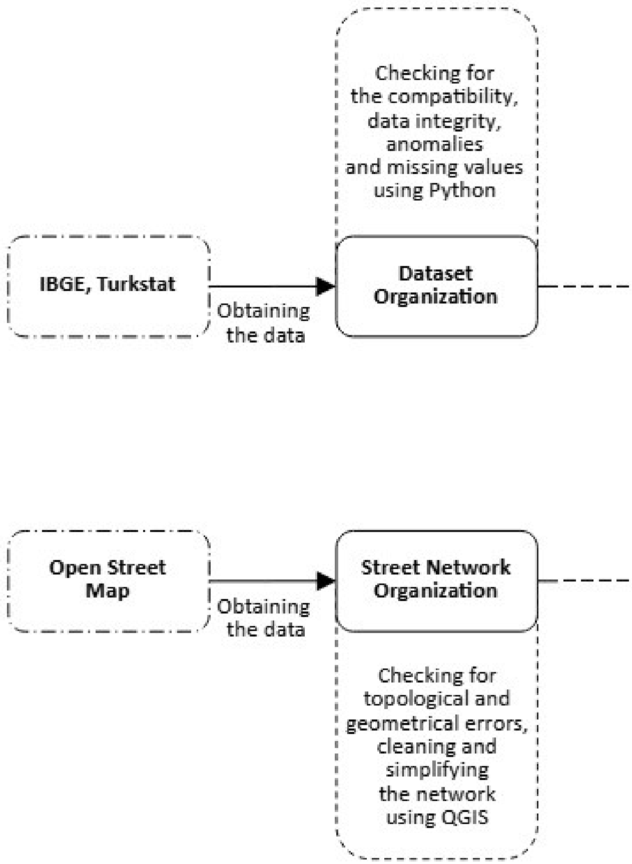
Table 8- Indicators used for Metropolitan Istanbul

Concept	Grouped Indicators	Meaning and Relation
Grouping	Area; Population; Population growth rate/density; Population registered in Istanbul/ other cities/abroad; Foreign population; Foreign-to-native ratio; Distribution of foreign population to municipalities	Identifies the spatialized social demography and macro-level population structures. Group identity, mobility patterns, and foreign-origin clustering reflect differentiated social bases for urban group formation.
Social Competition	Annual average income; Housing sales; Homeowners to tenants ratio; Car/Technological device ownership rate	Indicates material resource control and accumulation. Proxies for spatial competition over status and socio-economic capital.
Social Cooperation	Health facility area per capita; Number of clinics/medical centers; Emergency medical services stations; Population per family physician; Social assistance recipients	Reflects institutional presence and access to welfare resources. Cooperative capacity is proxied by state-supported and community-oriented services, enabling analysis of mutual aid potentials.
Centrality	Population density; Access to healthcare facilities (clinics, EMS, physicians); Duration of residence in current housing; Housing sales	Indicates spatial nodality, infrastructure concentration, and urban embeddedness. Higher centrality correlates with core zone stability, service concentration, and retention of long-term populations.
Territoriality	Area; Average house net size (m²); Duration of residence; Household structures (e.g., extended family, single-person); Water consumption	Captures spatial attachment, material entrenchment, and use of domestic infrastructure. They relate to embedded habitation patterns and degrees of control over territoriality.
Social Inequality	Gender ratio; Education by sex (primary to doctorate); Income; Foreign-to-native population ratio; Literacy ratio; Social assistance recipients	Highlights disparities across gender, origin, and socio-economic capital. Educational attainment by sex and foreign-native gaps serve as indicators of stratification and systemic inequality within the city.
Urban Segregation	Household types; Population registered elsewhere; Education distribution; Duration of residence; Social assistance recipients; Water consumption; Health facility access	These indicators reflect socio-spatial fragmentation, and service differentiation. Variations in household structure, origin, educational attainment, and resource access signal the depth and geography of segregation.

Source: Author, 2025.

As a result, the above mentioned approaches can be chosen according to the scale of the study, the size of the available data set, the ability of the tools used in the analysis and the ease of interpretation of the results obtained. However, when the complexity of the phenomenon of urban segregation with the dynamics of competition and solidarity is taken into account, it is seen that the above approaches alone will not be sufficient. Thus, the methodological framework of the study comprises six stages designed to unravel the intertwined roles of social competition, cooperation, territoriality and centrality in producing socio-spatial segregation (Figure 26 and 27).

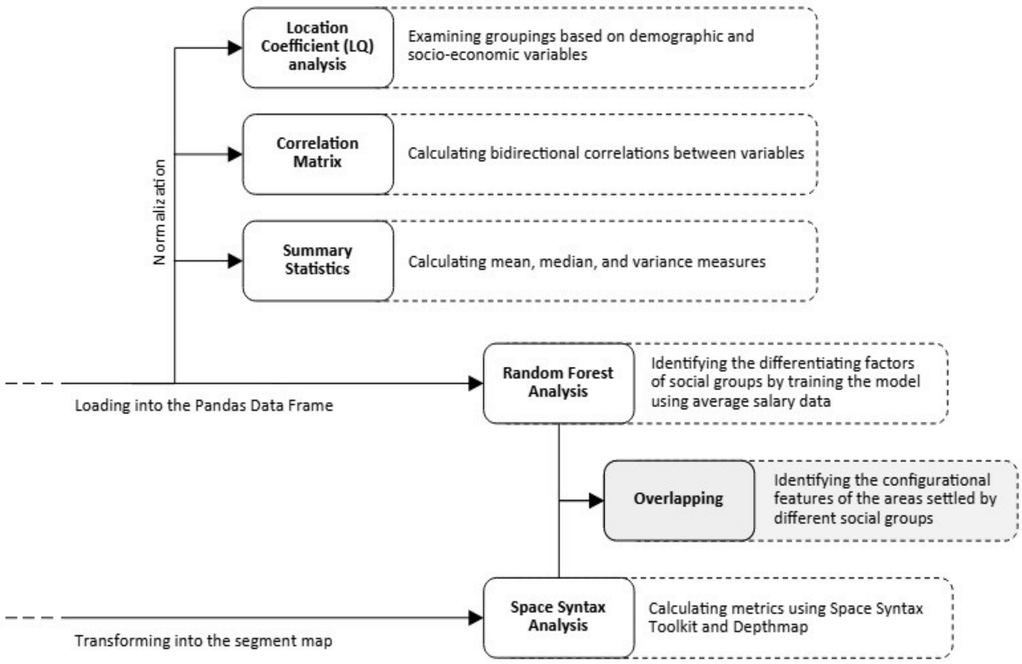
Figure 26 – The research flow 1



Source: Author, 2025.

The study areas were first profiled through a set of statistics. Central tendencies (mean, median) and dispersion measures (standard deviation, variance) quantified the typical and divergent values of key demographic, socioeconomic, and infrastructural variables based on municipality borders (Table 7 and Table 8). These descriptive statistics provides important outputs in obtaining information on social groups in urban settlements. The mean gives the average value, while the median provides the middle value of the data set. Standard Deviation and Variance show how much the values are spread around the mean. The standard deviation is the square root of the variance. Since these metrics are easy to calculate and interpret, they provide easy information on data sets belonging to the settlement in question. However, ignoring the relationships between variables is a disadvantage. Therefore, it does not provide information on complex relationships and separation patterns between social groups.

Figure 27 – The research flow 2



Source: Author, 2025.

The variables were obtained from official statistics institutions IBGE (2021-2022) for São Paulo and Turkstat (2020-2021) for Istanbul. Skewness and kurtosis diagnostics revealed the degree of asymmetries and tail extremities. In addition, outlier screenings by Z-scores ensured data integrity (Agresti and Finlay, 2009; IBGE, 2022). To do so, python and related libraries were used. In the beginning of the process, Pandas library was used for data processing, dataset structure analysis, descriptive statistics, and data summarization. In addition, Seaborn and Matplotlib libraries were used to visualize variable relationships and distributions. Furthermore, StandardScaler from Scikit-learn package was used for statistical analyses, including correlation matrices and outlier detection. This stage of the analysis provides a basis for understanding the underlying socio-spatial structures that shape the issue (Figure 26).

In the second stage, spatial concentrations were mapped using Location Quotient (LQ) analysis to further examine basic demographic and socio-economic variables such as age group, gender distribution, household types, and education levels (see figure 27). Municipalities with a coefficient higher than one (LQ >1) indicate relative over-representation, while the lower ones (LQ <1) point to under-representation (HOOVER, 1948). Following that, QGIS (v2.18) is used to convert these values into visuals, highlighting the areas where competition between groups might occur and where cooperational networks could compensate for deficiencies. This is important to identify whether certain groups are over or under represented in certain municipalities and to understand spatial patterns of segregation and group density. Python was also used for these calculations.

Furthermore, LQ analysis provides a systematic approach to identify spatial patterns resulting from historical and contemporary processes of social competition and cooperation. High LQ values in certain areas may indicate privileged access to central areas while low values may indicate marginalized groups pointing to displacement, lack of access to basic resources or economic barriers to settling in certain places. Using Python for also these calculations guarantees computational efficiency and accuracy, allowing for large-scale data processing. Following that, QGIS (v2.18) is used to convert these values into visuals, highlighting the areas where competition between groups might occur and where cooperational networks could compensate for deficiencies.

The third stage employed a machine learning approach using the Random Forest (RF) algorithm to operationalize the concept of social group differentiation by identifying the primary factors that differentiate each social group. For this stage, attributes (variables) were selected to reflect resource access and identity dimensions. These attributes serve as proxy indicators of differential access to resources and institutionalized advantages or disadvantages across social groups. In addition, these attributes are not neutral, but represent the material and symbolic dimensions through which group boundaries are both drawn and maintained in space. Here, RF identified the most discriminative variables and those most responsible for separating group identities. Variable importance measures (based on the mean reduction in Gini pollution) provided insight into which attributes had the greatest importance in classifying group membership.

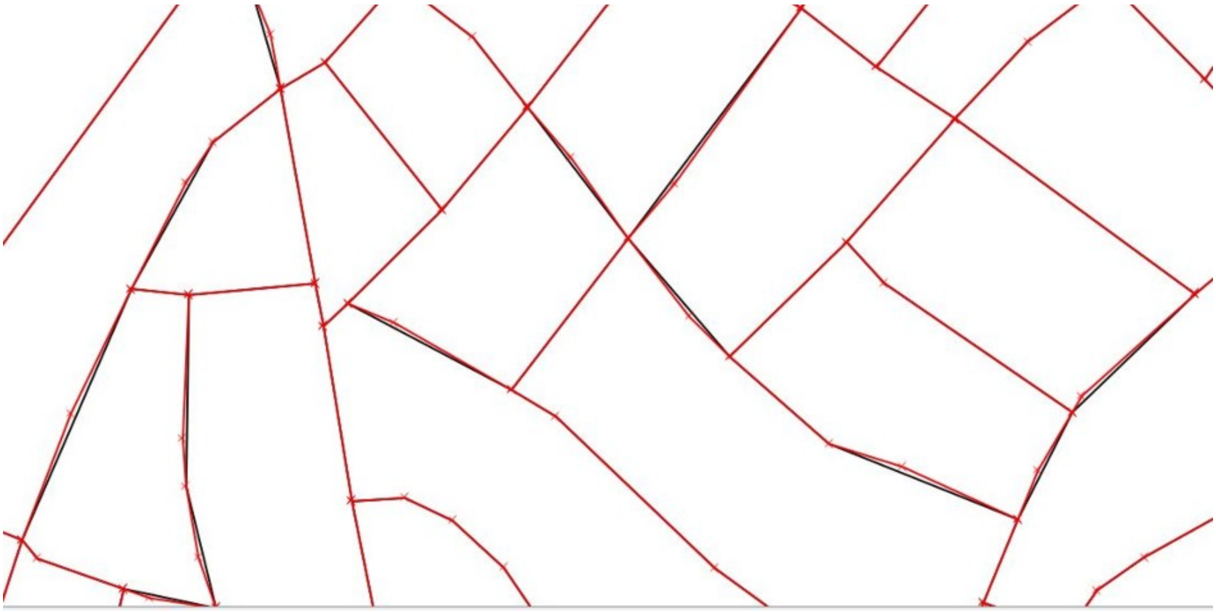
To empirically detect social group territories, models were trained to predict average incomes as a proxy, assuming that economic resources and the ability of exchange are important in social competition and cooperation, using a multidimensional set of predictors. Prior to modeling, all input variables were standardized to ensure comparability and to prevent scale-dependent bias in variable selection. To find the best model configuration, GridSearchCV was used with a defined set of hyper-parameters. These parameters include the number of trees in the forest, the maximum depth of each tree, and the minimum number of samples required to split or leaf a node. Grid search was performed in a nested cross-validation framework to improve model performance and prevent over-fitting. K-Fold cross-validation, which splits the data into different folds, was used to validate the generalization capabilities of the model. Thus, once the best hyper-parameters were found, the models were applied to an 80/20 train-test partition. Furthermore, R-squared (R^2) basic metrics were calculated to evaluate the accuracy of the predictions. The final models achieved high coefficients of determination, indicating strong predictive performances and capacities to capture nonlinear and high-order interactions among variables without evidence of overfitting. Meanwhile, each decision tree constructed hierarchical threshold splits based on feature values to allocate municipalities into branches. These thresholds are not arbitrary. They represent empirically observed breakpoints that distinguish one social group's profile from another. For instance, one tree may repeatedly isolate a cluster of municipalities where both income and employment are high, while another tree isolates municipalities marked by racialized marginalization and deficient infrastructure. As such, thresholds in RF modeling are analytically interpretable as latent boundaries of social stratification. They show how certain combinations of variables or resources demarcate distinct group positions in the urban hierarchy. The ensemble structures of RF also ensured that groupings are not dependent on any single decision rule, but rather emerge from the convergence of patterns across many trees. Thus, they defined social groups not as fixed identity categories, but as emergent, spatialized formations grounded in differential access to opportunities, resources, and infrastructure.

To interpret the results, decision trees were visualized using plot_tree and the decision rules of the trees were extracted to provide insights into how the models make predictions. In addition, feature importance was calculated, which shows how much each variable contributes to the predictions. Thus, the most effective socio-demographic factors affecting income distribution have been determined. These factors have also been evaluated as resources, opportunities or identity elements that are targeted to be reached by individuals through competition and cooperation as the determinants of groups. Thus, according to the results of the decision trees, the populations have been divided into different groups. This has been achieved by assigning a group to each municipality according to the decisions taken by the tree. Finally, the final results including the prediction errors (R^2), feature importance and municipality groupings have been reported.

Furthermore, by assigning municipalities to specific social groups according to decision tree classifications, the analysis provides a spatial dimension to socio-economic dynamics. This categorization allows for a more nuanced examination of the relationship between territoriality and centrality, showing how certain groups are concentrated due to economic opportunities, historical patterns, or social exclusion. The interpretability of the Random Forest model, especially with decision tree visualizations, allows the findings to be directly linked to urban policy assessments. In addition to providing statistical results, the model also provides outputs that are applicable to real-world urban planning and social equity discussions.

The fourth stage is configurational analysis. Road center lines networks were extracted from OpenStreetMap using OSMnx and topologically cleansed in GRASS GIS (Figure 28 and Figure 29). Through Space Syntax Toolkit in QGIS, DepthmapX generated segment map was used to calculate key metrics such as segment count, minimum/mean/maximum length, standard deviation of lengths. Furthermore, Normalized Angular Integration (NAIN) values (OLIVEIRA, 2024) were used to evaluate centrality. Then, the analysis proceeded to disaggregate these results by social group territories. Using QGIS, the classified social group areas, previously delineated through RF modeling, were spatially intersected with the segment maps. This allowed the extraction of segment-based measures specific to the geographic extent occupied by each social group. Through this overlaying, measures were recalculated for each group's territory. This step enabled the spatial characterization of the built environment as experienced by distinct social formations, linking street network configuration directly to patterns of socio-spatial differentiation.

Figure 28 – The preparation process of road networks



Obs. Same parts of Istanbul's obtained (red), cleaned and simplified (black) networks. The red network has 951001 lines, while the black one has 818,569 in total. Source: Author, 2025.

Figure 29 – The street network of Metropolitan Istanbul

Source: Author, 2025.

Among the measures (Table 9), the NAIN serves as the primary measure of spatial centrality. It reflects how integrated a street segment is to all others in the entire network. High NAIN values indicates better access to the labor market, services, and institutional infrastructure.

Table 9- Measures used in the configurational analysis

Measures	Definition	Interpretation
Number of segments	Total numbers of segments in the system	Indicates spatial density. Higher values suggest more interfaces for group interaction, competition, or control.
Mean segment length	Arithmetic average length of all segments	Reflects dominant urban scale. Shorter lengths relate to fine-grained, possibly cooperative spaces, longer to infrastructural dominance.
Standard deviation	How much individual segment lengths deviate from the mean	High values suggest spatial heterogeneity tied to uneven group access and mobility.
Variance	Square of the standard deviation	Highlights variability between zones. Signals spatial inequality affecting group interactions.
Median	The midpoint value of segment lengths when sorted	Indicates typical spatial grain. Lower values often found in dense, marginalized or cooperative areas.
Minimum segment length	Shortest segment length in the system	Suggests fragmentation, common in informal or excluded zones.
Maximum segment length	Longest segment length in the system	Marks dominant axes of movement, reinforcing spatial advantage.
First quart (Q1)	25th percentile of segment lengths	Captures short-segment zones, typical of constrained or peripheral areas.
Third quart (Q3)	75th percentile of segment lengths	Marks threshold for well-connected areas often tied to dominant groups.
IQR (Q3 − Q1)	Range of the middle 50% of data	Indicates morphological diversity. Supports coexistence or contest among groups.
GINI	Inequality in segment length distribution	Higher values reflect infrastructural inequality, aligned with segregation patterns.
NAIN (Normalized Angular Integration)	Network centrality score normalized across systems	High NAIN marks accessible, high-value areas. Low NAIN signals isolation, inhabited by disadvantaged groups.

Source: Author, 2025.

In contrast, low NAIN scores are characteristic of peripheral, disconnected areas, where isolation exacerbates socio-economic marginalization (HILLIER, 1996; HILLIER, YANG; TURNER, 2012). Within the logic of this study, NAIN thus operates as a proxy for the structural advantages that centrality affords in urban competition.

Moreover, the maximum segment length corresponds to large-scale infrastructural corridors. While such segments may increase mobility in the entire area, they may also function as barriers to local connectivity as they create physical separations that fragment territories and limit access (TURNER, 2007; MEDEIROS, 2013). Thus, the spatial fragmentation can serve as a mechanism of social exclusion when disadvantaged groups are disconnected from infrastructural corridors that service more advantaged territories.

In contrast, the minimum segment length reflects the shortest navigable segments and are associated with dense, fine-grained environments. In affluent areas, this fine grain supports walkability, commercial diversity, and civic interaction (HILLIER, 1996; MEDEIROS, 2013). On the other hand, in lower-income zones, it may reflect unplanned or organic urban expansion in the absence of formal planning (LOUREIRO, MEDEIROS, AND GUERREIRO, 2019). Thus, the presence of short segments can signify both advantageous and disadvantageous urban conditions, depending on the socio-political context.

Furthermore, the total number of segments within each territory serves as a measure of internal street density and micro-level accessibility. A higher count typically indicates diversified movement and intra-territorial access. Contrary, territories with low segment counts may exhibit spatial discontinuities and reduced permeability (HILLIER, 1996; MEDEIROS, 2013). This may reflect peripheral expansion, topographical constraints, or infrastructural neglect. These conditions very likely limit the ability of individuals to access urban resources and reinforce patterns of socio-spatial inequality. In this framework, centrality metrics are not merely technical descriptors of road networks. They are interpreted as spatial expressions of group-based strategies in the competition for urban resources.

Beyond these, a deeper exploration of linear relationships among all numerical variables was undertaken by correlation analyses. Pearson's correlation coefficient is used to detect linear relationships. The values obtained between -1 and 1 as a result of the calculation provide an idea about the direction and strength of this relationship.

While values close to 0 indicate a weak relationship, results close to -1 and 1 indicate a strong relationship and direction between the variables. For instance, the strong positive correlations (r ≈0.7-0.99) between segment count and population, formal employment, and household numbers may confirm that infrastructural proliferation accompanies demographic and economic expansion. Meanwhile, moderate correlations (r ≈0.5-0.69) between mean segment length with nominal income and per capita health expenditure might suggest that fine-grained street networks may facilitate localized cooperation and improved access to services, whereas longer corridors correspond to enhanced connectivity for higher-income groups but also reinforce spatial stratification.

By synthesizing these five stages, descriptive statistics, LQ mapping, correlation analysis, Random Forest classification, and Space Syntax configuration, the method forges a multi-scalar, mixed-method on how social competition, cooperation, territorial claims, and network centrality intertwine to produce enduring patterns of inequality and segregation.

Finally, a comparative analysis is conducted to identify commonalities and differences in the socio-spatial dynamics of the two areas by juxtaposing the statistical data, Random Forest outputs, and configurational findings. This synthesis is valuable for understanding whether the interactions between urban form and social dynamics are universal or whether historical, economic, and cultural contexts create significant differences in spatial group interactions.

In summary, to analyze the socio-spatial dynamics addressed, the study adopts an integrative multi-stage methodology that strategically combines well-accepted analytical techniques with spatial and machine learning tools (Table 10). Each method used aims to compensate for the limitations of the others while creating a synergistic framework that increases explanatory depth and empirical rigor.

Descriptive statistics provide an overview by capturing the underlying trends and variability in key indicators and constitute the first stage of socio-demographic differentiation. However, this first stage does not provide insights into multivariate interactions or spatial distribution patterns. Location Coefficients (LQ) then detect spatial patterns of over or under-representation by determining relative group densities across municipalities. However, they do not offer inferences about causality or network effects, as they remain static, descriptive, and scale-sensitive.

Table 10- Comparative overview of the proposed framework

Approach	Typical Application	Contribution in the Study
Descriptive Statistics (Mean, Median, SD, Var, Skewness, Kurtosis)	Univariate distribution analysis; central tendencies and dispersion measures based on socio-economic and demographic variables.	Foundational baseline; facilitates initial profiling of urban groups and patterns; serves as a diagnostic pre-processing step for machine learning.
Location Quotient (LQ)	Relative over/under-representation of demographic or socio-economic groups within municipalities.	Socio-spatial inequalities in geographic space; used to trace competition/cooperation dynamics; linked to group representation across municipalities.
Random Forest (Machine Learning)	Predictive modeling of group identities and resource-based differentiation; multi-dimensional pattern recognition.	Operationalizes competition and cooperation via predictive stratification; pictures group formations; maps resource-based urban segmentation.
Spatial Network Analysis (Space Syntax: NAIN, segment metrics)	Configuration analysis of road networks; evaluates centrality, integration, and fragmentation in spatial systems.	Interpreted as spatial proxies for resource access; tied to territorial competition and fragmentation; contextualized by social meanings of space.
Correlation Analysis (Pearson's r)	Strength and direction of linear relationships between numerical variables.	Used to verify linkages; explores co-dependencies between configuration and socio-demographic variables; supports RF model assumptions.
Comparative Synthesis (Cross-case Analysis)	Integrates findings across different contexts to discern universal and contextual drivers of socio-spatial segregation.	Highlights global/local intersections in competition/cooperation dynamics; tests theoretical universality of socio-spatial mechanisms.

Source: Author, 2025.

To overcome these shortcomings, Random Forest (RF) modeling provides a robust, multivariate, and non-parametric approach to identify latent group formations through high-dimensional pattern recognition. It operationalizes competition and cooperation mechanisms through predictive classification based on the variables used. However, this approach lacks causal inference and relies heavily on the interpretability of feature importance. At this point, configurational network analysis plays a critical role by carefully embedding social behavior in the spatial logic of the built environment. Then, Pearson correlation analysis acts as a statistical bridge between the social and configurational dimensions of urban space.

Finally, the case-comparative synthesis applied to Metropolitan São Paulo and Istanbul places the findings in a global context, increasing generalizability while paying attention to localities. The risk of over-generalization inherent in comparative methods is tired to mitigate by standardized analytical steps and parallel indicator construction.

Thus, the combined methodological design aims to balance inductive pattern discovery with deductive validation, quantitative rigor with spatial specificity, and context-sensitive interpretation with cross-case comparability. This integrated approach is suitable for uncovering the interplay between social competition, cooperation, and spatial segregation.

4 RESULTS AND DISCUSSION

This section presents theoretically grounded empirical findings on how competition and cooperation between social groups structure the socio-spatial organization. Based on statistical results, including summary statistics (Appendix A and D), location coefficients (Appendix C and F), and correlation matrices (Appendix G and H), each metropolis is first outlined. These indicators help to understand how systemic inequalities manifest socio-spatially in the urban area. Then, through Random Forest analysis, social groups are algorithmically identified according to basic identity characteristics and different levels of access to urban resources. Here, decision tree modeling provides a hierarchical interpretation of group formation, identifying main groups and their subgroups according to the most distinctive variables. These groupings are then comparatively evaluated in terms of advantage or disadvantage as a strategic and situational fit of multiple identities and resource demands.

Throughout the empirical procedure, it directly engages with the theoretical premise that urban segregation is the spatial formation of competing and cooperating strategies among social groups that negotiate their position within global and local structures. The results reveal how both centrality and territoriality serve as arenas through which social groups assert or defend access to resources, thereby reproducing spatial hierarchies. Furthermore, the dynamic boundaries of social groups through shifting alliances and strategies confirm the notion that group formation is flexible, contextual, and conditioned by both the unequal circulation of global capital and the constraints of urban structure. Finally, the chapter concludes with a comparative analysis, emphasizing how socio-spatial mechanisms can manifest similarly or differently across geographical and historical contexts while being driven by common logic of social differentiation, spatial dominance, and survival-oriented cooperation.

4.1 Profiles of cases

Descriptive statistics became the starting point for understanding the structural differences between municipalities. Spatial inequalities were documented through the indicators used. While these inequalities constituted the objective basis of resource competition between groups, they were also functional in explaining the forms of cooperation developed against conditions of deprivation in some municipalities. In addition, location quotient (LQ) analyses (Appendix C and F) were used to analyze the extent to which certain social groups were concentrated in certain areas compared to the entire areas. These clusters are also reflections of urban competition, cooperation and territoriality as a result of social groups' strategies to strengthen or maintain their spatial positions in the historical process. Moreover, correlation coefficients (Appendix G and H) helped to understand how inequalities are systematically produced by revealing the relationships between variables.

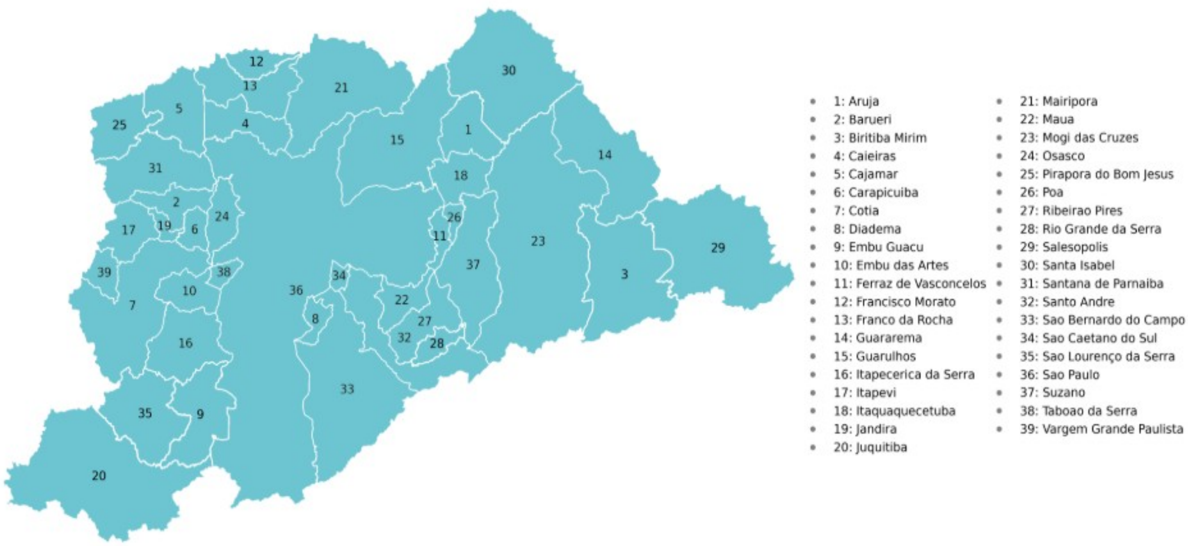
As a result, when these quantitative tools are used together, not only urban inequalities are mapped, but also their impact on social hierarchy is analyzed. Thus, the boundaries of social competition and cooperation and the differentiations that shape the territories become more clearly visible.

4.1.1 Metropolitan São Paulo's profile

The emergence of São Paulo began in the late 19th and early 20th centuries. Initially, coffee was exported from the interior of São Paulo through financial and logistic systems, through the city of São Paulo, the state capital today (DEAN, 1976). The export-based economic system of this period was followed by a rapid industrialization drive from the 1930s onwards, when Brazil pursued industrialization with import substitution under the name of developmentalism. The city of São Paulo, the heart of the metropolitan region, became the target of flows of immigrants from the Brazilian Northeast and, increasingly, international immigrants. Thus, a dense, stratified urban fabric emerged, characterized by spatial inequality as well as productive dynamism (ROLNIK, 1997; CALDEIRA, 2000). Thus, its emergence as Brazil's primary industrial center is the result of a century-long processes of economic concentration, demographic agglomeration and infrastructural transformation directed by capitalist development and global economic restructuring.

Today, Metropolitan São Paulo (Região Metropolitana de São Paulo – RMSP), hosting more than 21 million inhabitants in 39 municipalities (Figure 30), is one of the largest urban agglomerations in the Global South. Nationally, it has become the economic center of Brazil, producing more than 30% of the country's GDP. At the same time, its importance has increased with financialization, industrial diversification and the development of advanced service sectors such as telecommunications, finance and higher education. On the global stage, the area is integrated into international networks of capital, labor and knowledge. Its importance in global commodity chains positions it as a regional node in global production networks in the agribusiness, automotive, aerospace and pharmaceutical sectors (SASSEN, 2001; SCHIFFER RAMOS AND RIBEIRO, 2007). Yet, unlike its Northern hemisphere counterparts, São Paulo’s global integration has been uneven, due to persistent infrastructure deficiencies, informal economies and contested urban governance. This characteristic makes São Paulo a worthy example of southern urbanization (ROY, 2009).

Figure 30 – Metropoltan São Paulo and its municipalities



Source: Author, 2025.

In support of the above framework, the summary statistics of the Metropolitan São Paulo (Appendix A and B) draw a heterogeneous picture with complex and multifaceted demographic, socio-economic and infrastructural inequalities. Municipalities have significant differences in terms of geographical size, population and the structure of this population. The changes in gender ratio, ethnic or racial structure and population density of each municipality reveal the diversity of the social fabric.

In addition, indicators such as the number of births and deaths, the number of married individuals and various dependency ratios also show significant changes. Life expectancy and education levels indicate the existence of relative homogeneity.

There are also gaps in economic welfare and income levels. Economic indicators, especially Gross Domestic Product, as well as official employment and average salary amounts, reveal this situation. Individuals' access to health services is another issue where inequality exists. Moreover, the distribution of scientific, technical, educational, cultural and social sectors are other indicators of the inequalities in the quality of life of individuals and the potential opportunities they have.

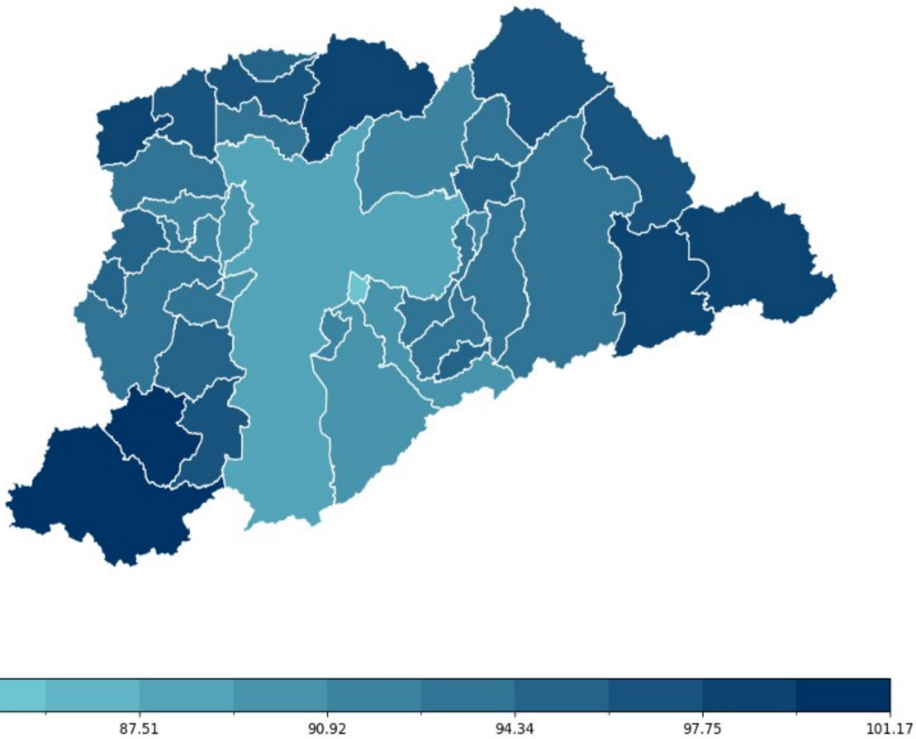
4.1.1.1 Population dynamics and geographic distribution

The average geographic size of the municipalities is 203.77 and the standard deviation is 268.64 square kilometers. This wide variety indicates that there are both small and large municipalities in the metropolitan area with a variety in urban and rural land use. The distribution is significantly skewed to the right with a value of 3.31. The kurtosis value is 13.11. These values show that the areas of a few municipalities are well above the average. Most municipalities have smaller surface areas compared to these municipalities.

The population distribution is also quite skewed and irregular. While the average population is 531,558, the standard deviation is very high. Thus, it is understood that there are remarkable differences in the population sizes. With a value of 5.81, the distribution is significantly skewed to the right and extremely leptokurtic (kurtosis = 32.46). Thus, it is understood that very few municipalities have very remarkable population sizes and the rest have much smaller populations. The heterogeneity that reveals a gap in the population sizes is understood from the existence of these extremes and a sharp peak.

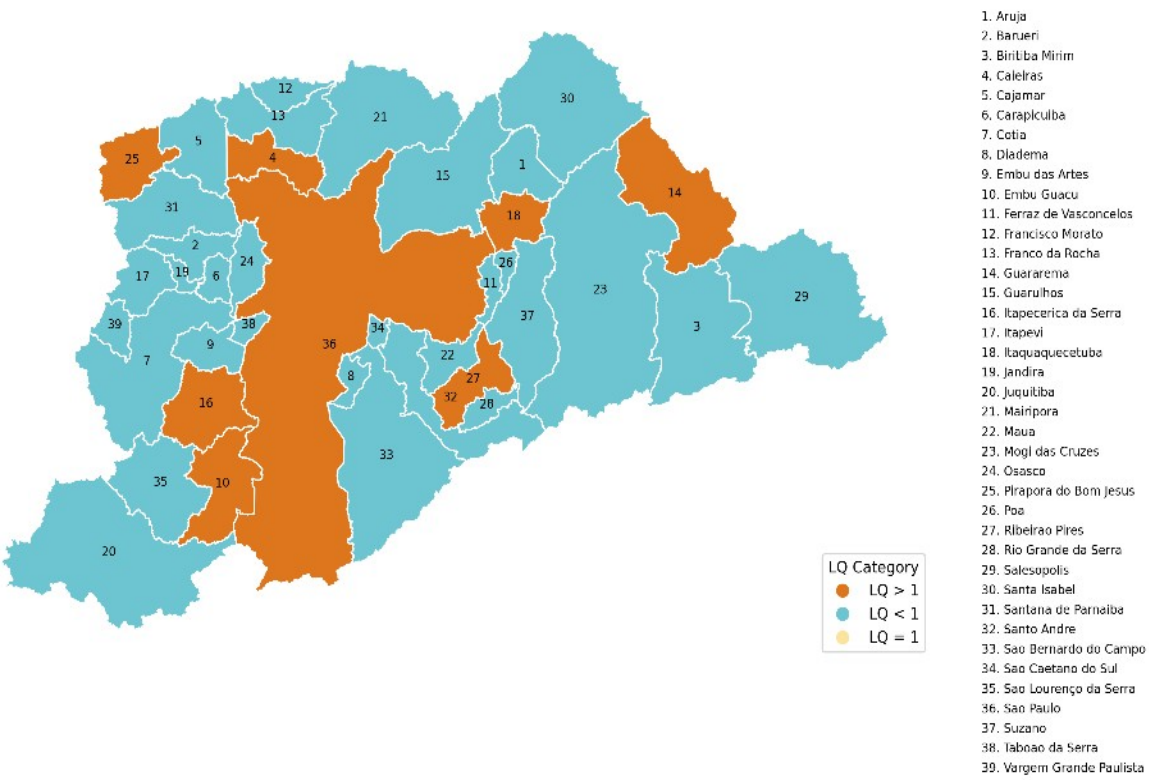
The distribution of the gender ratio is less unbalanced with a skewness of -0.34 and a standard deviation of 3.40. There are an average of 94.27 males per 100 females. Thus, it can be said that the gender distribution among the municipalities is relatively consistent (Figure 31). In addition, the female and male populations are strikingly skewed and leptokurtic. The average female population is 278,351 while the male population is 253,240. The skewness and kurtosis values of 5.80 and 32, respectively, reveal large differences in population sizes. While a few municipalities host very high populations, most municipalities host fewer people. Thus, it is seen that there are striking demographic inequalities among the municipalities.

Figure 31 – Gender ratio distribution in Metropolitan São Paulo



Source: Author, 2025.

Figure 32 – LQ results for indigenous population in Metropolitan São Paulo



Source: Author, 2025.

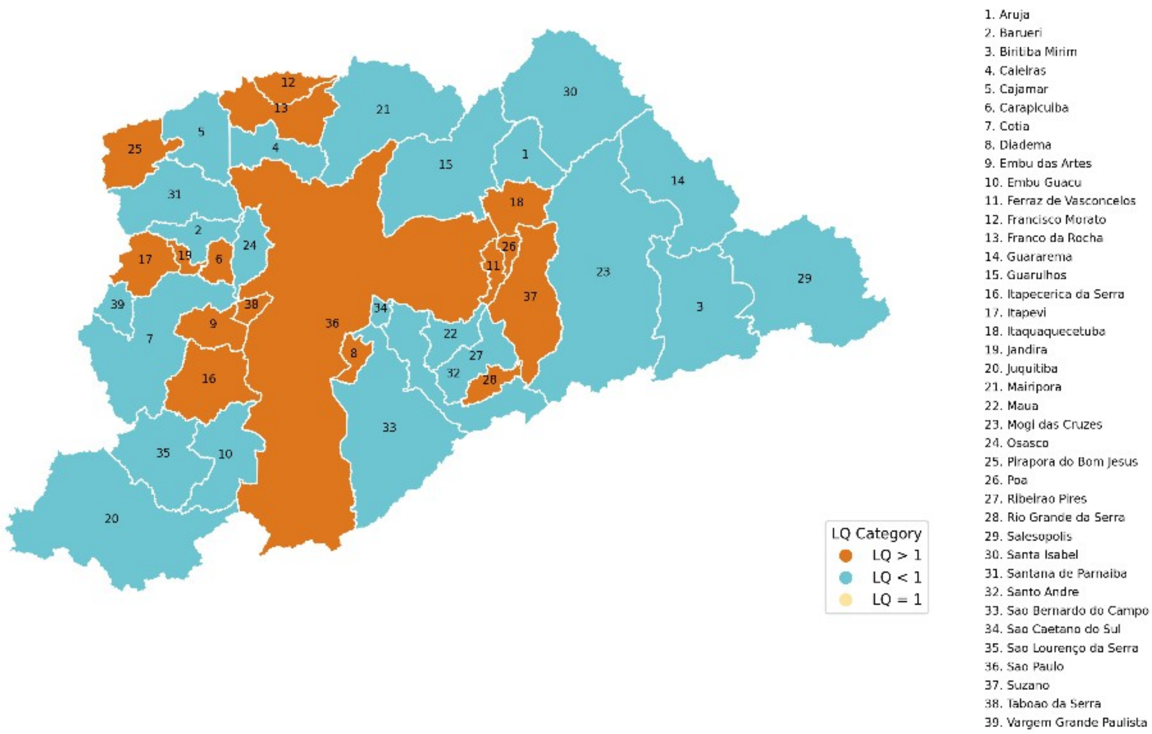
Another heterogeneous distribution that is the population by race or ethnic background. The distributions show that certain groups have higher populations in fewer municipalities, while the remaining municipalities have lower numbers. Indigenous populations are more concentrated in peripheral and semi-rural municipalities such as Pirapora do Bom Jesus, Guararema and Itapecerica da Serra (Figure 32). These areas should offer opportunities for appropriate shelter, proximity to natural resources and cultural preservation, which are important for indigenous communities.

In contrast, these populations are less concentrated in urbanized municipalities such as Salesópolis, Itapevi and Osasco. These areas may be less accessible or desirable for them due to cultural factors and economic pressures. In these municipalities, due to historical processes, cultural or social networks that would support indigenous populations may not have developed. Municipalities such as São Paulo and Guarulhos, where the population is moderately represented, indicate a relative integration into the general social structure. Thus, it can be seen that despite the presence of indigenous communities in the metropolitan area, their integration and segregation vary significantly depending on local socio-economic factors and the historical context of each municipality.

The results for the black population paint a complex demographic picture (Figure 33). The population is concentrated in Embu das Artes, Francisco Morato and Diadema. These municipalities must have strong community networks serving the group, thus standing out as concentration areas with cultural resources that increase the group's resilience. On the other hand, Salesópolis and São Caetano do Sul have lower density values, indicating important obstacles such as systemic inequalities for Afro-Brazilian residents.

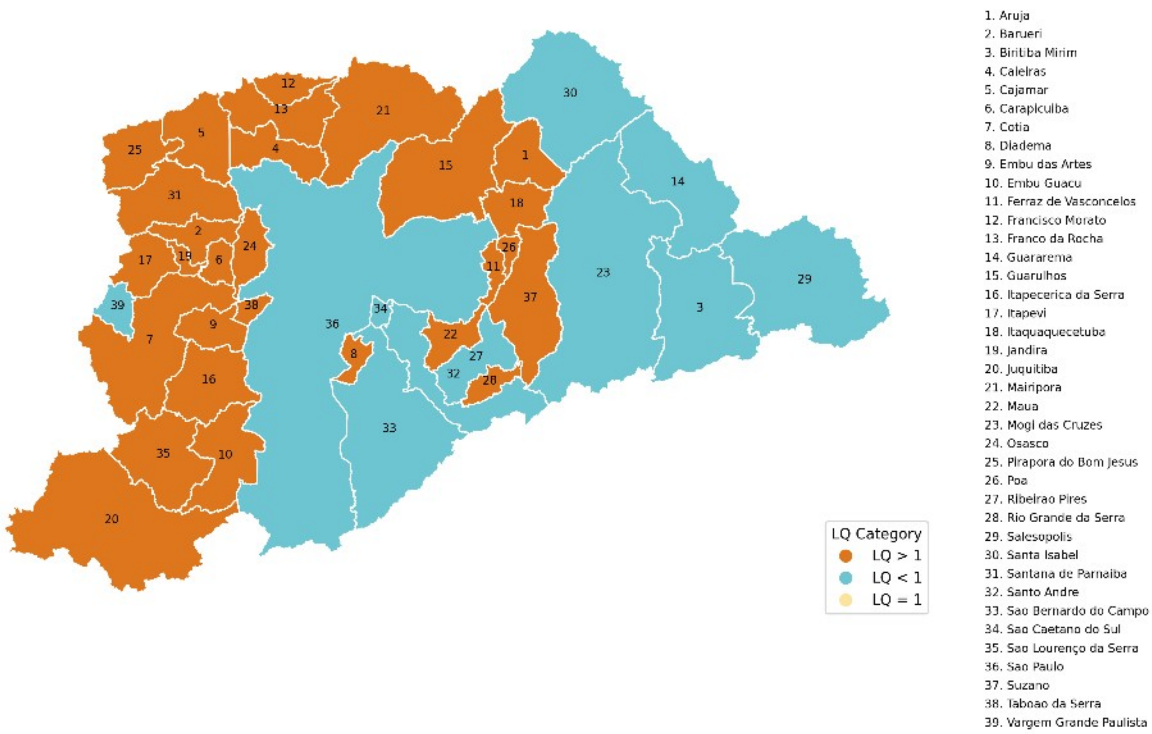
The municipalities of Embu das Artes, Francisco Morato and Pirapora do Bom Jesus are important centers for the brown population (Figure 34). Apparently, these areas can provide the group with suitable housing, cultural vitality and community cohesion. On the other hand, the low densities encountered in São Caetano do Sul and Salesópolis suggest that there are socio-economic barriers that prevent the settlement and growth of this group. These findings suggest the specific difficulties faced by these communities in the areas of housing, employment and cultural support.

Figure 33 – LQ results for black population in Metropolitan São Paulo



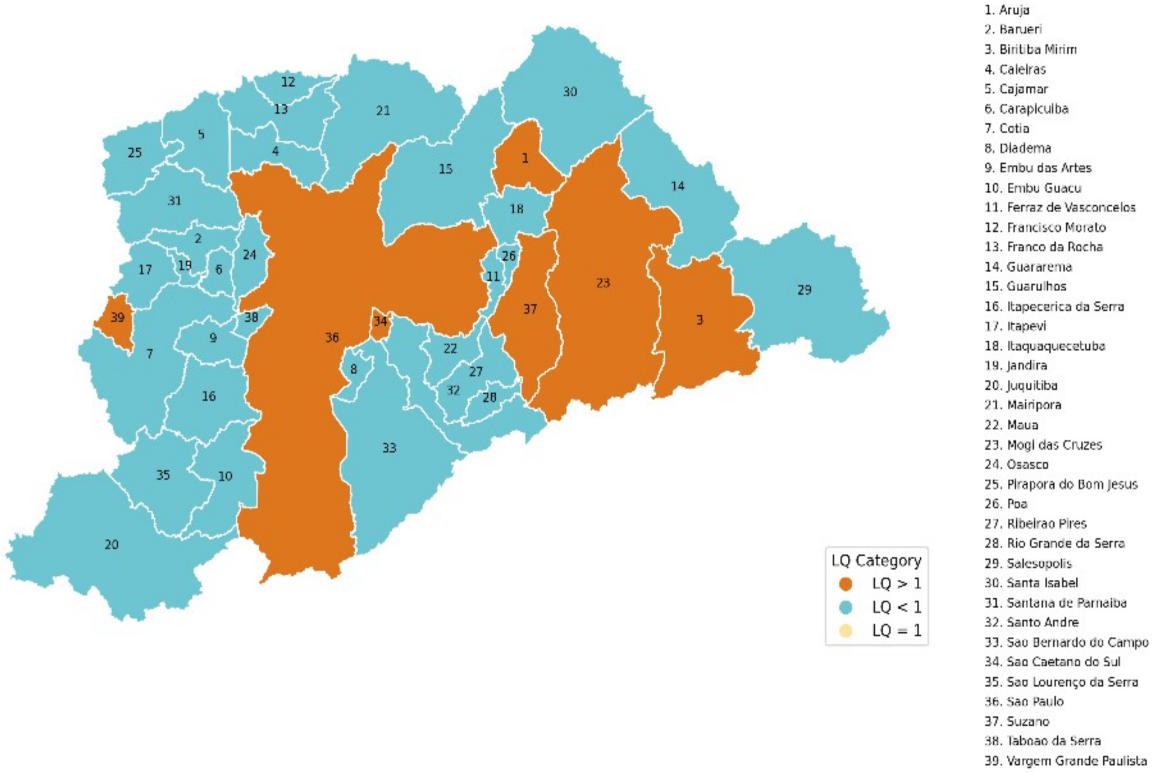
Source: Author, 2025.

Figure 34 – LQ results for brown population in Metropolitan São Paulo



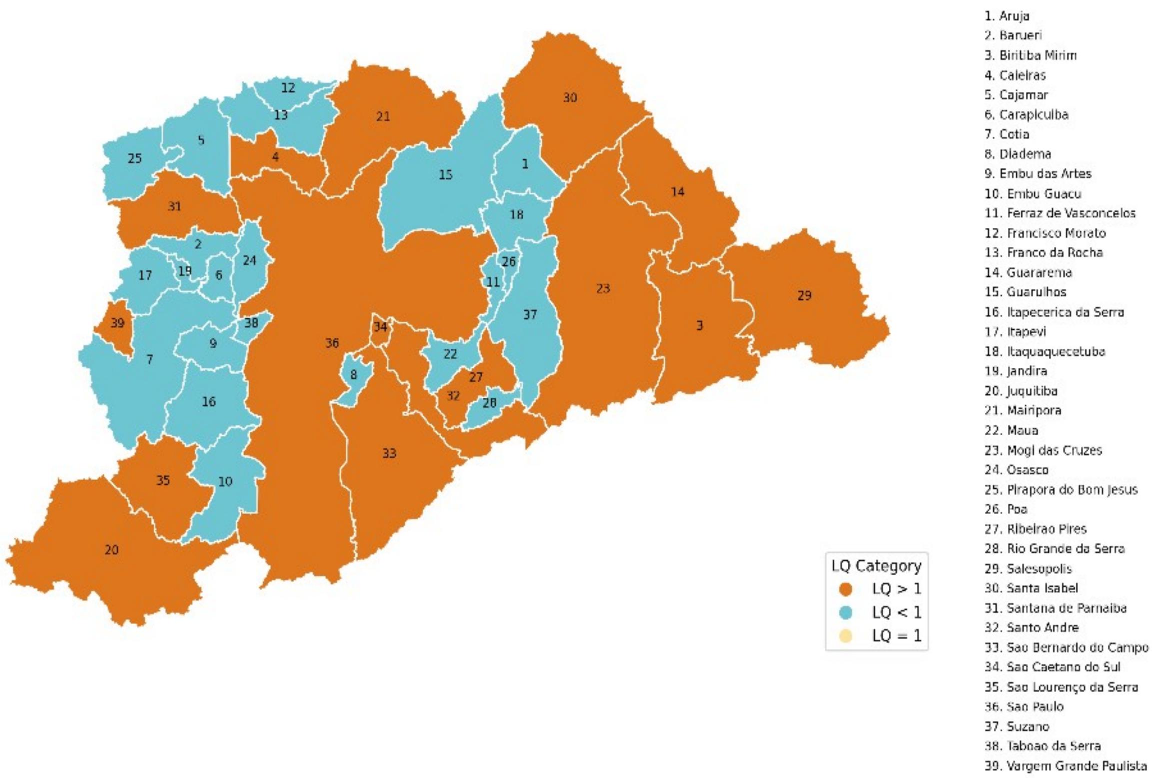
Source: Author, 2025.

Figure 35 – LQ results for Asian population in Metropolitan São Paulo



Source: Author, 2025.

Figure 36 – LQ results for white population in Metropolitan São Paulo



Source: Author, 2025.

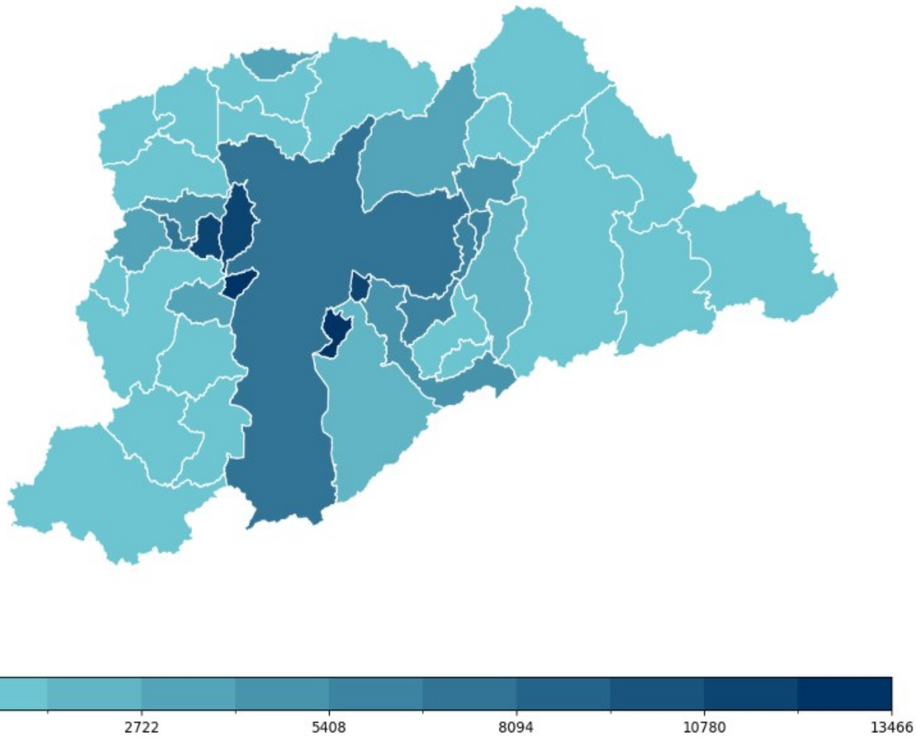
There are also clear spatial variations in the yellow population distributions (Figure 35). The over-representation in municipalities such as Biritiba Mirim and Mogi das Cruzes suggests the existence of racial pockets or historical settlements that have persisted over time. These municipalities may offer cultural, social or economic environments that are attractive to this racial group due to existing social networks. However, municipalities with very low LQ values such as Ferraz de Vasconcelos and Francisco Morato show a limited presence of this population. This is probably due to socio-economic factors that do not match the preferences or needs of this group. The relatively balanced distribution in municipalities such as São Bernardo do Campo and Osasco suggests integration into the general social structure.

The high LQ values of the white population (Figure 36) in municipalities such as São Caetano do Sul, Santo André and Salesópolis suggest that historical migration patterns, socio-economic factors and housing availability contribute to their concentration in these areas. It is noteworthy that these municipalities generally offer higher living standards and more developed infrastructures. In contrast, municipalities such as Francisco Morato and Embu das Artes have lower densities. These areas are more populated by other groups. Peripheral areas and low-income areas tend to host relatively fewer members of the group than other areas.

Population density (Figure 37) showed moderate variation among municipalities. The positive skewness of the distribution means that a few municipalities have significantly higher population densities than others. However, the kurtosis of the distribution is close to normal. This closeness indicates that extreme values are minimal. The average population density is approximately 3480.42 people/km². The standard deviation is 3941.86 people/km². This deviation value particularly emphasizes the diversity of dense urban settlements and relatively low-density suburban and rural areas. These differences within the metropolitan area have been shaped by factors such as historical land use of urban development and settlement patterns, infrastructure development and economic activities.

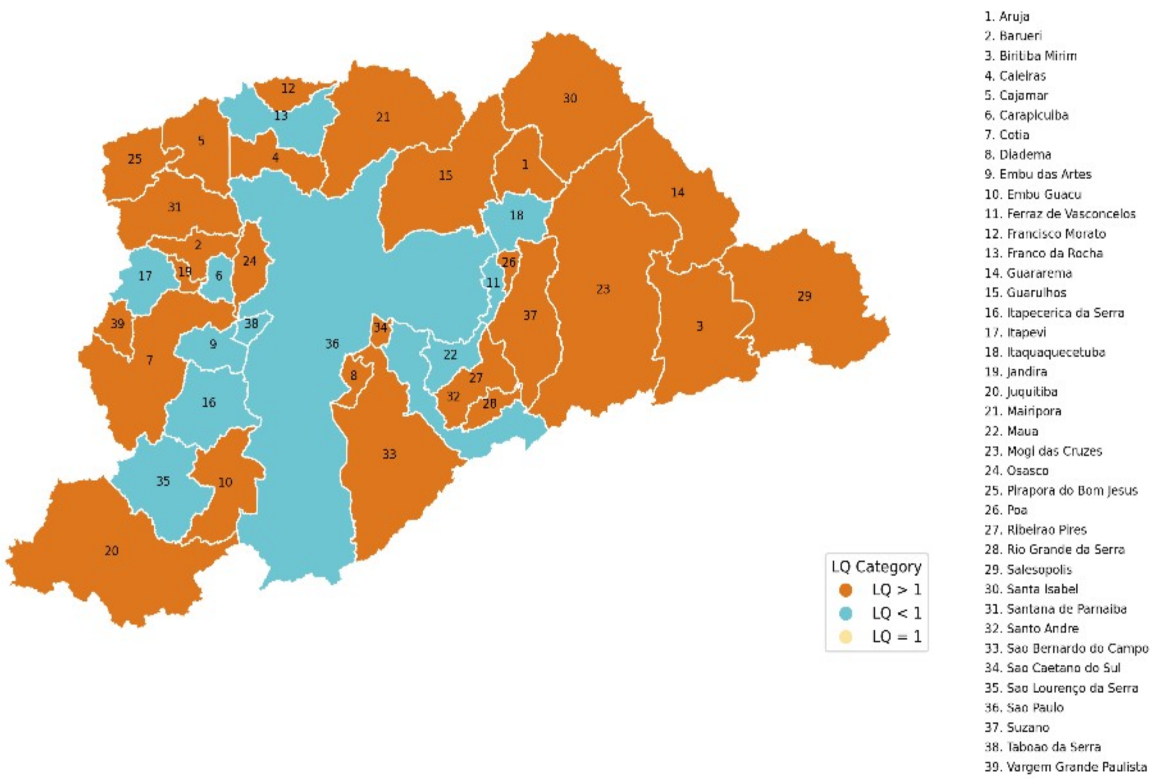
Apart from these data, the distribution of married couples among municipalities is also significantly skewed. Most municipalities have relatively few married individuals (Figure 38). In contrast, a small group of municipalities have significantly higher married populations. This imbalance is supported by the many outliers and extremely high kurtosis in the data.

Figure 37 – Population density in Metropolitan São Paulo



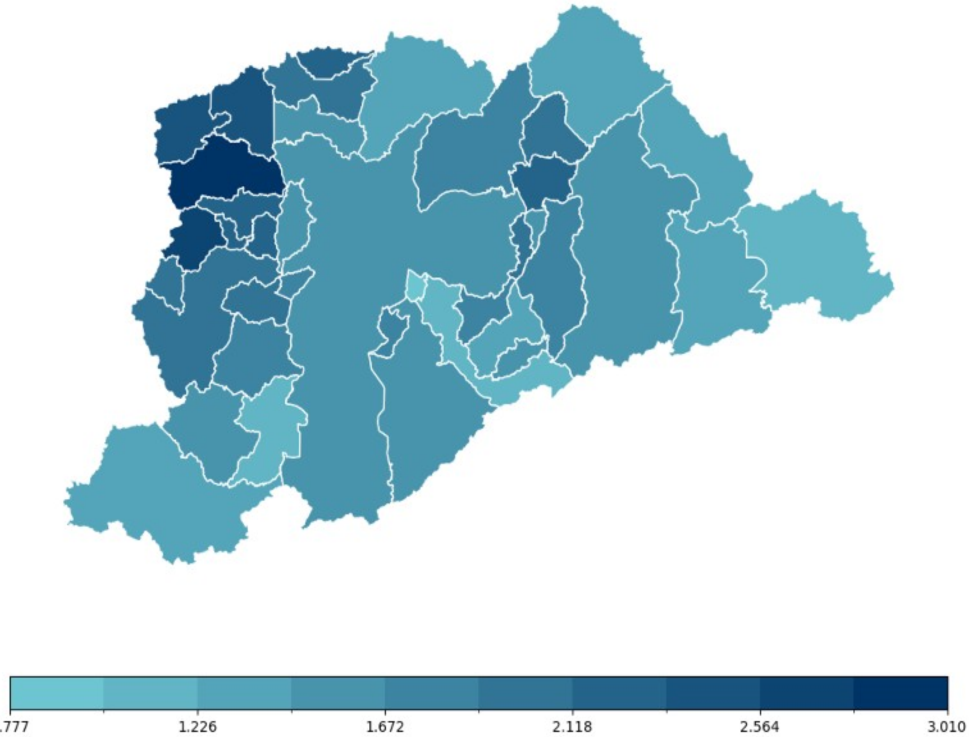
Source: Author, 2025.

Figure 38 – LQ results for married population in Metropolitan São Paulo



Source: Author, 2025.

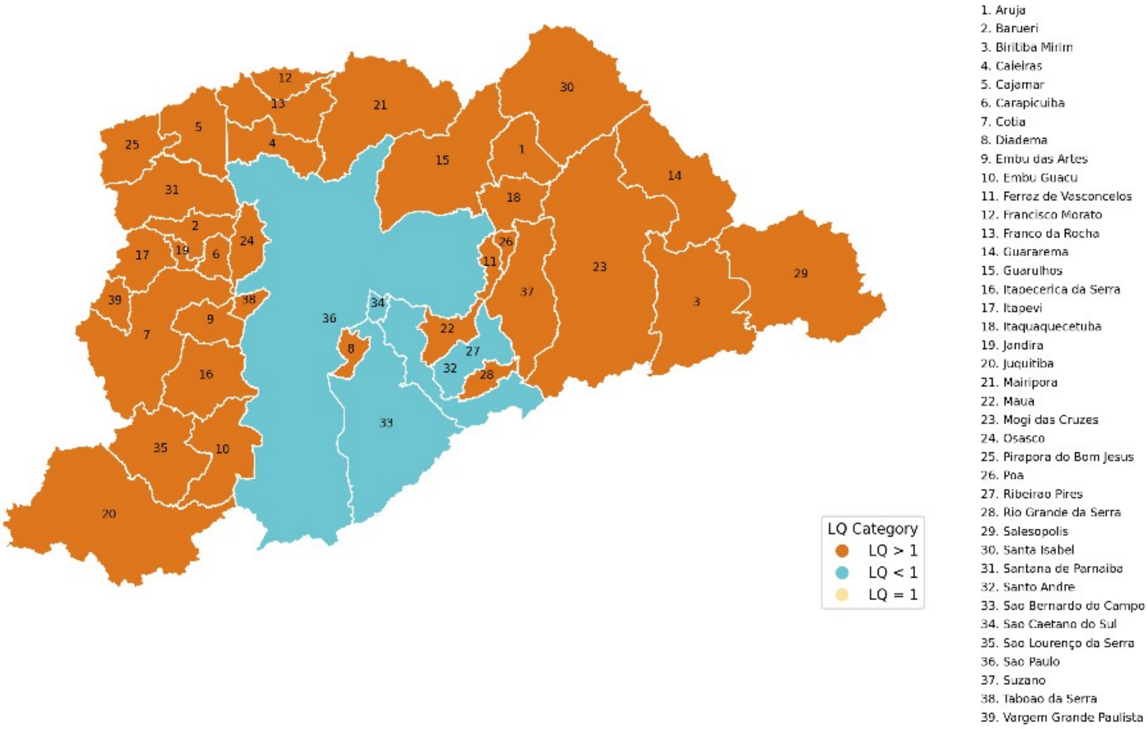
Figure 39 – Birth to death ratio in Metropolitan São Paulo



Source: Author, 2025.

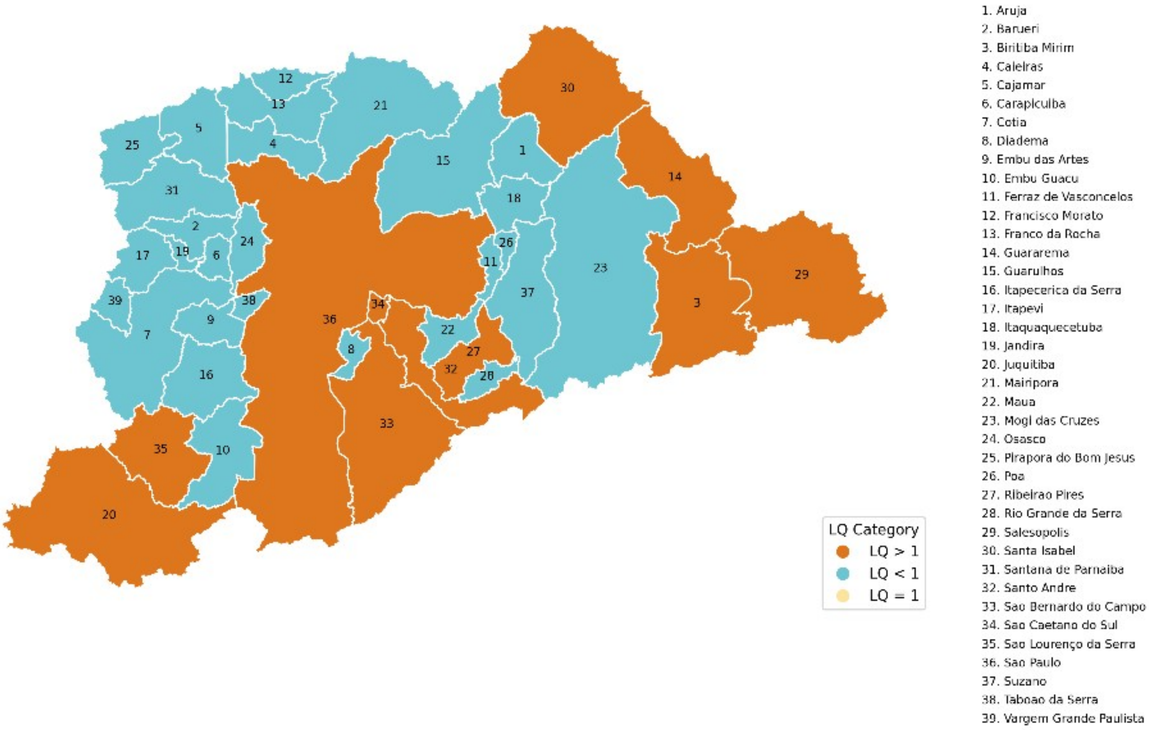
The marriage rate is less skewed. The distribution is close to normal. There are an average of 2,768 married individuals, but this number varies across the metropolitan area. The rates have an average of 6.78 per 1,000 people. The ratio of births to deaths presents a relatively balanced distribution, indicating population growth (Figure 39). The average number of infant deaths is 71. However, the differences are indicative of inequalities in public health. The average number of births and deaths are 6311 and 3903, respectively. In addition to natural causes, unnatural causes such as accidents and homicides have a significant share among the causes of death. The interaction of socioeconomic and health factors between municipalities must be the reason for this inequality. The child population is also concentrated in a few municipalities (Figure 40). High skewness and kurtosis values indicate that some municipalities have higher child populations. While there are approximately 95,663 children in each municipality on average, the standard deviation (307.998) confirms the significant differences. However, the child dependency ratio exhibits a balanced distribution with a skewness of -0.35 and a kurtosis of -0.12. The standard deviation of 2.30 supports the interpretation of a more balanced distribution.

Figure 40 – LQ results for child population in Metropolitan São Paulo



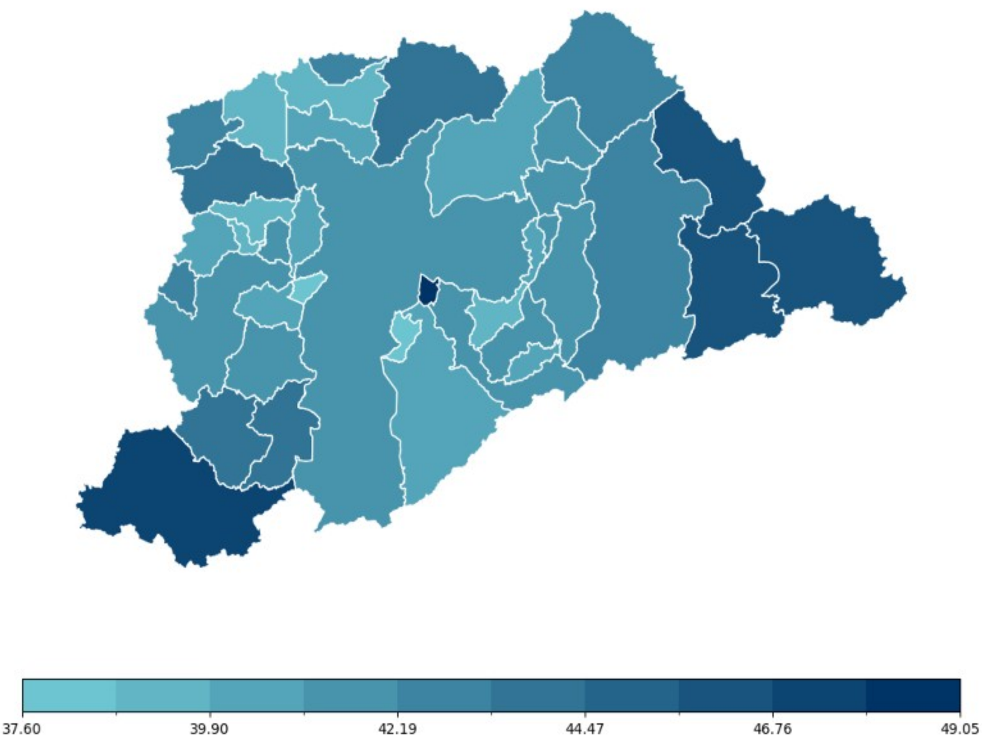
Source: Author, 2025.

Figure 41 – LQ results for elderly population in Metropolitan São Paulo



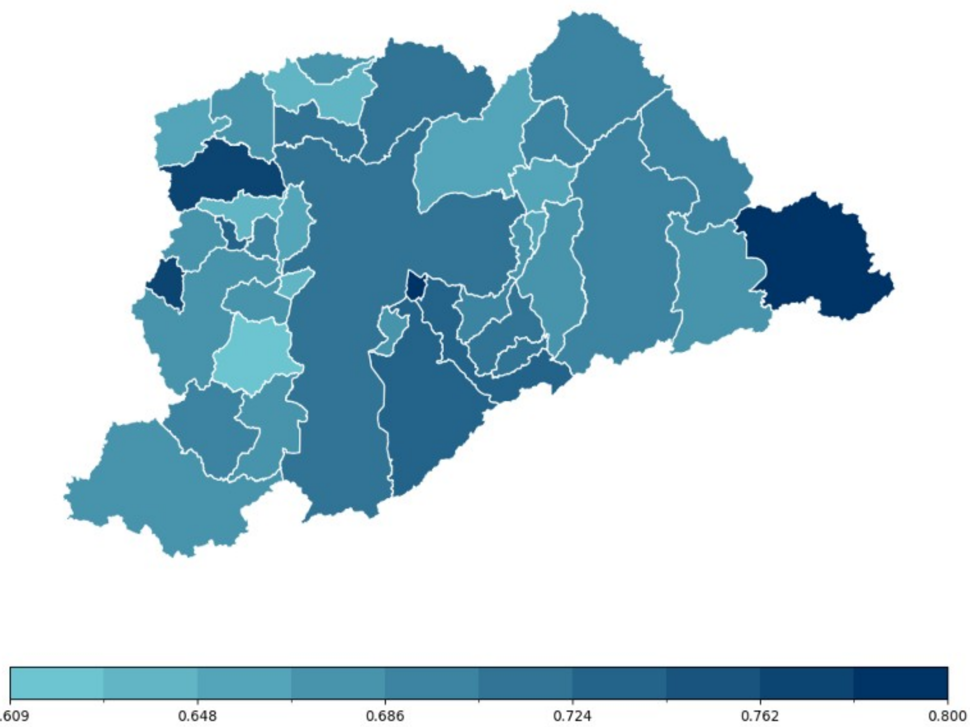
Source: Author, 2025.

Figure 42 – Total dependency ratio in Metropolitan São Paulo



Source: Author, 2025.

Figure 43 – Life expectancy in Metropolitan São Paulo



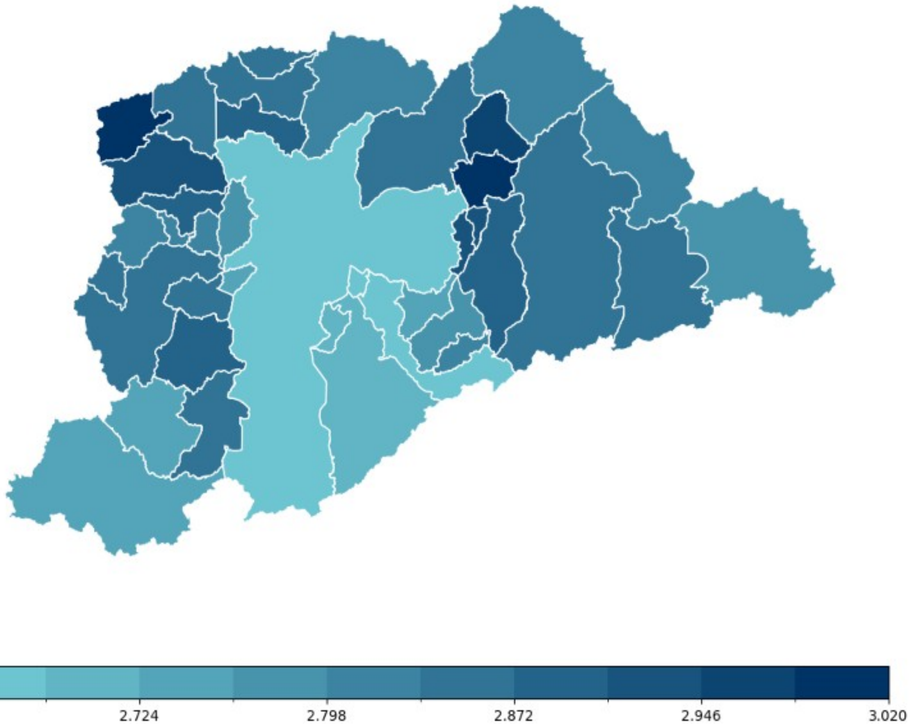
Source: Author, 2025.

Similar to the child population, the elderly population is also concentrated in a small number of municipalities (Figure 41). The distribution shows a positive skew (5.86) and a leptokurtic shape (32.89). The average number of elderly individuals in the municipalities is 59,290. However, the current standard deviation emphasizes that this population varies greatly among municipalities. The elderly dependency ratio also shows higher rates in some municipalities with a skew of 1.36 and a leptokurtic distribution value of 2.96. On average, there are 14.07 elderly people per 100 working-age individuals. The standard deviation values in this regard also support the changes in the rates that municipalities have.

The distribution of the total dependency ratio across municipalities is closer to a normal distribution (Figure 42). The skewness (0.84) and the kurtosis values (0.73) indicate that the general dependency burden on the working-age population is unevenly distributed. The average total dependency ratio is 41.90 with a standard deviation of 2.43. The ratio of the child population to the elderly population shows a slight imbalance between municipalities. A low skewness value of 0.18 indicates that higher rates are concentrated in some regions. However, the kurtosis value (-0.36) shows that the distribution is quite flat and there are few extreme values. In general, there are 2.09 children per elderly person on average. In addition, the standard deviation value (0.55) supports that there is a moderate level of difference between the municipalities. As a result, fertility rates, mortality rates and other trends cause fluctuations in the ratio of the child population to the elderly population. These fluctuations in the population structure are also a result of the interaction with economic factors.

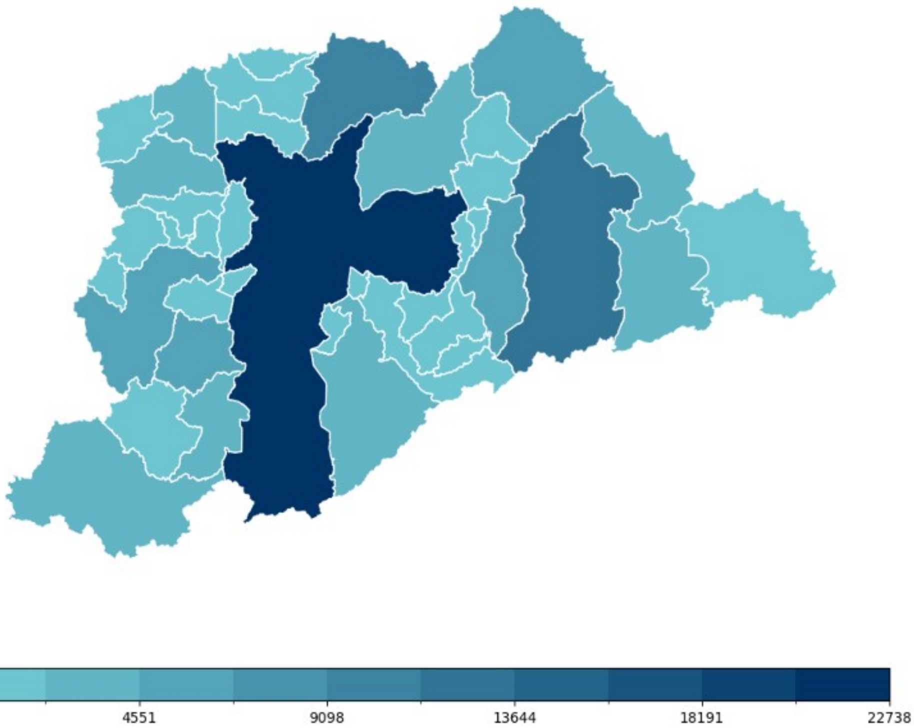
The average life expectancy of individuals exhibits a moderately uneven distribution. In some regions, this expectation reaches higher values (Figure 43). The skewness value of 0.73 supports this interpretation. However, the results for most municipalities are concentrated around the mean value. This is understood from the kurtosis value of 0.40. At the same time, the low standard deviation shows that there is very little change in life expectancy among municipalities. The average life expectancy is 69.3 years. These values points to the existence of difficulties faced by individuals in some municipalities in terms of socioeconomic status, access to health services and environmental conditions.

Figure 44 – The average number of residents in Metropolitan São Paulo



Source: Author, 2025.

Figure 45 – Households without sewage connection in Metropolitan São Paulo



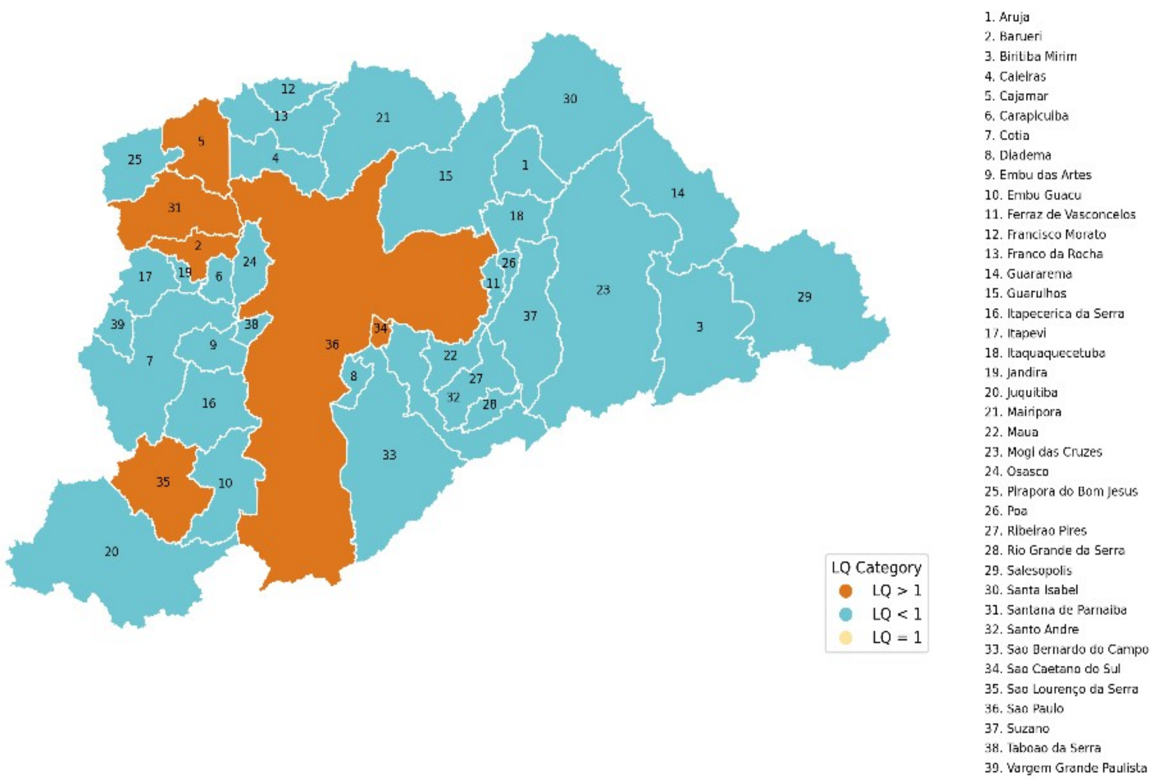
Source: Author, 2025.

The distribution of education levels among municipalities also exhibits a moderate imbalance. The skewness value (0.78) indicates that groups with higher education levels are concentrated in some regions. The leptokurtic distribution (kurtosis = 1.89) is characterized by a sharp peak and heavy tails. This characteristic indicates that there are notable differences among some municipalities. A significant portion of the population has a certain level of education. However, the standard deviation of 0.061 still highlights the inequalities. Socio-economic factors, access to educational resources and different historical developments of municipalities form the basis of these inequalities.

The distribution of household structures is also extremely unbalanced. A small number of municipalities host the majority of the total number of households, while the remaining municipalities host a very low number of households. The extreme right-skewed distribution with a value of 5.83 and the leptokurtic kurtosis with a value of 32.68 lead to this interpretation. There are an average of 224,978 households in each municipality. The standard deviation value of 791.463 also highlights the large differences between municipalities. Following this, the distribution of private households is again concentrated in a small number of municipalities. There are an average of 224,820 private households and the standard deviation value is 790.772. Collective households have a lower average of 157.64. The fact that these households have a distribution with extreme right skew and high kurtosis values suggests that such living arrangements are less common in the metropolitan area. Again, the distribution of the number of collective households shows remarkable differences among municipalities.

On the other hand, the average number of residents per private household is consistent (Figure 45). At the same time, a tendency towards smaller households is observed with a skewness value of -0.09. On average, approximately 2.83 people live in each private household. The low standard deviation value indicates that there is no significant difference in this regard among municipalities. The distribution of total occupied private households is skewed to the extreme right (5.82). When considered together with the leptokurtic kurtosis value (32.61), it is understood that some of these households are concentrated in a small number of municipalities. While the average number of households is 195,272.36, the high standard deviation value also supports that there are large differences among municipalities. Thus, it can be said that the household size in the municipalities forming the metropolitan area exhibits a homogeneous structure, while the number of occupied households has a heterogeneous structure. It is natural that urban development, economic stratification, the status of the housing market and the diversity in demographic structure give rise to these differences.

Figure 46 – LQ results for formal employment in Metropolitan São Paulo



Source: Author, 2025.

In addition to these data, it is understood that while most of the permanent private households are connected to the general sewage network, a significant portion of them do not have access (Figure 45). The distribution of households that are not included in the system is moderately skewed to the right with a value of 3.20, which supports this finding. This distribution, which has a kurtosis value of 11.06, contains heavier tails than normal. This indicates a wide range of values. While the average number of households without a sewer connection is 2835, the standard deviation value of 4273.3 also underlines the significant differences between municipalities. In addition to these households, the connection status of all household types to the sewer network reveals a more severe differentiation. In conclusion, all these findings indicate imbalances in access to basic infrastructure among municipalities. This imbalance also contributes to inequalities in public health and environmental quality.

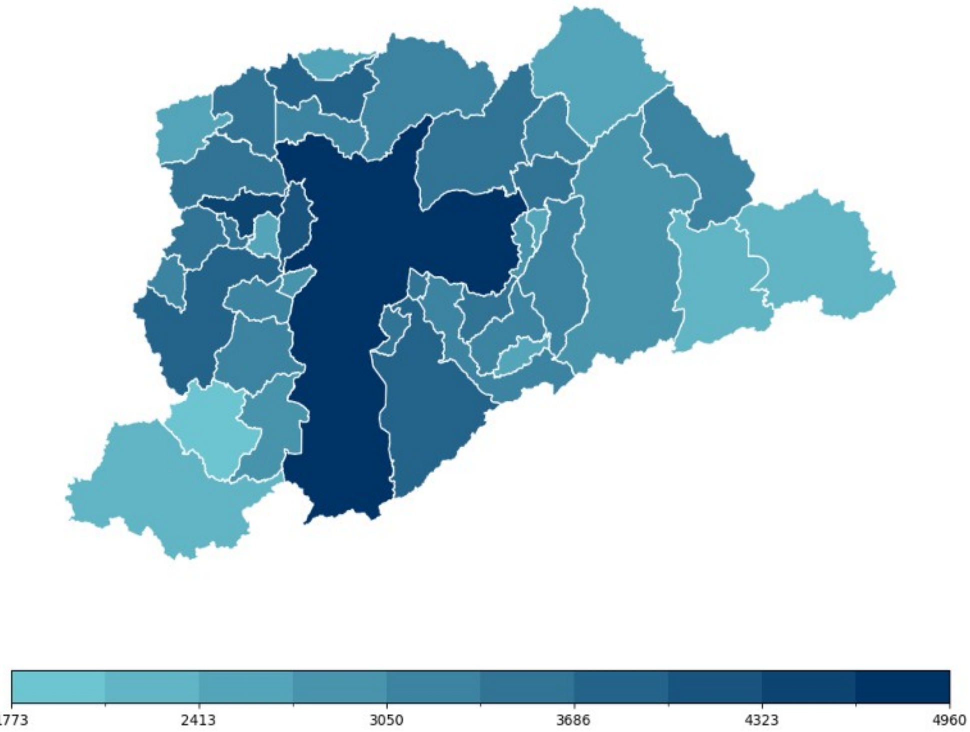
Gross domestic product (GDP) is concentrated in a few municipalities due to the low economic output of others. The disproportionate contribution of a small number of municipalities to GDP is understood from the extreme right skew of 5.78 and leptokurtic kurtosis values of 32.23. The average GDP per municipality is approximately 35,643,660.77 units. However, the standard deviation (132,015,793.97) highlights the large variability. The formal employment data also indicate a similar clustering (Figure 46).

The distribution is extremely right skewed (5.90) and leptokurtic (33.21), indicating that some municipalities offer significantly more formal jobs. The average number of formal employment is 192,363.92 per municipality. The relatively high standard deviation confirms the large differences among municipalities, as well. The distribution of nominal average salaries is relatively more balanced. A slightly positive skewness of 0.27 and a meso-cortical structure resulting from the kurtosis value of 0.77 indicate this. The average nominal salary is 3,206.90 Real per month and the standard deviation is 619.75 (Figure 47). All these findings indicate an unbalanced economic development throughout the area. There is stratification between areas of economic prosperity and poverty. However, a more balanced salary distribution indicates a certain income convergence.

Another indicator showing asymmetry in the distribution is the total number of companies and other organizations. The skewness value (5.94) indicates that these numbers are significantly higher in some municipalities. The high kurtosis value (33.50) also supports this. The average number of companies hosted by municipalities is approximately 22966. This figure reflects the dynamic business environment offered by the metropolitan area. However, the high standard deviation values underline that there is still a large variability among municipalities.

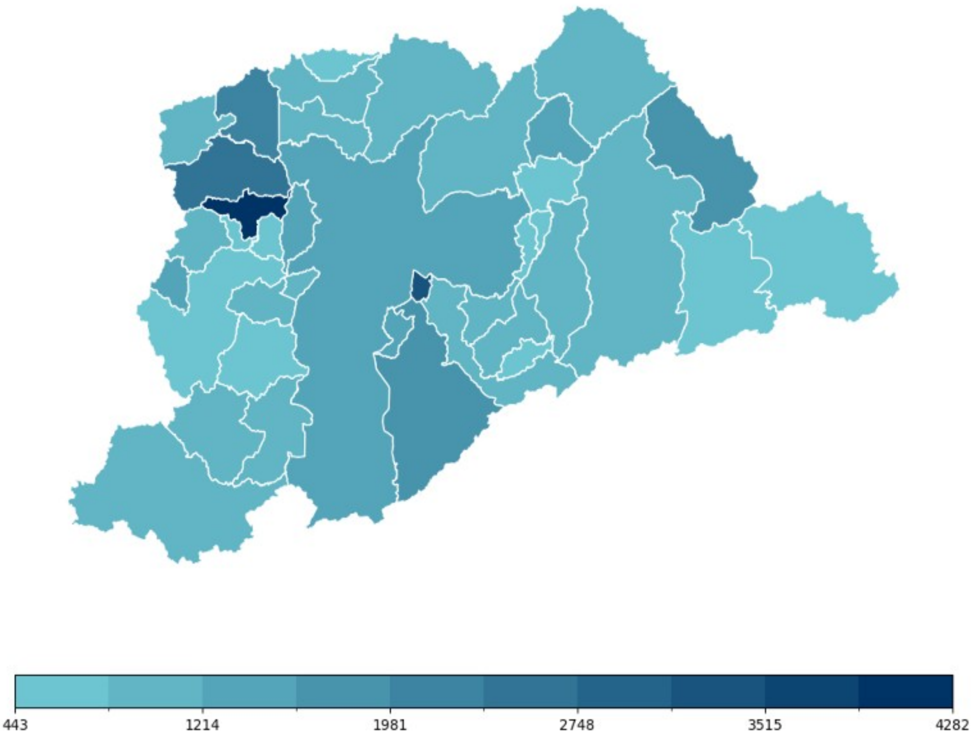
Finally, it should be stated that there are also significant differences between municipalities in health service use and expenditures (Figure 48). With the skewness value of 5.81 to the right and the high kurtosis value of 32.48, it is seen that hospitalization rates and health facilities are concentrated in certain municipalities. The average number of patients per municipality is 26,188.49. The high standard deviation value supports the existence of the mentioned concentration.

Figure 47 – Nominal average salary in Metropolitan São Paulo



Source: Author, 2025.

Figure 48 – Healthcare expenditure per inhabitant in Metropolitan São Paulo



Source: Author, 2025.

Health expenditure per capita also shows a similar concentration. This situation is revealed by a medium level positive skewness value (2.52). The average expenditure is 1191.2 and the standard deviation value is 736.49. All these differences reflect the differences in health status, access to services and medical infrastructure among municipalities.

4.1.2 Metropolitan Istanbul's profile

Metropolitan Istanbul served as the capital of successive Roman, Byzantine and Ottoman empires, each of which left a lasting mark on the city's urban morphology, institutional architecture and symbolic significance. This historical background gave Istanbul a layered spatial structure marked by religious, administrative and commercial functions organized around the Golden Horn and the Bosphorus. Thus, the settlement was fixed at the intersection of Europe and Asia. After the establishment of the Republic of Turkey in 1923 and the transfer of the capital to Ankara, Istanbul ceased to be the political center of the new system. However, it retained its economic and cultural superiority.

Figure 48 – Metropolitan Istanbul and its municipalities

Source: Author, 2025.

Karpat (1976) and Erder (1996) describe the post-World War II period as the beginning of Istanbul's transformation into a modern metropolis. The accelerated migration from the remaining rural areas of the country to Istanbul resulted in rapid population growth and uncontrolled urban sprawl, thus leading to large informal settlements (gecekondu) and peripheral urbanization. At the same time, the settlement has faced a gradual restructuring of the economy from industrial production to service-based and finance-oriented sectors. Since the 1980s, the settlement has aligned with global neo-liberal trends (KEYDER, 2005; ERKIP, 2000).

Today, Metropolitan Istanbul, Türkiye's largest and economic center with its 39 municipalities (see figure 48), produces approximately one-third of the national GDP (TÜİK, 2023). At the same time, it hosts the headquarters of multinational corporations, cultural institutions, and global events as the receiving country's primary interface with the global economy. However, it has emerged as a strategic node in transnational circuits such as capital, migration, and geopolitics, especially through its role in Eurasian energy routes and regional diplomacy. Metropolitan Istanbul also illustrates the urban contradictions characteristic of its counterparts in the Global South, with deep socio-spatial inequalities, fragmented governance regimes, and contested visions of urban futures. On the one hand, large-scale infrastructure projects signal efforts to reposition Istanbul as a world-class city and logistics hub (BALKAN; BALFOUR, 2020), while on the other hand, these projects reinforce speculative urbanization and contribute to a structure where prosperity and precariousness come together (KARAMAN, 2013; SASSEN, 2001).

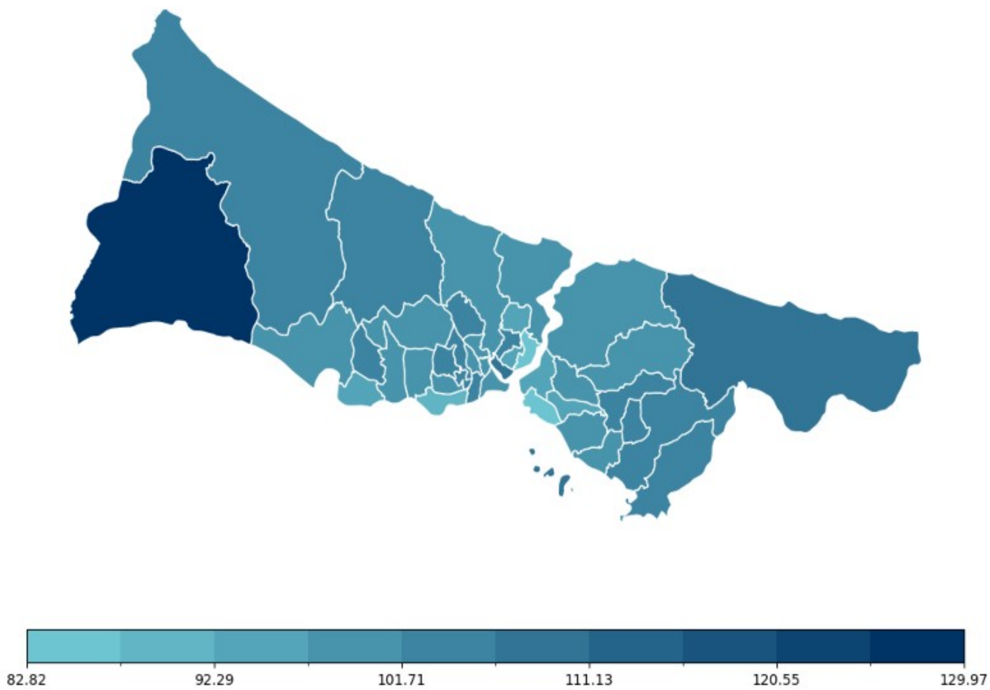
4.1.2.1 Population dynamics and geographic distribution

Summary statistics (Appendix D and E) for Metropolitan Istanbul exhibit significant heterogeneity in terms of geographical size, population and density, as well. This heterogeneous totality expresses the mixture of large and relatively smaller settlements. While the gender ratio has a moderate variability, the population growth rate, age distribution, gender and household structures have remarkable diversity.

From this point of view, the existence of various social compositions within the metropolitan area is seen. At the same time, the unequal distribution of education levels, income and various infrastructures indicate disparities in economic and other areas of development. Summary statistics also reveals significant disparities in housing market, water consumption and social loyalty. Even vehicle ownership and technological adaptation issues show a moderate level of variability within the population. Finally, there are various patterns in the origins of the residents, including those who migrated from other cities and abroad.

The municipal areas are right-skewed (skewness: 2.82). There are many small municipalities and some large municipalities. In addition, a kurtosis of 7.75 indicates extreme values. Municipalities range in size from 7 to 1142 square kilometers, with an average area of 140 square kilometers.

Figure 49 – Gender ratio in Metropolitan Istanbul



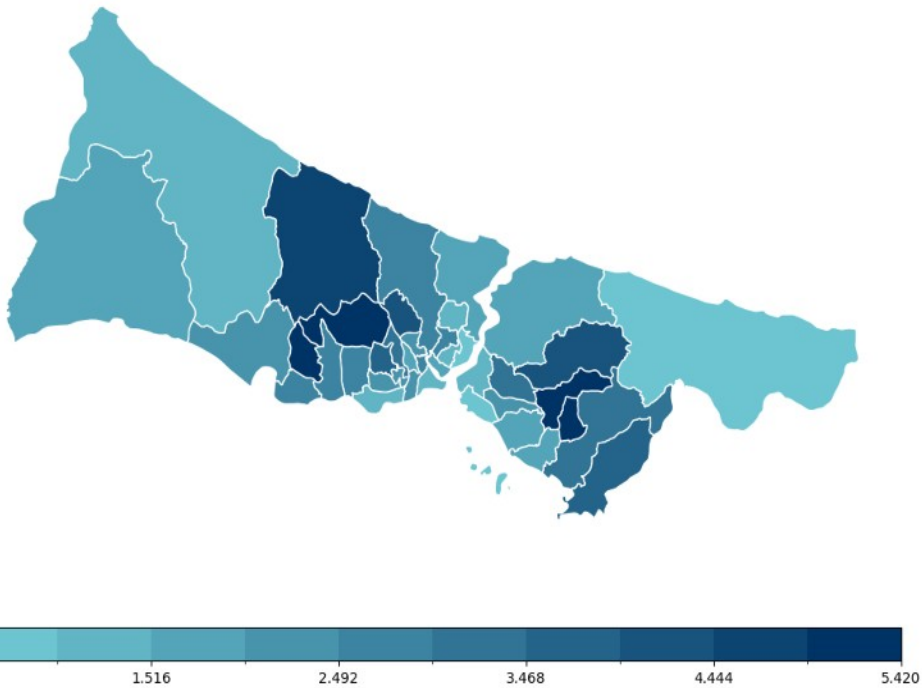
Source: Autor, 2020.

The population distribution among the 39 municipalities is slightly positively skewed (skewness: 0.58). Some municipalities have much larger populations. The kurtosis value is 0.56, indicating a slightly flatter distribution than normal. Populations range from 16,033 to 957,398. The average population is 396,473. The population density distribution is also positively skewed (skewness: 0.98). This value indicates that more municipalities have lower densities. A kurtosis value of 0.36 indicates a flatter distribution. Densities range from 44.18 to 53,748.8 people/km².

The gender ratio, calculated as the number of females per 100 males, varies between 82.87 and 129.97 among municipalities (Figure 49). The average ratio is 101.04. A positive skew (0.82) indicates concentration in municipalities with low gender ratios. A kurtosis value of 6.47 indicates the presence of extreme values. On average, 197,734 females and 198,739 males live in the municipalities. The positive skew is 0.66 for males and 0.51 for females. However, the number of married people is 168,357, and the distribution shows a slight positive skew and high variability.

The average annual birth rate in the municipalities is approximately 4940. Male births, which are 2529, are slightly higher than female births, which are 2410. The average number of deaths is 1959. The number of male deaths is higher than females. The birth to death ratio varies between 0.54 and 5.42. Thus, it is understood that the general population shows an increasing trend (Figure 50). The total birth distribution exhibits a positive skewness of 1.20. This indicates a concentration in municipalities with low birth rates. On the other hand, there are outliers with high birth rates. This situation is also valid for female births with a skewness value of 1.24 and male births with a value of 1.16. High kurtosis values of 2.65 for female births and 2.20 for male births indicate birth rates above expectations in certain municipalities.

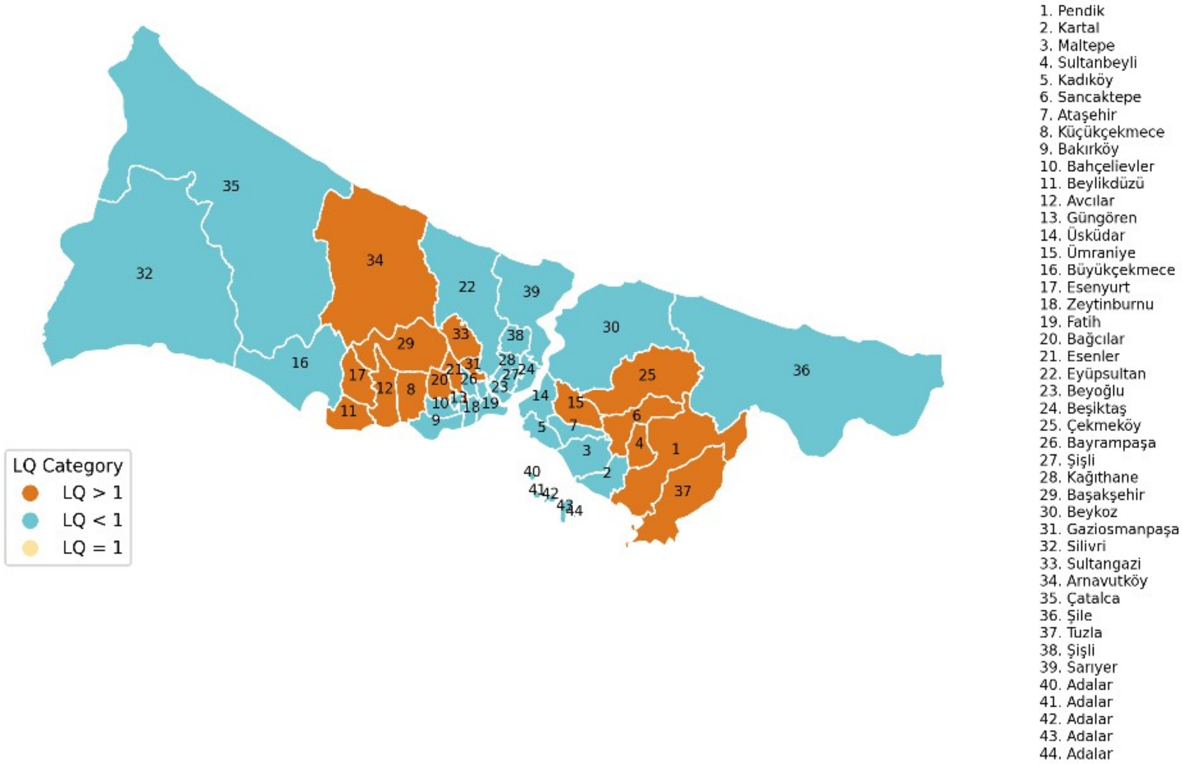
Figure 50 – Birth to death ratio in Metropolitan Istanbul



Source: Author, 2025.

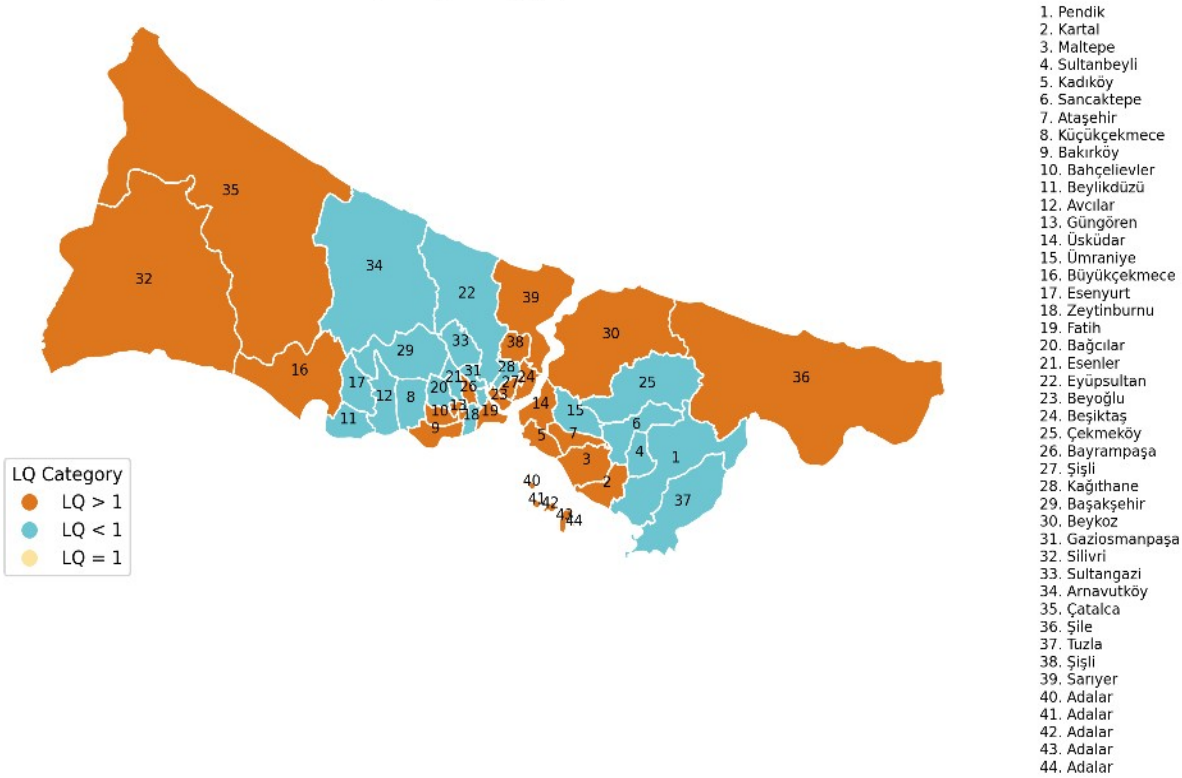
The number of deaths exhibits a less pronounced positive skew. The skewness value of -0.23 for male deaths indicates that municipalities with high male death rates are less concentrated. Kurtosis of -0.21 and -0.76 respectively indicate that the distribution of total and male deaths has a flatter structure than the normal distribution. The positive kurtosis of 1.21 for the number of female deaths emphasizes the existence of some municipalities with high female mortality rates. The positive skewness value of 0.68 indicates that fewer municipalities have high birth mortality rates.

Figure 51 – LQ results for child population in Metropolitan Istanbul



Source: Author, 2025.

Figure 52 – LQ results for elderly population in Metropolitan Istanbul



Source: Author, 2025.

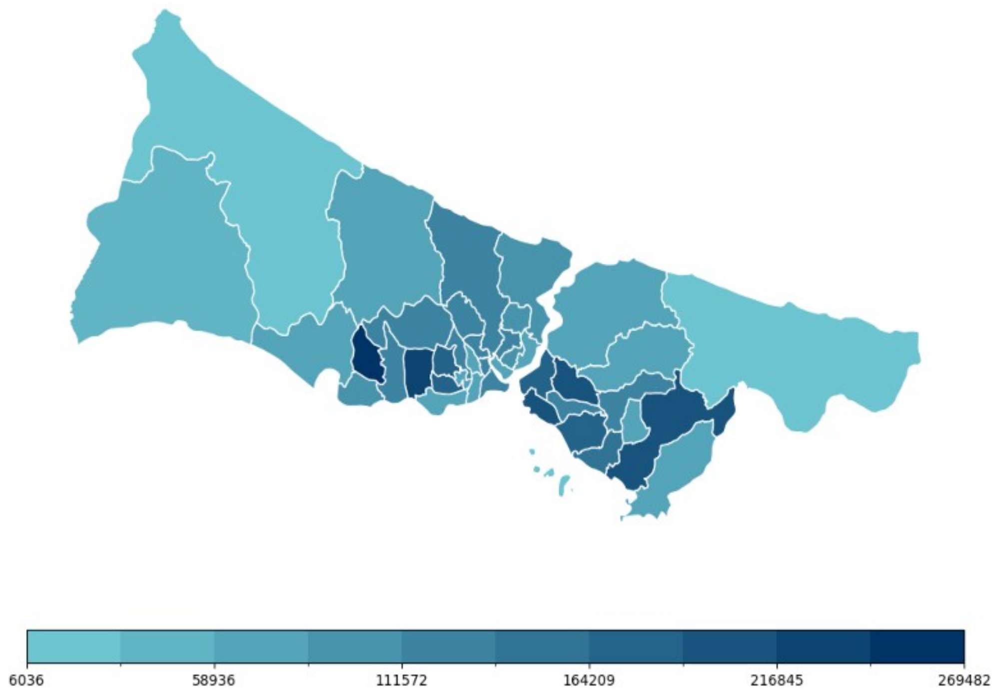
Thus, the existence of various population growth trends in the metropolitan area is understood. Platykurtic distribution (kurtosis = -0.42) reveals more birth mortality rate variability than the Normal distribution. All these values prove the heterogeneity of population dynamics among municipalities. Municipalities with low growth rates are dominant within the metropolitan area. This result is supported by the negative skewness value of -0.91 in the distribution of population growth rates. However, the existence of exceptional municipalities with high growth rates is also revealed by a kurtosis value of 2.70. Population growth rates vary between -110.86% and +50.86% among municipalities. The average growth rate is -2.24. Recent demographic changes and the general population decline determine this negative growth rate.

Despite the exceptional municipalities with high values, the majority of municipalities have low child populations (Figure 51). The positive skewness of the child population distribution indicates this. In addition, the kurtosis of 1.47 confirms the presence of extremes. The distribution of the elderly population is skewed to the right. The kurtosis of 4.74 indicates municipalities with high elderly populations (Figure 52). There are an average of 101,067 children and 29,169 elderly individuals. The child dependency ratio is 28.69, the elderly dependency ratio is 11.99 and the total dependency ratio is 40.67. The majority of municipalities have low dependency ratios in terms of both old age and total dependency. Both dependency ratios show a flatter shape than the normal distribution.

The distribution of the total number of households among municipalities shows positive skewness. Thus, it is understood that there are low household numbers in more municipalities. On the other hand, a small number of municipalities have high household numbers. However, the distribution is close to the normal curve due to the kurtosis value being close to zero. In general, household sizes are evenly distributed among municipalities. The distribution of the total number of households shows fewer extremely large or small households than the normal distribution. In numbers, there are an average of 117,857 households in each municipality. This number varies between 6,299 and 269,482. The average household size is 3.21.

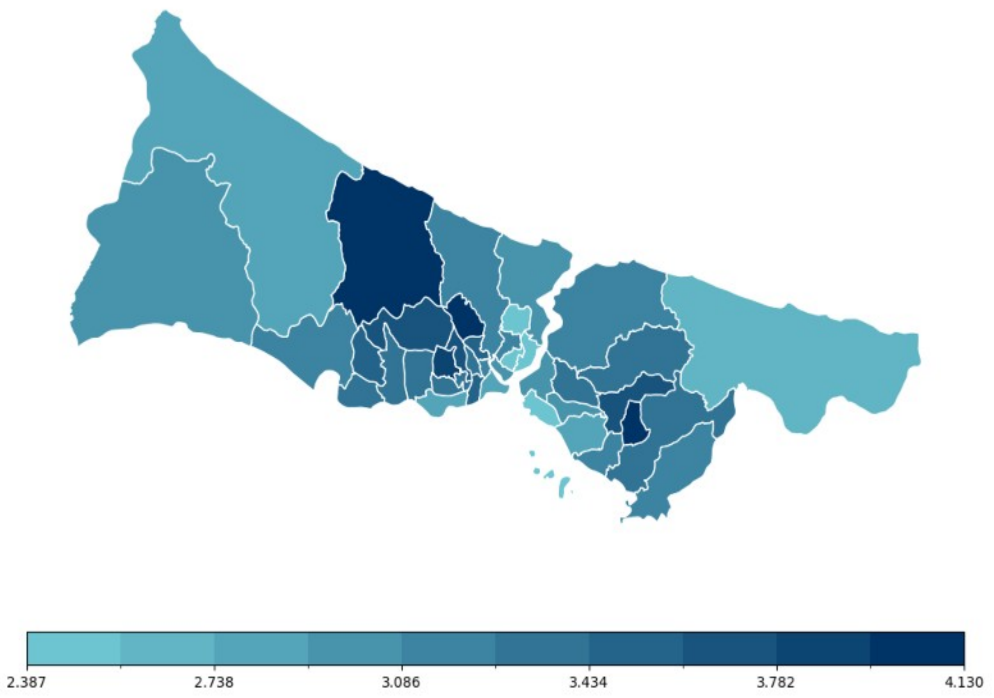
The household structure also shows notable differences among municipalities (Figure 53 and 54). Although most households conform to the nuclear family structure, there are also variations. 5,176 households consist of more than one person without a nuclear family structure. A kurtosis of 3.01 indicates a distribution indicating municipalities with high rates of these households.

Figure 53 – Total number of households in Metropolitan Istanbul



Source: Author, 2025.

Figure 54 – Average household size in Metropolitan Istanbul



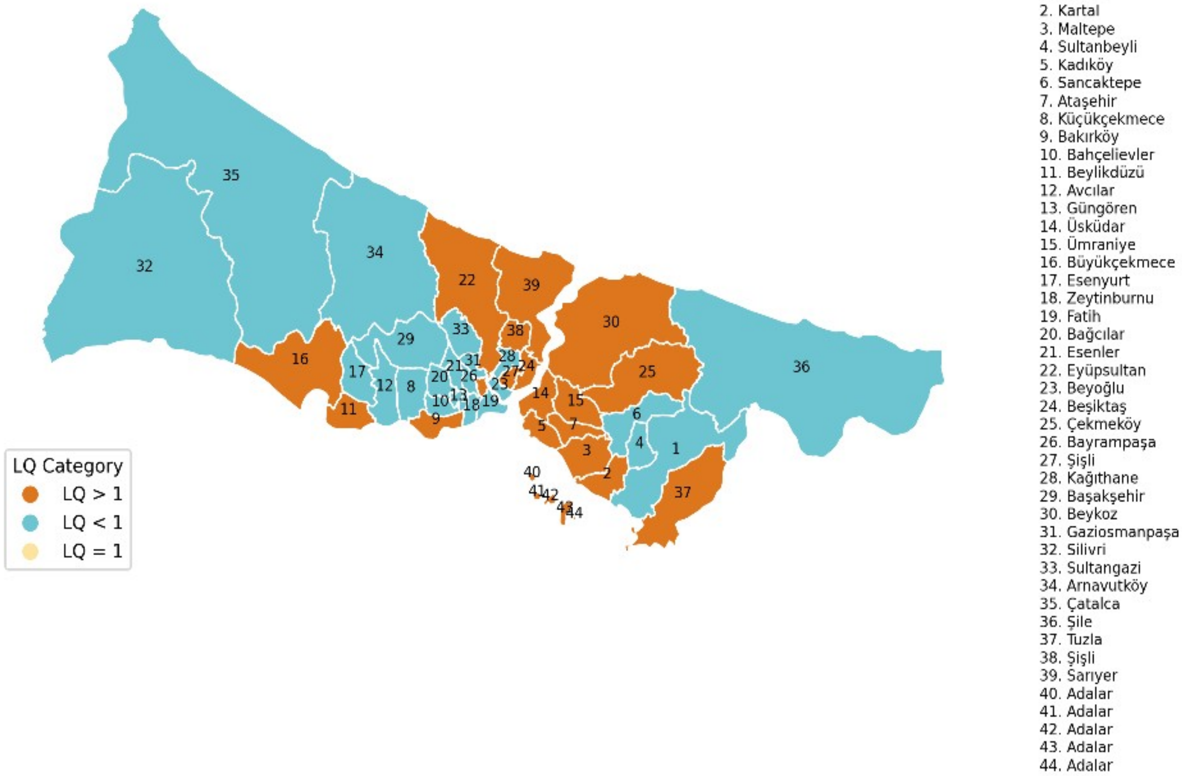
Source: Author, 2025.

In addition, 16,802 households combine nuclear family units with other individuals. 51,353 consist of nuclear families with only children. The average number of single-parent and single-person households is 11,914 and 21,166, respectively. However, the distribution of household types varies significantly. Households with many individuals without a nuclear family structure exhibit a heterogeneous structure, while Households combining nuclear families with other individuals have a more homogeneous structure. Households with nuclear families are concentrated in certain municipalities with positive skewness, both with and without children. However, it can be said that these skews tend to normalize. Households with families have a slightly flat distribution, while single-parent households with children exhibit a more uniform distribution.

Even with a 98.35% literacy rate in the metropolitan area, the distribution of the rates among municipalities shows a slight positive skew (skewness: 0.24). This value shows that municipalities with high literacy rates are in the majority. The kurtosis value of 0.02 shows that the distribution is close to the normal curve and confirms this situation. While the average number of literate individuals is 292,007, the distribution of these individuals also exhibits a positive skewness of 0.38. Again, the kurtosis value of -0.09 is close to the normal distribution. Naturally, the results of the literacy rate and the number of literate individuals confirm each other. On the other hand, the fact that women have a lower level of education than men indicates a significant gender difference. The biggest difference is encountered at the Higher Education level (Figure 55), women with an average of 36,415 and men with 72,549 individuals reveal a significant gap. As a result, the distribution of education levels across municipalities is heterogeneous, confirmed by different skewness and kurtosis values. Some municipalities host a significant number of individuals with a Higher Education level.

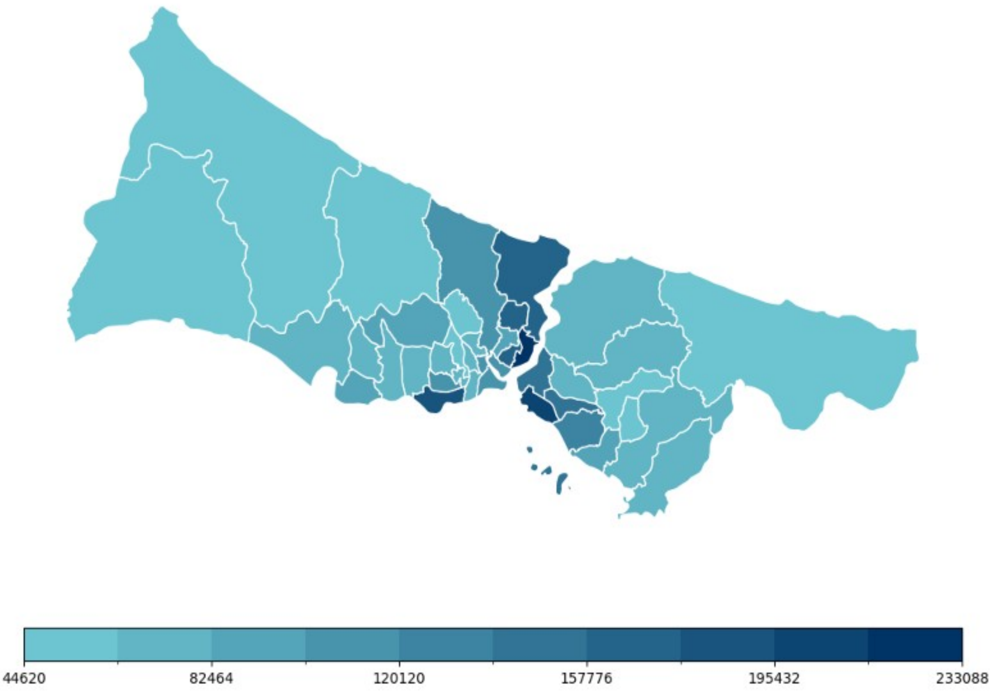
As a result of the analysis, a significant variability in annual average income was also detected among municipalities (see figure 56). While most municipalities host individuals with lower average incomes, a larger number of municipalities host individuals with significantly higher average incomes. The skewness value of 1.28 confirms this situation. In addition, the kurtosis value of 1.07 indicates the existence of exceptionally high average incomes in several municipalities. Significant income differences between municipalities are revealed by these values.

Figure 55 – LQ results for people with higher education in Metropolitan Istanbul



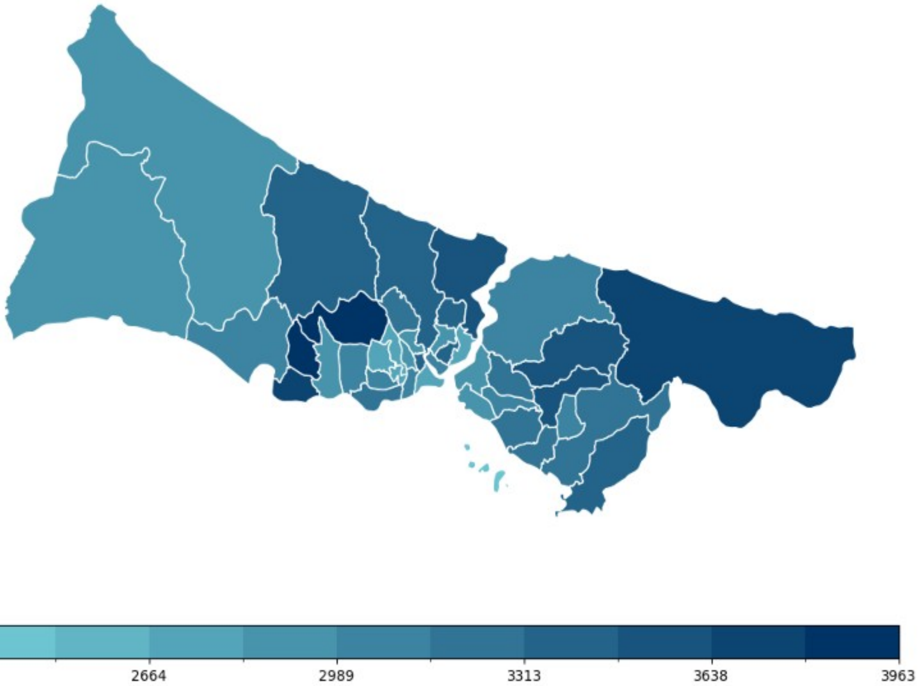
Source: Author, 2025.

Figure 56 – Annual average income in Metropolitan Istanbul



Source: Author, 2025.

Figure 57 – Population per family physician in Metropolitan Istanbul



Source: Author, 2025.

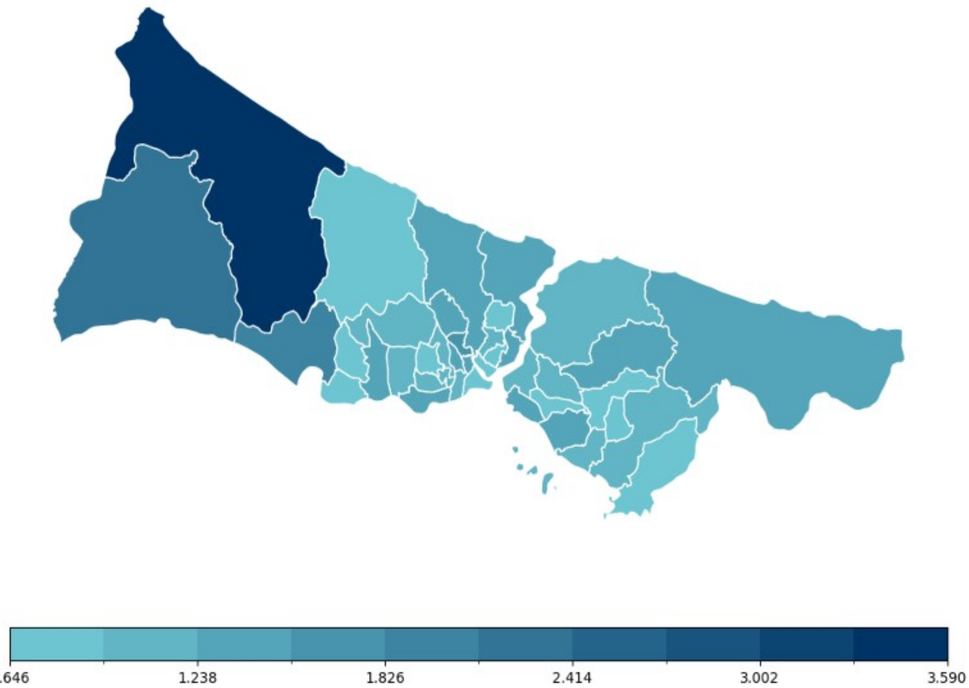
The distribution of health infrastructure is another area where significant differences are seen. The health facility areas per capita, which are an important indicator of the availability of resources, exhibit a significant positive skewness. This positive skewness indicates many municipalities with limited resources. However, the average health facility area is 0.44 square meters. The municipalities have an average of 169 clinics and 6 Medical Centers. The number of clinics varies between municipalities between 2 and 1677. In addition, the average population to family physician is 3167. Emergency medical service stations show positive skewness but are closer to a normal distribution. The distribution of clinics shows high kurtosis values, while the population to family physician ratio also indicates high patient-physician ratios. These values reveal the existence of an inequality where resources for health services are much greater in some regions than in others (Figure 57).

The housing market is another area where municipalities show remarkable heterogeneity. Most municipalities have low sales volumes, with a strong positive skew and an irregular distribution. On the contrary, some municipalities have high levels of activity in the housing market. Property ownership rates are generally significantly skewed in favor of tenants (Figure 58). In some municipalities, the ratio of owner-tenants is much higher. The average household size is 91.36 square meters. While the duration of living in the current house varies by municipality, it has been determined that there are shorter periods in some regions with a skewness value of 0.86. However, the overall forehead is close to a normal distribution with a kurtosis value of 0.69. This value shows that there is no extreme variability between municipalities. The sizes of houses also naturally vary between municipalities. The average largest sizes are generally smaller with a skewness value of 0.31. However, while the distribution is close to the normal curve (kurtosis: 0.14), it does not show significant extreme values. Water consumption also shows a significant imbalance. It is understood that most municipalities consume relatively low water with a positive skewness in the distribution. Some municipalities even have significantly high water consumption rates. The kurtosis value of 3.41 confirms this consumption. These extreme values can be attributed to large-scale industrial activities and extensive agricultural practices. The annual average water consumption of the municipalities is 21,629,854 cubic meters.

The distribution of individuals receiving social assistance across municipalities is also unbalanced (Figure 59). The fact that most municipalities have relatively low numbers of individuals with social support is supported by positive skewness values. On the other hand, the high kurtosis value of 6.14 indicates that some municipalities host a large number of individuals in need of assistance, creating a gap. These values indicate layers in the social structure in terms of economics. The average number of social assistance recipients in each municipality is 11942.

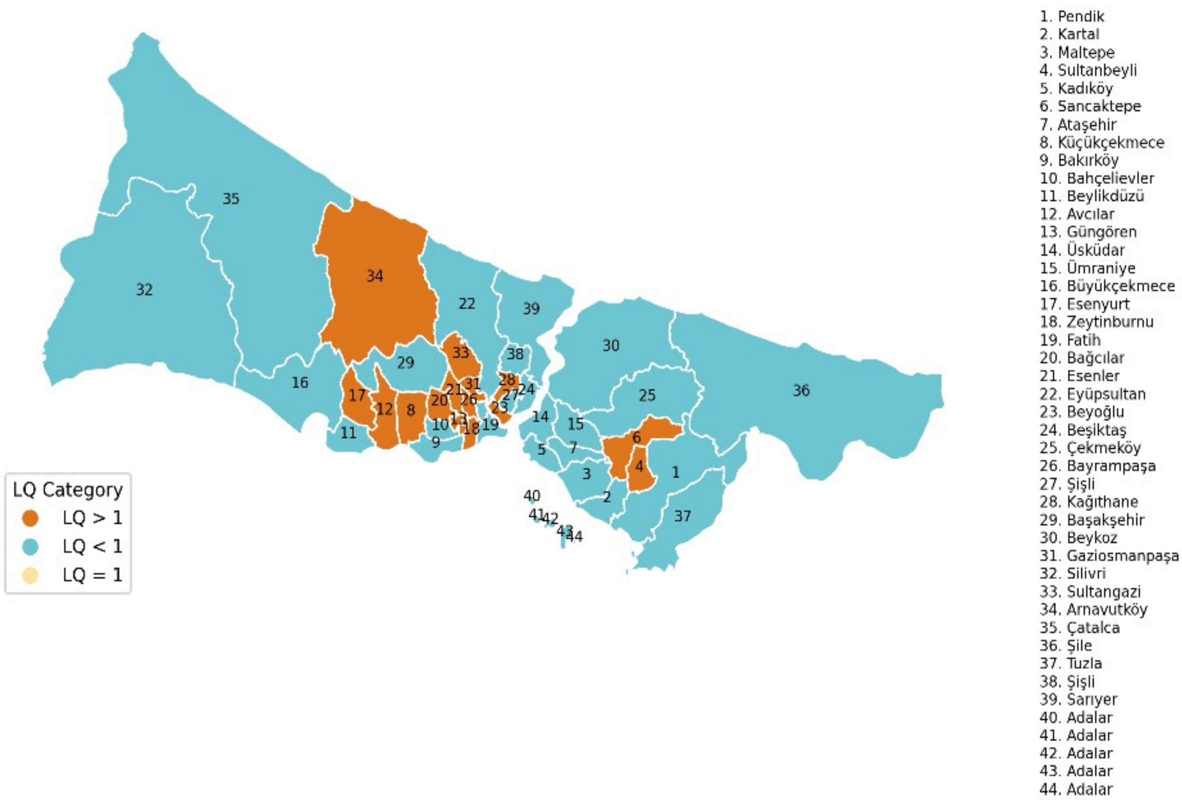
Vehicle ownership, another indicator of individuals’ economic level, is also unevenly distributed among municipalities. Positive skewness values indicate that most municipalities host relatively low numbers of vehicle owners. A kurtosis value of 3.61 indicates a remarkable level of vehicle ownership in some municipalities. This inequality is an indicator of socio-economic differences as well as vehicle dependency differences among municipalities. Access to technological resources reveals an even more pronounced inequality. The distribution of data on this subject exhibits a significant positive skewness. This situation allows us to understand that there are gaps in technological access among municipalities. While most municipalities have lower ownership rates, some municipalities stand out with extremely high rates. The skewness of 3.43 and kurtosis of 11.52 confirm this distinction.

Figure 58 – Homeowners to tenants ratio in Metropolitan Istanbul



Source: Author, 2025.

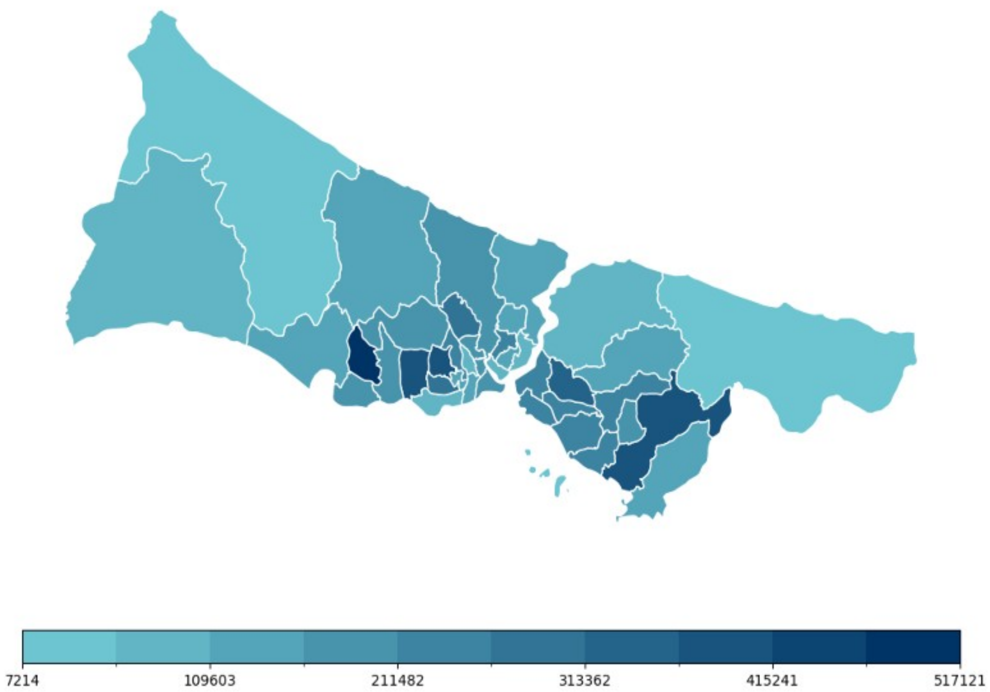
Figure 59 – LQ results for social assistance recipients in Metropolitan Istanbul



Source: Author, 2025.

When migration dynamics are considered, the positive skewness of the distribution of registered residents in other cities indicates that most municipalities host relatively low numbers of registered residents in other places (Figure 60). However, a kurtosis value of 1.01 reveals the existence of a high number of individuals registered in different cities in some municipalities. This inequality is a reflection of migration movements resulting from economic conditions. The distribution of individuals registered in Istanbul to municipalities exhibits a slightly positive skew. It is close to a normal distribution. This indicates that individuals registered in Istanbul show a more stable distribution. However, there are still variations, although not as much as seen in individuals registered in other cities.

Figure 60 – Population registered in other cities in Metropolitan Istanbul



Source: Author, 2025.

There are also significant differences in the distribution of foreign immigrants among municipalities. In most municipalities, the number of citizens registered abroad and the foreign-born population are relatively low. The high skewness detected indicates this situation. However, the high kurtosis values and the foreign-native population ratio presented by both data indicate that some municipalities host these individuals to a much greater extent than others. As a result, there is a heterogeneous integrity in which certain areas are centers of attraction for immigrants.

4.2 Social groups of cases

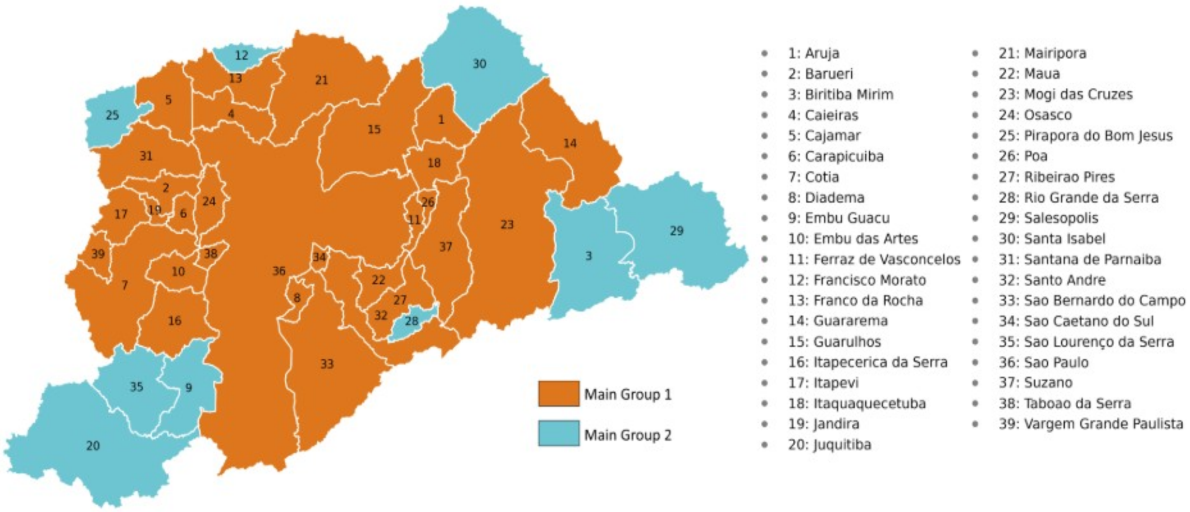
In the study, Random Forest algorithm was used in the models developed to estimate the income levels of individuals living in the municipalities of Metropolitan São Paulo and Istanbul. The model tried to estimate the amount of income, which is the target variable and a proxy that can express the opportunity to access resources for individuals, based on various demographic and socio-economic indicators, while also helping to identify spatially separated social clusters.

In this process, the model automatically learns threshold values that form branching points in the decision trees for each of the variables in the dataset (Appendix I and J). These thresholds are critical limits that provide the highest variance reduction in subdividing the data. For example, a threshold of ≤ -0.75 for the population density variable is selected by the decision tree when it provides a meaningful distinction in terms of the average wage levels of individuals residing in the districts. In this case, districts where individuals residing in the population density is 0.75 standard deviations below the mean are included in the group consisting of low-wage individuals. Similarly, a threshold of > 0.42 for the per capita health expenditure variable identifies municipalities where individuals residing in the public health infrastructure have relatively greater access and can earn higher average wages. The obtained threshold values are interpreted not only as technical points of separation but also as quantitative projections of social segregation at the metropolitan level. In areas such as Istanbul and São Paulo, which have historically experienced intense migration, high levels of socioeconomic differentiation and spatial inequality, such threshold-based separations provide an analytical framework for understanding the multi-layered nature of social competition and rivalry. In this context, the Random Forest model serves not only as a predictive tool but also as a classification mechanism to explain urban segregation.

4.2.1 Social groups in Metropolitan São Paulo

As a result of the analysis with an R^2 value of 89,1368, two main groups, four subgroups under them in the first layer, and four subgroups under these four groups in the second layer were determined (Table 11). At the highest level, the tree divided the municipalities of Metropolitan São Paulo into two main groups (Figure 61), based on gross domestic product and the presence of arts, culture, sports and entertainment institutions. Municipalities falling below the threshold value (≤ -0.16) form the first main group, representing areas with low economic output and limited cultural infrastructure. These are predominantly peripheral or rural municipalities. Municipalities above this threshold form the second main group, representing more economically dynamic areas with greater access to social and cultural infrastructure. This group is located in more urbanized or centrally integrated municipalities.

Figure 61 – Main social groups in Metropolitan São Paulo



Source: Author, 2025.

Within the first group, there are two subgroups based on demographic density and education level. The first subgroup (1.1) includes municipalities with relatively low population density and low education level (≤ -0.83). This subgroup is further divided based on the total female population and unnatural deaths. Municipalities with lower female population and lower unnatural deaths form subgroup 1.1.1. These are rural and relatively isolated municipalities. In contrast, subgroup 1.1.2 includes Biritiba Mirim and Juquitiba, which are characterized by slightly higher female population or unnatural death rates, possibly indicating early urbanization stages or higher social vulnerability. The second subgroup (1.2) within this main group includes municipalities with slightly higher density and education levels (> -0.83). This group is further divided by a threshold combining unnatural deaths and per capita health expenditure. The second-level subgroup 1.2.1, which includes Embu Guaçu, Pirapora do Bom Jesus and Rio Grande da Serra, reflects lower investment in health care and fewer recorded unnatural deaths. Subgroup 1.2.2, Francisco Morato and Santa Isabel, has higher expenditure and mortality rates, indicating increased state involvement in health care or high social risk factors.

Table 11- Groups and their municipalities in Metropolitan São Paulo

Municipality	Main group	First level subgroup	Second level subgroup
Salesópolis	1	1.1	1.1.1
São Lourenço da Serra	1	1.1	1.1.1
Biritiba Mirim	1	1.1	1.1.2
Juquitiba	1	1.1	1.1.2
Embu Guaçu	1	1.2	1.2.1
Pirapora do Bom Jesus	1	1.2	1.2.1
Rio Grande da Serra	1	1.2	1.2.1
Francisco Morato	1	1.2	1.2.2
Santa Isabel	1	1.2	1.2.2
Arujá	2	2.1	2.1.1
Caieiras	2	2.1	2.1.1
Cajamar	2	2.1	2.1.1
Carapicuíba	2	2.1	2.1.1
Cotia	2	2.1	2.1.1
Embu das Artes	2	2.1	2.1.1
Ferraz de Vasconcelos	2	2.1	2.1.1
Franco da Rocha	2	2.1	2.1.1
Guararema	2	2.1	2.1.1
Itapecerica da Serra	2	2.1	2.1.1
Itapevi	2	2.1	2.1.1
Itaquaquecetuba	2	2.1	2.1.1
Jandira	2	2.1	2.1.1
Mairiporã	2	2.1	2.1.1
Mauá	2	2.1	2.1.1
Mogi das Cruzes	2	2.1	2.1.1
Poá	2	2.1	2.1.1
Ribeirão Pires	2	2.1	2.1.1
Santana de Parnaíba	2	2.1	2.1.1
Santo André	2	2.1	2.1.1
São Caetano do Sul	2	2.1	2.1.1

Table 11 - Groups and their municipalities in Metropolitan São Paulo - continues

Municipality	Main group	First level subgroup	Second level subgroup
Suzano	2	2.1	2.1.1
Taboão da Serra	2	2.1	2.1.1
Vargem Grande Paulista	2	2.1	2.1.1
Diadema	2	2.1	2.1.2
Osasco	2	2.1	2.1.2
Guarulhos	2	2.2	2.2.1
São Bernardo do Campo	2	2.2	2.2.1
Barueri	2	2.2	2.2.2
São Paulo	2	2.2	2.2.2

Source: Author, 2025.

The second main group exceeds the first threshold of GDP and cultural infrastructure, indicating greater integration into the regional economy and services (Table 12). This group is further subdivided according to the combination of child-elderly ratio and cultural organization density. The first first-level subgroup (2.1) has an older demographic structure and limited cultural access (≤0.00) than the second first-level subgroup (2.2). Within it, the second-level subgroup 2.1.1 includes municipalities with lower density and fewer working-age adults, including a wide range of urban environments such as Itapevi, Mauá, Suzano and Cotia. This group reflects medium levels of development, with dense populations but lacking central city functions. Within the group, Carapicuíba, Mogi das Cruzes and Santo André form a tighter cluster, probably due to the interaction of their dense populations and economies.

The second-level subgroup 2.1.2 includes Diadema and Osasco, both with high density and a significant working-age population. These cities are functionally integrated into the core economy of São Paulo, serving as industrial and residential extensions of the metropolis. The second first-level subgroup (2.2) within the second major group consists of municipalities with younger demographics and greater access to cultural and recreational infrastructure. This subgroup is distinguished on the basis of dark-skinned population and per capita health expenditure. Subgroup 2.2.1 includes Guarulhos and São Bernardo do Campo, large industrial cities with moderate public health investment and racial diversity. Subgroup 2.2.2, Barueri and

São Paulo, represent the most economically developed and socially heterogeneous areas in the region and are marked by high health investment and demographic complexity.

Table 12 - Main group profiles in the Metropolitan São Paulo according to the most determining indicators

	1	2
Population	436179	20295741
Area	2163,83	5783,12
Female population	220922	10634757
Male population	215357	9660993
Indigenous population	424	26729
Brown population	185130	7180084
Married population	2482	105502
Number of birth	5781	240380
Number of death	3429	148790
Total households	193014	8581129
Private households	192887	8575108
Collective households	127	6021
Formal employment	50420	7451773
Number of companies and other organizations	6465	889218
Demographic density	201,577	3509,477
Gender ratio	0,975	0,908
Birth to death ratio	1,686	1,616
Child dependency ratio	29,854	25,490
Elderly dependency ratio	14,023	16,216
Total dependency ratio	43,296	41,110
Average number of residents in private households	2,833	2,715
Life expectancy	0,686	0,700
Nominal average salary	2480,076	4536,054
Healthcare expenditure per inhabitant	724,133	1361,961
Private households ratio	0,999	0,999
Collective households ratio	0,001	0,001

Source: Author, 2025.

This tree structure expresses a clear social geography from low-density, underdeveloped rural municipalities on the periphery, through transitional suburban and industrial corridors, to dense, demographically complex, and economically diversified urban centers. The logic of segregation reveals both socio-spatial stratification and differential access to public and private resources across the metropolitan landscape.

4.2.1.1 Main group 1

This group consists of municipalities where the contribution of arts, culture, sports and recreational organizations to the gross domestic product is below or equal to -0.16. The group is characterized by relatively stronger economic barriers and socio-cultural marginalization (Table 12). The urban and social fabric is less developed, as can be seen from the correlation values. As a result, more intense competition and less solidarity should be expected in the mentioned sectors and limited economic resources. Thus, the existing social and spatial segregation is further strengthened. This vortex causes the inequalities between the groups to continue and the upward social mobility to be restricted.

The correlation coefficients between GDP and demographic characteristics provide us with more information about this group. The population (0.996), female population (0.997), and male population (0.996) are strongly correlated with GDP. These coefficients show that the group members are quite engaged in economic activities. However, the majority of these activities are not arts, sports, culture and recreation organizations. However, the relatively underdeveloped nature of the aforementioned sectors can be seen as an obstacle to personal development, social engagement and, consequently, social capital development. A high correlation with the child population (0.996) and working-age population (0.996) show that the municipalities hosting the group host a significant number of young individuals and families with children. In addition, the strong correlation with married populations (0.997) and the number of births (0.996) show that the group members attach less importance to starting a family compared to the other group. A weak negative correlation was observed with the child dependency ratio (-0.316). This value indicates economic pressures on young couples. It is likely that marriage is a strategy for solidarity for individuals facing economic difficulties. When the high number of children and working-age individuals is considered together with the low investments in the mentioned sectors compared to the peer group, it can be predicted that competition within and between groups will increase. There will be competition for investment funds for the construction of the infrastructure required for socio-cultural activities.

The correlation between GDP and formal employment (0.997) indicates that economic activities are concentrated outside the mentioned sectors. The correlation value between the nominal average salary and GDP, (0.547) also supports this assumption. The restrictions in the variety of sectors that will provide employment opportunities to individuals can again be seen as a factor that harms upward mobility. The limited number of sectors and job opportunities will increase social stratification and crystallize urban segregation between municipalities that host developed cultural economies and those that do not. At the same time, the concentration of economic activities in certain sectors will create a privileged segment, although it will make a stable income possible for everyone. Cultural capital will be concentrated in the hands of a relatively privileged segment, while others will face isolation.

Again, it can be understood from the low correlation coefficients with the birth-to-death ratio (-0.091) and the child-to-elderly ratio (-0.215) that the populations of the municipalities included in this group do not experience rapid aging or significant changes compared to the peer group. However, it may also lead to the migration of the young population to municipalities with more developed infrastructure due to insufficient socio-cultural resources. The migration of better educated and economically mobile individuals will further strengthen the social spatial segregation. Moreover, the correlation between GDP and healthcare expenditure per inhabitant (0.119) points to another dimension of socio-economic inequality. This situation contributes to the socio-spatial marginalization of at least a certain part of the group. Thus, it can be interpreted that individuals included in the group are more deprived of engaging in socio-cultural activities compared to the other main group and struggle more to access resources that will meet their basic needs. It is understood that they are condemned to a spiral of social inequalities and deprivation in the metropolitan area in general and in the municipalities where the group is located. On the other hand, it can be expected that the lack of formal socio-cultural infrastructure will not only lead to competition among individuals but also pave the way for solidarity within the group. The communities that make up the main group will try to eliminate this deficiency through informal networks. Although individuals may follow this strategy through solidarity, they will not be very successful due to the lack of investment.

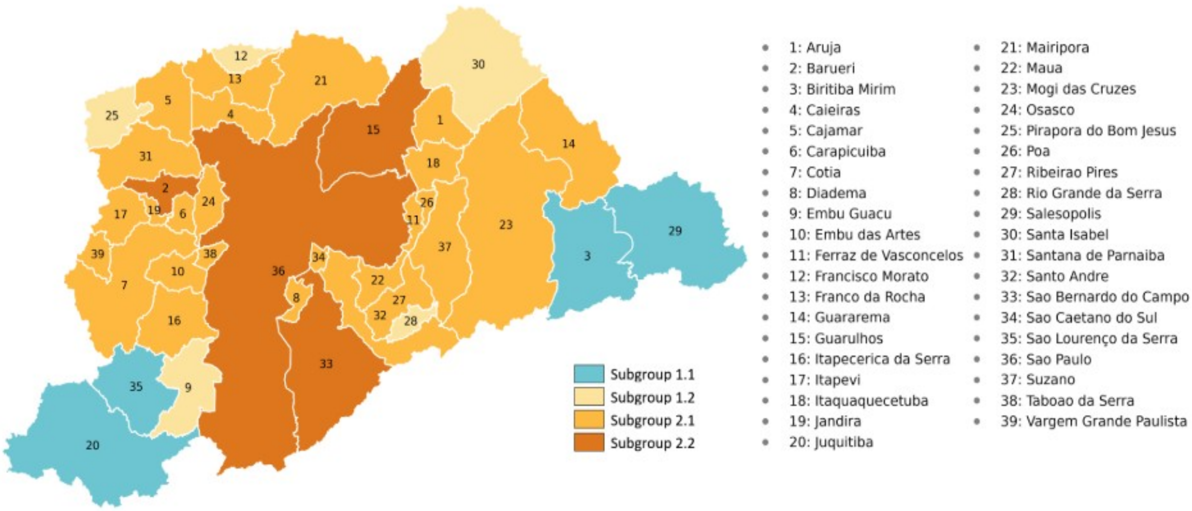
The correlation between GDP and collective households (0.993) shows that more individuals prefer common living spaces as a method to cope with economic difficulties. The correlation with private households (-0.355) also supports this assumption. Although this can be seen as an example of solidarity, it is not sufficiently useful in removing socio-economic obstacles in front of individuals. In addition, the correlation with the absence of permanent connections to general networks (0.749) points to basic infrastructure deficiencies. This situation will also restrict economic development and community building efforts. Thus, the addition of physical infrastructure deficiencies to the socio-cultural infrastructure deficiencies of the municipalities included in the group will cause the deepening of social spatial segregation.

As a result, the fact that socio-cultural sectors are less developed compared to the other main group can be seen as the reason for more dominant socio-economic marginalization. Lack of investment in the arts, sports, culture and recreation sectors means more limited resources for the individuals who make up this group. Scarce resources will cause intra-group competition as well as inter-group competition. Social mobility is limited due to inter-group competition and spatial inequalities occur. Similarly, intra-group competition will also produce similar results within the borders of the municipalities where the main group is located. At the same time, individuals who find the opportunity will also resort to solidarity in order to overcome the obstacles they encounter and reach limited resources. However, it can be seen from the existence of large-scale structural inequalities that this solidarity is insufficient to achieve the goal. In a sense, it can be seen that economic, cultural and infrastructural marginalization, which can be seen as a result of competition and solidarity dynamics, will support social stratification by limiting upward mobility. The main element that determines stratification is cultural capital.

4.2.1.1.1 Subgroup 1.1

This subgroup (Figure 62) consists of a population characterized by a relatively lower demographic density combined with education levels (≤ -0.83) compared to subgroup 1.2 (Table 13). It draws a profile with predominantly rural and semi-rural areas and relatively limited educational infrastructure. Economic opportunities restricted as a result of competition with subgroup 1.2 deepen existing socio-economic inequalities by preventing social mobility and economic welfare. In addition to the criteria determining the main group to which it belongs, education in this subgroup is an important factor that deepens social stratification. In parallel with this deepening, the competition between individuals also intensifies. It increases the effects of deprivation and marginalization for individuals who become disadvantaged as a result of the competition.

Figure 62 – First level subgroups



Source: Author, 2025.

Considering that the demographic density in the municipalities where the group is settled is relatively low compared to subgroup 1.2, the correlation values with other variables provide important information. For example, while the male population will be higher in high demographic density, it can be expected that the female population will be higher in this group with relatively lower demographic density. However, more homogeneous ethnic structures will be seen with low demographic density. As the density decreases, ethnic diversity decreases. Especially the brown and black population is less in this group. The negative correlation of 0.191 between demographic density and marriage rates means that the marriage rate increases as the density decreases. Thus, it can be said that individuals tend to marry more in less dense municipalities. The negative correlation of 0.357 determined with the average household size shows that the household size is higher in the group compared to the peer group. Individuals live in more crowded households. Another point where the group differs is the birth death and child death rates. All these rates are slightly lower than in the group with high density.

Table 13 - First level subgroup profiles in the Metropolitan São Paulo according to the most determining indicators

	1.1	1.2	2.1	2.2
Population	88356	347823	6424769	13870972
Area	1451,03	712,8	3468,01	2315,11
Female population	44139	176783	3323198	7311559
Male population	44217	171140	3101571	6559422
Indian population	75	349	6344	20385
Brown population	29571	155559	2475464	4704620
Married population	493	1989	35054	70448
Number of birth	1098	4683	77909	162471
Number of death	791	2638	44813	103977
Total households	48221	144793	2611960	5969169
Private households	48181	144706	2610746	5964362
Collective households	40	87	1214	4807
Formal employment	16111	34309	1451162	6000611
Number of companies and other organizations	1797	4668	168833	720385
Demographic density	60,892	487,964	1852,579	5991,496
Gender ratio	1,002	0,968	0,933	0,897
Birth to death ratio	1,388	1,775	1,739	1,563
Child dependency ratio	28,599	30,151	27,399	24,507
Elderly dependency ratio	17,268	12,921	14,605	16,837
Total dependency ratio	45,802	42,660	41,073	41,128
Average number of residents in private households	2,774	2,852	2,806	2,674
Life expectancy	0,704	0,681	0,690	0,705
Nominal average salary	2088,733	2663,844	3409,835	4808,413
Healthcare expenditure per inhabitant	887,484	682,638	1088,333	1488,700
Private households ratio	0,999	0,999	1,000	0,999
Collective households ratio	0,001	0,001	0,000	0,001

Source: Author, 2025.

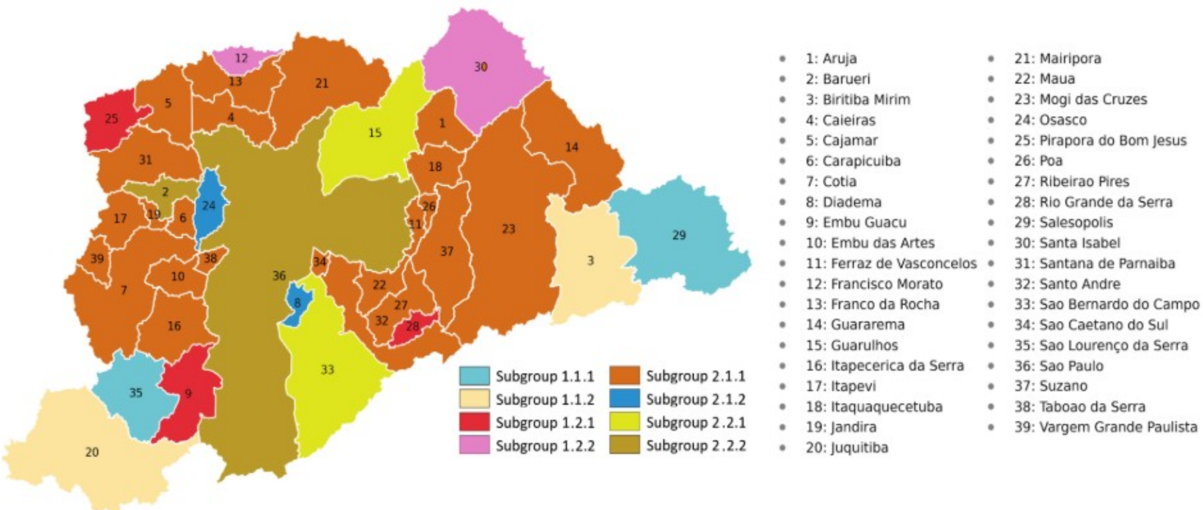
The positive correlation value of 0.328 between the nominal average salary and demographic density means that salaries will also decrease as the density decreases. Thus, it can be said that economic opportunities are lower in less dense areas. Formal employment also shows a similar trend, although less severe. This group has access to a narrower labor market. Job opportunities are relatively limited. Child and total dependency rates are also relatively high in this group. Thus, it can be said that the economic dependency is higher for both children and the elderly in this group that settles in more rural or low-density areas. Finally, as a result of the positive correlation of 0.218 between demographic density and gross domestic product, GDP decreases at low demographic density. Economic productivity is lower in the areas where this group settles.

When evaluated together with the lower level of education, it can be said that the male population has increased slightly compared to the peer group. Another striking relationship between the variables is the value of 0.163 between the level of education and marriage rates. Although it is a low value, it is an important result for the group with a large population. Thus, it can be thought that marriage rates increase slightly as the level of education decreases. Individuals with low education tend to marry at a higher rate. This situation also supports the relationship between population density and marriage rates. It can be thought that individuals who encounter barriers in accessing economic resources prefer the institution of marriage as a result of a strategy. The negative correlation of 0.709 means that the child dependency rate increases at lower levels of education. The elderly dependency rate may decrease slightly starting from the value of 0.630.

Another interesting correlation is between the level of education and life expectancy. The value of 0.393 indicates that life expectancy will decrease as the level of education decreases. Since education is an important factor in accessing all other resources, the relationship between its level decreasing and the shortening of the average life expectancy can be understood. The relationship between the level of education and economic indicators is parallel to the relationship between population density and economic indicators. As a result of the relationship between all these variables, it can be said that individuals in this group have access to lower salaries, less stable employment and less economic productivity. The positive correlation of 0.628 with health expenditures indicates that the group also faces more problems in accessing health services compared to the peer group. The negative correlation of 0.485 between the level of education and the average number of household members also confirms the comment made previously about the household structure that characterizes this group. As the level of education decreases, the number of people per household increases. The level of education is also related to the child dependency ratio (-0.709). As the level of education decreases, the child population increases.

As a result, the decrease in the level of education will also negatively affect human resource development and will also limit the economic opportunities that individuals can access. When low population density is considered together with fewer services and job opportunities, a geographical isolation can also be mentioned. The municipalities where the group settles are separated from more developed areas physically and socially. Thus, group members face separation. They have difficulty integrating into the wider economic system. Furthermore, low population density and inadequate infrastructure constitute obstacles to the development of social networks and a healthy social fabric.

Figure 63 – Second level subgroups



Source: Author, 2025.

The group is divided into subgroups that will compete with each other again in terms of female population and unnatural deaths, in line with the criteria mentioned above (Figure 63). Salesópolis and São Lourenço da Serra are distinguished from Biritiba Mirim and Juquitiba by their relatively low female population and deaths. While the low female population indicates demographic imbalance, the unnatural deaths bring security concerns. Salesópolis and São Lourenço da Serra (Sub-Group 1.1.1) have a more unbalanced demographic profile compared to their peer group (Table 14). However, they have relatively more stable security conditions. A safe environment brings with it some stability in living conditions. The relatively low female population can also negatively affect community dynamics. When the low level of education is considered together with these problems, it is inevitable that socio-economic difficulties will increase.

Biritiba Mirim and Juquitiba (Sub-Group 1.1.2) have more female individuals, unlike the first group, but they exhibit higher numbers of unnatural deaths. The high female population will make a positive contribution to the social fabric and the labor market. However, the increase in the number of deaths will negatively affect the quality of life. When considered together with the decrease in the level of education, it can be seen that individuals in this group also have problems in accessing economic resources. In both subgroups, the low investment in the arts, culture and recreational sectors creates even more obstacles for individuals. Thus, it can be expected that the competition between these two groups in accessing limited economic and educational resources will intensify. In fact, the number of unnatural deaths can be linked to the most severe form of competition, social conflict. On the other hand, examples of solidarity can also be found as local efforts. However, competition and, moreover, conflict are important obstacles in the construction of social harmony, solidarity and a healthy social fabric.

4.2.1.1.2 Subgroup 1.2

Subgroup 1.2 is characterized by higher population density and education level than subgroup 1.1. This indicates a relatively more developed socio-economic environment. However, the group is still shaped by the low level of economic impact of the environment, arts, culture, sports and recreation sectors. This group is also divided into subgroups in terms of total unnatural deaths and total health expenditures per capita. Embu Guaçu, Pirapora Do Bom Jesus, and Rio Grande da Serra (Sub-Group 1.2.1) is characterized by relatively low deaths and health expenditures per capita. While the low number of deaths may be the result of more stable security, low health expenditures can be interpreted as constraints that negatively affect public health and quality of life. A higher level of security than subgroup 1.2.2, will contribute to a more stable socio-economic environment. Despite the higher level of education and population density, residents in these municipalities have difficulty accessing health resources. This situation may be an obstacle for the group members to fully benefit from their educational and demographic advantages.

Table 14 - Second level subgroup (1.1.1 to 1.2.2) profiles in the Metropolitan São Paulo according to the most determining indicators

	1.1.1	1.1.2	1.2.1	1.2.2
Population	31269	57087	129510	218313
Area	611,45	839,58	300,47	412,33
Female population	15693	28446	65766	111017
Male population	15576	28641	63744	107396
Indian population	15	60	173	176
Brown population	9344	20227	57922	97637
Married population	179	314	742	1247
Number of birth	396	702	1508	3175
Number of death	286	505	1080	1558
Total households	16894	31327	55463	89330
Private households	16875	31306	55407	89299
Collective households	19	21	56	31
Formal employment	8227	7884	14036	20273
Companies and other organizations	724	1073	1983	2685
Demographic density	51,139	67,995	431,023	529,458
Gender ratio	0,993	1,007	0,969	0,967
Birth to death ratio	1,385	1,390	1,396	2,038
Child dependency ratio	27,426	29,209	29,342	30,612
Elderly dependency ratio	17,497	17,138	13,330	12,660
Total dependency ratio	44,865	46,314	42,482	42,766
Average households number	2,764	2,780	2,854	2,851
Life expectancy	0,749	0,680	0,691	0,675
Nominal average salary	1880,956	2305,549	2794,248	2573,560
Healthcare expenditure per inhabitant	996,821	827,595	765,059	633,743
Private households ratio	0,999	0,999	0,999	1,000
Collective households ratio	0,001	0,001	0,001	0,000

Source: Author, 2025.

Francisco Morato and Santa Isabel (Sub-Group 1.2.2.) are defined by higher death tolls and health expenditures. Higher health expenditures can be attributed to the group facing more health and security problems. The fact that these problems are relatively more effective indicates greater socio-economic pressures. At the same time, higher education levels and population density may cause an increase in individuals' health service demands and thus their expenditures. The increase in demand and expenditure amounts will create pressure on resources, thus increasing competition between individuals. As a result, although these two groups are located together in an umbrella group defined by common characteristics, they are separated from each other by the factors mentioned. This differentiation can be seen as a result of competition, and it will also cause further competition. These two subgroups, which face common problems within the same group, may also resort to solidarity in solving these problems.

4.2.1.2 Main group 2

The second main group is limited by municipalities where art, culture, sports and recreational organizations contribute more to the economy (threshold: > -0.16). These sectors have a high correlation coefficient with the Gross Domestic Product (0.994). This value indicates the relative abundance of investments contributing to the development of these sectors. It is also a reflection of a more dynamic socio-economic structure. A more dynamic socio-economic structure leads to the formation of a larger and more diverse group. The high correlation values that GDP has with various socio-cultural organizations and demographic indicators support this situation. Again, the high correlation (0.994) determined with educational organizations shows the way municipalities with developed socio-cultural infrastructure also invest in educational infrastructure. In line with these relationships, it is inevitable that the social competition between individuals and subgroups will aim to access these resources. Social stratification will be embodied according to the amount of cultural capital accumulated in individuals and subgroups according to the result of this competition. Individuals and groups will benefit from solidarity in accessing these resources or developing alternative strategies.

It is expected that inter-group solidarity will occur between public institutions, private sector and community organizations to develop cultural industries. The correlation of GDP with formal employment (0.997) and total number of companies (0.996), when considered together with the correlation values above, supports this interpretation. The economic importance of the mentioned sectors is seen. This solidarity will strengthen social cohesion around common cultural values. Conversely, the development of these sectors can also lead to urban inequality. The development of the infrastructure of various sectors can also lead to an increase in property values and the displacement of low-income individuals. Gross domestic product and property-related indicators, such as the average number of residents in private households (-0.355) and the rate of permanent private households connected to the general sewage system (0.997), show the impact of these investments on space. At the same time, the correlation values with various socio-economic indicators, such as nominal average salary (0.547) and total healthcare expenditure per inhabitant (0.119), give the impression that these investments are not very effective in eliminating existing inequalities. Thus, it can be interpreted that among individuals competing with each other, those with advantages will settle in privileged urban areas, while others will have to make do with less desirable areas. Socio-economic stratification and urban segregation mutually guarantee each other's existence.

4.2.1.2.1 Subgroup 2.1

The first subgroup of the second main group is the child-to-elderly ratio and the contribution of arts, culture, sport, and recreational organizations is less than or equal to 0.00. Although the sectors mentioned for the second main group are relatively developed compared to the first main group, the services targeting the young and elderly population are less developed compared to subgroup 2.2. Thus, it can be interpreted that within this subgroup, individuals of working age have more advantages in terms of socio-cultural investments than individuals in other demographic groups. The fact that young and elderly individuals have restricted access to resources arising from these sectors can be linked to the intra-group competition between individuals of working age and is also a situation that will increase the intensity of this competition. Thus, it is seen that the young and elderly population is exposed to demographic exclusion. The inability of these individuals to access limited resources will fuel the feeling of alienation and exacerbate social separation.

Table 15 - Second level subgroup (2.1.1 to 2.2.2) profiles in the Metropolitan São Paulo according to the most determining indicators

	2.1.1	2.1.2	2.2.1	2.2.2
Population	5302917	1121852	2102500	11768472
Area	3372,33	95,69	728,21	1586,9
Female population	2738636	584562	1091407	6220152
Male population	2564281	537290	1011093	5548329
Indian population	5521	823	2611	17774
Brown population	2032899	442565	784022	3920598
Married population	28538	6516	11377	59071
Number of birth	65325	12584	25671	136800
Number of death	36862	7951	14895	89082
Total households	2160448	451512	848460	5120709
Private households	2159331	451415	848160	5116202
Collective households	1117	97	300	4507
Formal employment	1179181	271981	605053	5395558
Number of companies and other organizations	140198	28635	63430	656955
Demographic density	1572,480	11724,307	2887,228	7416,000
Gender ratio	0,936	0,919	0,926	0,892
Birth to death ratio	1,772	1,583	1,723	1,536
Child dependency ratio	27,743	25,681	26,356	24,145
Elderly dependency ratio	14,790	13,729	14,326	17,208
Total dependency ratio	41,435	39,364	40,333	41,270
Average number of residents in private households	2,817	2,755	2,787	2,656
Life expectancy	0,695	0,667	0,691	0,708
Nominal average salary	3287,811	3938,870	3711,282	4931,445
Healthcare expenditure per inhabitant	1039,144	1320,846	1270,604	1527,664
Private households ratio	0,999	1,000	1,000	0,999
Collective households ratio	0,001	0,000	0,000	0,001

Source: Author, 2025.

The imbalance in sectoral investments will also lead to spatial inequalities such as public spaces that young and elderly cannot access. In other words, failure to meet the spatial needs arising from the diversity of demographic structure will lead to spatial segregation arising from land uses. Such spatial inequalities may cause segregation by age groups, as well as the removal of certain groups from central urban spaces. On the other hand, this inequality may also lead to the emergence of solidarity for the group. Community organizations may emerge around the goal of meeting the spatial needs of each age group. As a result, the inequalities mentioned will lead to marginalization in the long term, damaging the social fabric.

This subgroup is divided into two groups according to the interaction of population density and the number of individuals of working age (Table 15). Municipalities with a threshold value equal to or below ≤ 0.10 (sub-group 2.1.1.) are inhabited by groups where the young and old population is in the majority. This situation brings with it additional social and economic pressures. The low economically active population is a part of the group profile in these municipalities. This part poses a risk in terms of economic mobility. Intra-group competition in the group occurs more when the old and young individuals have limited job opportunities, health services and access to public services.

The decrease in the number of individuals of working age and the demographic density affect many dynamics of the social structure. The potential effects of the population having lower values compared to the peer group can be understood from the correlation data. For example, this variable has a strong positive relationship with racial and ethnic populations. The decrease naturally indicates that the participation of these groups in the labor force and their social interactions will weaken. In addition to the child dependency rate showing a negative correlation of 0.317, an increase in the elderly dependency rate can be expected with the decrease in the working age population. Thus, the total dependency rate will increase, and the social burden on children and the elderly will increase. A strong positive correlation of 0.999 is observed with the elderly population. Thus, it is confirmed that the rate of the elderly population outside the labor force is higher compared to the peer group. This will increase the demand for social services. In addition, the married population and the number of births are directly related to the working age population. The decrease in the number of employees also indicates a decrease in marriage rates and fertility. The decrease in fertility can negatively affect the birth-mortality rate. The child population is also closely related to the working age group. The decrease will also bring a decrease in the number of children. The inadequacy of the economic resources that the group can access, in other words, the decrease in official employment opportunities, negatively affects the participation of individuals in the labor force.

The strong positive correlation of 0.996 and 0.997 between the Gross Domestic Product and official employment data and the number of individuals of working age, respectively, supports this interpretation. However, the moderate correlation of 0.520 with the average salary allows the interpretation that low-income individuals in the group may withdraw from the labor force. Low salaries will affect the motivation to participate in the labor force. The high positive correlation demonstrated with the total number of companies and all kinds of organizational activities indicates a relative lack of resources in these sectors in the municipalities where the group is located. There is also a negative correlation of 0.358 between the working-age population and the average number of households. Thus, a slight increase in the number of household residents can be expected with the decrease in the number of individuals of working age. Therefore, it can be said that the mobilization of individuals is also negatively affected.

As a result of the competition, new subgroups are formed by the determination of the sides of the individuals. Sub-group 2.1.1.1 is characterized by a relative decrease in birth rates and elderly dependency ratios (≤ -0.09). As a result of the competition, the elderly population, which becomes disadvantaged, forms a new group (sub-group 2.1.1.2). The increase in the number of economically active individuals will relieve the pressure on social systems. Health, social and cultural services for the elderly population, which needs more support than the young population, gain importance with this distinction. In addition, the relative decrease in the female population and health expenditures per capita (≤ -0.24) creates a new subgroup (Sub-group 2.1.1.1.1) where health resources gain even more importance and the population balance is disrupted. The correlation between the low female population and the decrease in birth rates also shows that there are obstacles to community development. The decrease in health expenditures further complicates access to already limited resources and intensifies the competition within the group.

More intense social competition defines a new group (sub-group 2.1.1.1.1.1) with a low total population and a greater lack of art, culture, sports and recreational organizations (≤ -0.16). The municipalities where this group is located, shaped by these characteristics, are Caieiras, Guararema, and Vargem Grande Paulista. It can be said that individuals settled in these areas face strong obstacles to participating in social life and are partially exposed to social isolation. Thus, the possibility of social cohesion in general is eliminated. The inability to access the sectoral resources mentioned is also an obstacle to the development of social capital. Social solidarity opportunities are restricted, and competition between individuals and subgroups is intensified.

On the other hand, Ferraz de Vasconcelos and Poá (sub-group 2.1.1.1.1.2) has a larger population but still has limited art, culture, sports and recreational activities (> -0.16). Having more individuals compared to the peer group will create relatively strong obstacles to accessing urban resources. This stratified separation shows once again that subgroups within the same group (sub-group 2.1.1) may have different social dynamics due to variations in population density, access to health services and amount of social activity. The struggle for limited resources and opportunities is the underlying reason for this grouping. Social harmony and solidarity are also determined by these socio-economic factors.

Another group under subgroup 2.1.1 (subgroup 2.1.1.1.2) has relatively better access to health services and a more balanced female population (> -0.24). The group is characterized by a higher female population and higher per capita health expenditure. This group faces fewer obstacles in accessing health resources. However, the obstacles faced by the upper groups they belong to are still present. Within this cluster, there is subgroup 2.1.1.2.1, which is determined by lower education levels and fewer companies and organizations (≤ -0.21). It can be said that the economic diversity is even more limited in terms of the municipalities where this group is settled. Lower levels of education and job opportunities are an important obstacle to upward mobilization. This result, which can be evaluated as a reflection of the competition between groups, also intensifies the competition within the group due to more limited education and job opportunities. As a result of the intensified competition, this group located in the municipalities of Cajamar, Franco da Rocha, Itapevi and Jandira causes the working age population and percentage of private households imputed interaction to be divided again depending on the threshold value of -0.22. The group located in the municipalities of Cajamar and Franco da Rocha, which remains below the value of -0.22, shows a profile where the economic resources are more stagnant and the obstacles to these resources are more apparent.

On the other hand, the group located within the borders of Itapevi and Jandira hosts more working age individuals. Despite the low level of education and fewer job opportunities inherited from the upper group, these two municipalities have a higher economic development potential due to the higher number of working age individuals compared to the previous two municipalities. Despite the intense competition, it is possible to see solidarity shaped around the family and the close circle in both groups. Although there is no data available, it can be assumed that informal work is used as a survival strategy in the group located within the borders of Itapevi and Jandira. Again, it is seen that the divisions mentioned occur even when there is very little change in the amount of resource access and the identities of the individuals trying to access these resources, despite being within the same supergroup.

Subgroup 2.1.1.2.2 consists of individuals with relatively higher levels of education and access to more companies and other organizations (> -0.21). Thus, the municipalities where this group is settled have slightly better economic and educational infrastructure. Thus, it can be said that social mobility opportunities are more. Intra-group competition and solidarity dynamics are shaped in line with economic and educational resources. A better level of education and a stronger economic structure bring about more dynamic group dynamics. A higher level of intra-group solidarity should be expected as a result of the establishment of education and business networks. However, individual competition will show its presence in reaching better job opportunities.

The mentioned inter-group and intra-group competition and solidarity dynamics cause the formation of two new clusters. Subgroup 2.1.1.2.2.1 is defined by a relatively lower indigenous population and number of companies (≤ -0.16). The community formed by indigenous people brings with it new cultural dynamics that can affect social harmony and resource distribution. In municipalities where economic resources are more restricted, indigenous peoples will face particular obstacles in accessing employment, education and public resources. In other words, as the competition between groups deepens, the intensity of intra-group competition will increase. It is seen that indigenous peoples are affected more by this situation, as it is determined as a determining factor. The group (sub-group 2.1.1.2.2.2) located in the municipalities of Cotia and São Caetano do Sul, where the interaction of the indigenous population and the total number of companies and other organizations is relatively higher, draws an opposite profile. Although indigenous peoples face specific social and cultural difficulties, they coexist with other individuals in a relatively more developed economic environment. The fact that the indigenous population is decisive in these groups indicates that solidarity issues may also include cultural needs in particular.

A new division (Sub-group 2.1.1.2.2.1.1), the child-to-elderly ratio and the number of permanent private households with no connection to the general network interaction ≤ -0.53 occurs. In Ribeirão Pires and Taboão da Serra, the resident group is more faced with infrastructural problems for basic needs. It also has a more aging character. Thus, it is inevitable to face more economic and social problems in the future. The individuals of this group, especially the elderly and the indigenous people, are in competition with each other and with the peer group for basic needs. If we talk about a possibility of solidarity, it can be considered that this will be in line with access to basic resources and improving living conditions. Infrastructure deficiencies also bring additional obstacles to economic development. Social mobility is quite restricted, the possibilities to build a healthy social fabric are limited, and the peer group, Sub-group 2.1.1.2.2.1.2, has a younger population compared to the peer group. Even if this indicator is evaluated positively in terms of the future of the group, the increase in the amount of access to basic services of household rights shows that fewer resources are accessed than the peer group. The character of the group is shaped by a more balanced generational structure with a future workforce despite more infrastructural challenges.

As always, the increase in the power of competition has led to the emergence of new clusters as a result of the competition of the solidarity networks built by individuals within the group. The determinant of this new cluster is the interaction of child-to-elderly ratio, education level and life expectancy. Six municipalities, Mairiporã, Mauá, Itapecerica da Serra, Suzano, Arujá and Embu das Artes (sub-group 2.1.1.2.2.1.2.1.) form a new structure where child_to_elderly ratio and education level <= 0.83. On the other hand, the structure consisting of Itaquaquecetuba and Santana de Parnaíba (sub-group 2.1.1.2.2.1.2.2.) appears where these values are above the threshold value of 0.83. The nuance between these two groups is the relative young or oldness of the population structure and the average level of education of individuals is low or high. Competition is given to access educational resources, and therefore future job opportunities. It can be said that the group with a relatively old population and a lower level of education is disadvantaged especially in accessing economic resources.

Mairiporã, Mauá, Itapecerica da Serra, Suzano, Arujá and Embu das Artes (sub-group 2.1.1.2.2.1.2.1.) then undergoes a division again. In this division, child_to_elderly_ratio and life_expectancy are again determining factors. The resident group in Mairiporã and Mauá (sub-group 2.1.1.2.2.1.2.1.1.) which is below the threshold value of -0.16, is in competition with the resident population in the municipalities of Itapecerica da Serra, Suzano, Arujá and Embu das Artes (sub-group 2.1.1.2.2.1.2.1.2.) which is above this threshold value. Low life expectancy indicates significant constraints in access to resources, especially health services. These municipalities, where intra- and inter-group competition is at its most intense, host individuals exposed to marginalization. The social fabric is quite fragmented, social mobilization is limited or even prevented at the highest level.

Itapecerica da Serra and Suzano (<= -0.01) versus Arujá and Embu das Artes (> -0.01) contains the most disadvantaged groups within the metropolitan system. This deepest division is determined by the ratio of the child population to the elderly population, as well as the health expenditures per capita. In both clusters, it can be expected that the vulnerable population, such as children and the elderly, will be much more affected by the difficulties in accessing health services. The competition for health expenditures, which is an important factor for survival, will be at the highest level.

On the layers where competition is not so strong, there is the subgroup 2.1.1.2. This group has higher birth rates and relatively controllable elderly dependency ratios (> -0.09) compared to its peers. Carapicuíba, Mogi das Cruzes, and Santo André are home to this group. These areas have a more balanced demographic structure. The stress created by the presence of an elderly population is lighter and birth rates are healthier. When the labor force potential is considered, it presents a healthier profile. The pressure on health and social services seems to be more manageable. From this perspective, it can be said that the chance of accessing these resources is higher for individuals. In other words, the intensity of the competition between individuals is lighter. The potential young population resulting from relatively high birth rates also promises a future for economic continuity and urban development. This also means a more dynamic labor market. In addition, it can be predicted that this dynamism will create competition in accessing job opportunities. Other areas of competition will be education, health and other public services, and housing. Solidarity within the community will also take shape in line with the goal of accessing the resources mentioned. As a result, it can be said that competition within and between groups will be more about positioning individuals and the group at higher points in the social hierarchy rather than being about survival.

When we go to the upper levels of social stratification, we come across a group with a larger working-age population and a higher population density (> 0.10) within the borders of Diadema and Osasco. As a result of the competition between the groups, it is expected that in addition to the profile it has, there will also be competition within the group for job opportunities and housing. The increase in working-age members will bring with it an increase in the labor force participation rate. This will also cause an increase in the need for housing. Thus, group members will find economic and social challenges before them.

The mentioned dynamics will also cause an increase in the rate of urbanization. The competition in obtaining job opportunities may accelerate for jobs that require higher wages and more skilled individuals. In order to access such jobs, the level of education and the distribution of resources that will increase this level are important. There is also stratification in the workforce in line with the differences in education levels and the jobs obtained in line with these differences. Individuals with a higher level of education will compete for more stable and higher-wage jobs, while individuals with a lower level of education will compete for lower-wage jobs.

The housing market is also affected by the increase in urban density. Competition for housing will increase property prices and rents. Thus, the reflection of socio-economic characteristics will be spatial segregation. Individuals with low wages will settle in less desirable areas compared to others. However, individuals with access to high wages will have easier access to urban services, infrastructure and facilities in addition to the advantageous areas they settle in. In addition to competition, solidarity for the group is also inevitable. Individuals will build professional and social networks and use these tools to improve their own positions. This solidarity is important in overcoming the obstacles encountered in accessing housing, work and urban services.

4.2.1.2.2 Subgroup 2.2

On higher levels of stratification, subgroup 2.1. is separated by subgroup 2.2, where both the child-to-elderly ratio and the arts, culture, sport, and recreational sectors are more prominent (> 0.00). This group can reach more dynamic sectors with a younger population structure. The diversity in the mentioned sectors plays an important role in determining the social and economic structure of the group by increasing the interaction between individuals.

With the increase in interaction between individuals, both competition and solidarity are encouraged. Activities that increase in direct proportion to the sectors support the construction of society on the axis of cultural production and consumption. Solidarity will be between local governments, various organizations, and communities within the framework of these activities. Thus, the increase in social harmony is inevitable. On the other hand, cultural capital also forms the axis of competition in this subgroup. The further accumulation of this capital in certain individuals and subgroups again brings about separation between individuals and groups.

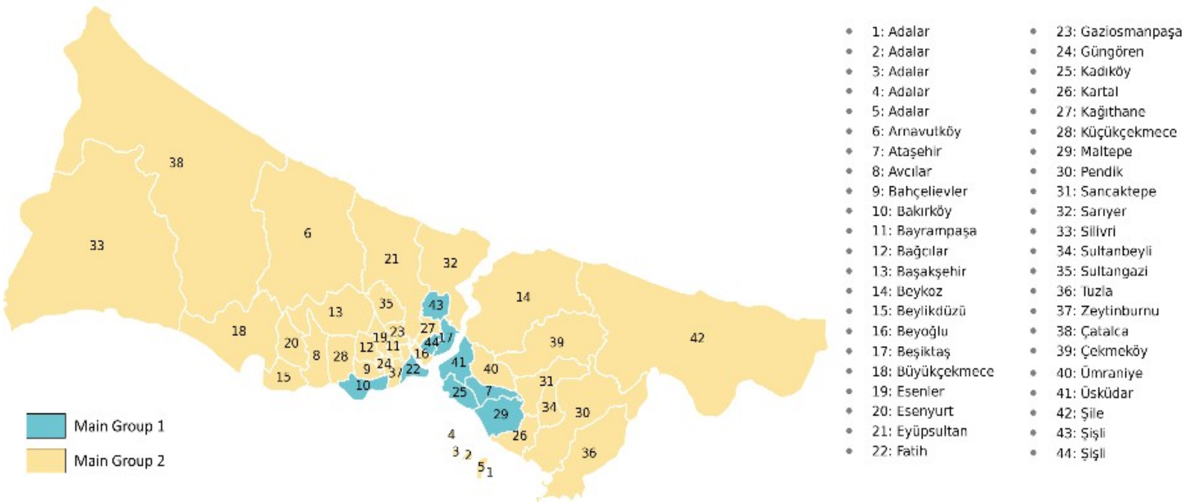
Guarulhos and São Bernardo do Campo (sub-group 2.2.1.) are distinguished from São Paulo and Barueri (sub-group 2.2.2.) by the decrease in health expenditures per capita and the population structure (<= 0.27). Although the cultural environment supports social cohesion, lower access to health resources may pose relative obstacles to this group, especially for children and the elderly. Thus, the competition for access to these resources will increase in line with the population growth.

On the other hand, the group settled in Barueri and São Paulo seems to have relatively more advantage. Nevertheless, competition can be expected within this group, especially in accessing higher quality health services. Although health expenditures are relatively higher, intra-group competition can be observed in terms of balanced distribution.

4.2.2 Social groups in Metropolitan Istanbul

According to the analysis with an R^2 value of 89,4038, two main groups, four subgroups under them in the first layer, and four subgroups under these four groups in the second layer were determined. The main point of distinction is based on the elderly dependency rate and the number of clinics variables. Those whose values are below -0.19 from the interaction of these two variables constitute one group, and those whose values are above constitute the other group.

Figure 64 – Main groups in Istanbul



Source: Author, 2025.

The first main group (Figure 64) is located in districts where elderly dependency and access to health services are relatively higher. The first distinction within this group is made according to the number of female births and the rate of people receiving social assistance. Districts where these variables are lower than -0.43 constitute Subgroup 1.1. The distinction within this subgroup is made with the variables of literacy rate and health facility area per capita.

Those below 0.48 (Subgroup 1.1.1) include districts such as Beşiktaş and Kadıköy, while those above 0.48 (Subgroup 1.1.2) include Bakırköy and Şişli. Districts with a female birth rate and a social assistance rate above -0.43 are grouped in Subgroup 1.2. This group is divided according to the rate of single-person households and the rate of male population with primary school education. Districts where these two variables are below 0.13 (Subgroup 1.2.1) include Ataşehir and Üsküdar, while those above 0.13 (Subgroup 1.2.2) include districts such as Fatih and Maltepe.

The second main group shows lower elderly dependency rates and reaches less clinics. The first distinction in this group is made according to the married population rate and the homeowner-tenant ratio. Districts where these rates are below -1.46 are included in Subgroup 2.1. This group is divided within itself according to the average length of residence variable. Districts with an average length of residence below -1.72 (Subgroup 2.1.1) include districts with shorter-term settlement dynamics such as Beykoz, Beylikdüzü and Beyoğlu. If the length of residence is above this threshold value (Subgroup 2.1.2), districts with more permanent settlement patterns such as Adalar and Sarıyer are included.

Table 16 - Groups and their municipalities in Metropolitan Istanbul

Municipality	Main group	First level subgroup	Second level subgroup
Beşiktaş	1	1.1	1.1.1
Kadıköy	1	1.1	1.1.1
Bakırköy	1	1.1	1.1.2
Şişli	1	1.1	1.1.2
Ataşehir	1	1.2	1.2.1
Üsküdar	1	1.2	1.2.1
Fatih	1	1.2	1.2.2
Maltepe	1	1.2	1.2.2
Beykoz	2	2.1	2.1.1
Beylikdüzü	2	2.1	2.1.1
Beyoğlu	2	2.1	2.1.1
Adalar	2	2.1	2.1.2
Sarıyer	2	2.1	2.1.2
Arnavutköy	2	2.2	2.2.1
Çatalca	2	2.2	2.2.1
Esenler	2	2.2	2.2.1
Şile	2	2.2	2.2.1
Silivri	2	2.2	2.2.1
Sultanbeyli	2	2.2	2.2.1
Sultangazi	2	2.2	2.2.1
Avcılar	2	2.2	2.2.2
Bağcılar	2	2.2	2.2.2
Bahçelievler	2	2.2	2.2.2
Başakşehir	2	2.2	2.2.2

Table 16 - Groups and their municipalities in Metropolitan Istanbul - continues

Municipality	Main group	First level subgroup	Second level subgroup
Bayrampaşa	2	2.2	2.2.2
Büyükçekmece	2	2.2	2.2.2
Çekmeköy	2	2.2	2.2.2
Esenyurt	2	2.2	2.2.2
Eyüpsultan	2	2.2	2.2.2
Gaziosmanpaşa	2	2.2	2.2.2
Güngören	2	2.2	2.2.2
Kağıthane	2	2.2	2.2.2
Kartal	2	2.2	2.2.2
Küçükçekmece	2	2.2	2.2.2
Pendik	2	2.2	2.2.2
Sancaktepe	2	2.2	2.2.2
Tuzla	2	2.2	2.2.2
Ümraniye	2	2.2	2.2.2
Zeytinburnu	2	2.2	2.2.2

Source: Author, 2025.

Municipalities with a married population rate and a homeowner-tenant rate above -1.46 constitute Subgroup 2.2. This group is divided into two according to the single-person household rate and the male population rate with a master's degree. Districts with these two variables below -0.55 (Subgroup 2.2.1) include peripheral districts such as Şile, Arnavutköy, Çatalca and Silivri. The municipalities where these variables are above -0.55 (Subgroup 2.2.2) are the central and semi-central districts of Istanbul with more dense and complex social texture such as Çekmeköy, Güngören, Tuzla, Bayrampaşa, Zeytinburnu, Avcılar, Büyükçekmece, Eyüpsultan, Kağıthane, Kartal, Gaziosmanpaşa, Sancaktepe, Bağcılar, Esenyurt, Pendik, Küçükçekmece, Ümraniye, Bahçelievler and Başakşehir.

4.2.2.1 Main group 1

This group is formed when the combination of the elderly dependency rate and the number of health clinics accessible by individuals exceeds the threshold of -0.19. It covers the municipalities where the elderly population, which needs the support of the working class in terms of dependency, is more settled. While the correlation coefficient between the elderly dependency rate and the number of clinics is 0.40, the health facility area per capita is 0.36. These values show the success of this group, defined by the relatively high presence of the elderly population, and the individuals who form it in obtaining these resources. This success is also supported by the correlation with the population per family physician (-0.29). Although with a low coefficient, the group has more access to health services. Thus, the group draws a relatively more stable portrait.

The correlations with the population growth rate (-0.14), child population (0.66) and birth rate (-0.66) are evidences of the out-migration of the young population. This may be due to the strategic relocation of individuals and families with children to municipalities with higher economic potential. Or, individuals constituting this population segment do not move to these areas in the first place. In addition, the negative correlations with the child dependency ratio (-0.83) and nuclear families with children (-0.59) also indicates a decrease in the number of young members of the group. Thus, the age imbalance among the group members becomes even more apparent.

According to the correlations, the annual average income (0.61) is higher in the municipalities that make up this group. At the same time, a negative correlation (-0.33) is observed with house sales. When these two values are considered together within the framework of the cost of living, it is seen that low-income individuals and families are prevented from settling in these areas. This situation indicates the existence of economic stratification both within the area where the group is settled and compared to the areas belonging to the other group. In addition, the negative correlations with total household numbers (-0.38) and water consumption (-0.41) indicate that individuals and extended families in the low-income group cannot be included in this group. This situation makes urban segregation even more evident. This clarity further contributes to the alienation of individuals seeking economic growth and family life. The negative correlation with the number of married populations (-0.46) is another indicator of this.

Other clues to the low presence of young group members are the negative correlations between the old dependency ratio and primary and secondary education levels for both males and females. These correlations are due to the tendency for families with relatively young individuals with school-age children to be left out of the group or to be left out. However, the positive correlations with females with master's degrees (0.37) and doctorate degrees (0.49) suggest the existence of pockets that contribute to stratification. Because access to higher-paying jobs is limited to individuals with higher degrees, individuals with lower incomes will face even greater barriers.

Table 17 - Main group profiles in the Metropolitan Istanbul according to the most determining indicators

	1	2
Population	3006498	12455954
Area	237	5224
Female population	1554292	6157324
Male population	1452206	6298630
Married population	1339478	5226426
Number of births	26801	165869
Number of deaths	20771	55636
Child population	568924	3372674
Elderly population	372429	765181
Number of households	1043132	3553287
Single person household	267728	557729
Primary school female	196472	1000527
College female	377762	852535
Masters degree female	70646	83536
Primary school male	126698	656398
Secondary school male	178184	1082933
Masters degree male	69471	101284
Higher education total	897376	1932022
Number of clinics	4806	1783
Number of medical centers	103	143
Social assistance recipients	60668	405084
Population registered other cities	1406878	6111685
Population registered Istanbul	1409284	5737154
Foreign population	160668	814623
Population density	12685,646	2384,371

Table 17 - Main group profiles in the Metropolitan Istanbul according to the most determining indicators - continues

	1	2
Gender ratio	0,934	1,023
Birth to death ratio	1,290	2,981
Population growth rate	-25,994	2,210
Child dependency ratio	22,295	32,870
Elderly dependency ratio	18,993	9,520
Average household size	2,767	3,414
Literacy ratio	98,647	98,210
Annual average income	159953,975	78255,818
Health facility area per capita	0,916	0,232
Homeowners to tenants ratio	1,105	1,119
Average duration of residence	12,317	11,238

Source: Author, 2025.

As the old dependency rate increases, the foreign population decreases (-0.39). The fact that the municipalities where the group settles do not attract foreign populations can be interpreted as the exclusion of some immigrants in the intra-group conflict, and it will also contribute to the homogeneity within the group. The relative low foreign population can be attributed to the inadequacy of economic opportunities for immigrants and the high cost of living. The negative correlation with population density (-0.23) is also an indicator of the limited diversity of group members.

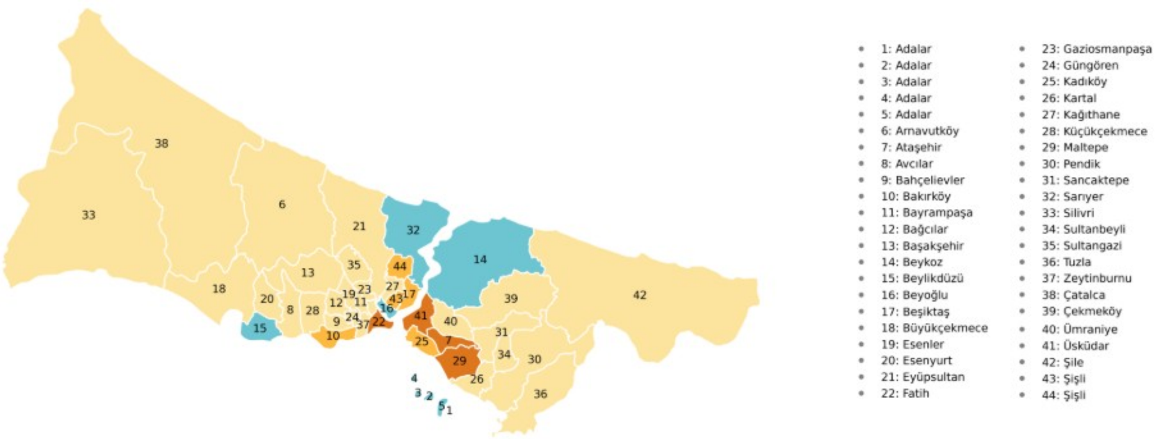
In conclusion, the factors mentioned above suggest demographic, social and economic separation between the municipalities that make up this group and the others. The struggle that initially takes shape between the old population and the young population deepens with socio-economic status, age, education, family structure and educational status. While individuals who follow successful strategies maintain their positions, others follow different strategies as part of the struggle and either choose pockets within these municipalities or other municipalities.

4.2.2.1.1 Subgroup 1.1

The determinants of the first level subgroups (Figure 65) are female birth number and social assistance recipients. The correlation coefficient between these two variables is 0.96 in the positive direction. Municipalities with values lower than or equal to the -0.43 threshold value are included in this group.

In order to reveal the general profile of this group compared to the peer subgroup 1.2, the correlation values between the data can be used. There is a strong positive correlation between the number of girls born and demographic data such as the total number of births, male births and child population. These values show that the population size directly affects birth rates in general, but most births in this group are male-dominant. Other data supporting this interpretation are the strong correlation encountered with female population, male population and nuclear families with children.

Figure 65 – First level subgroups

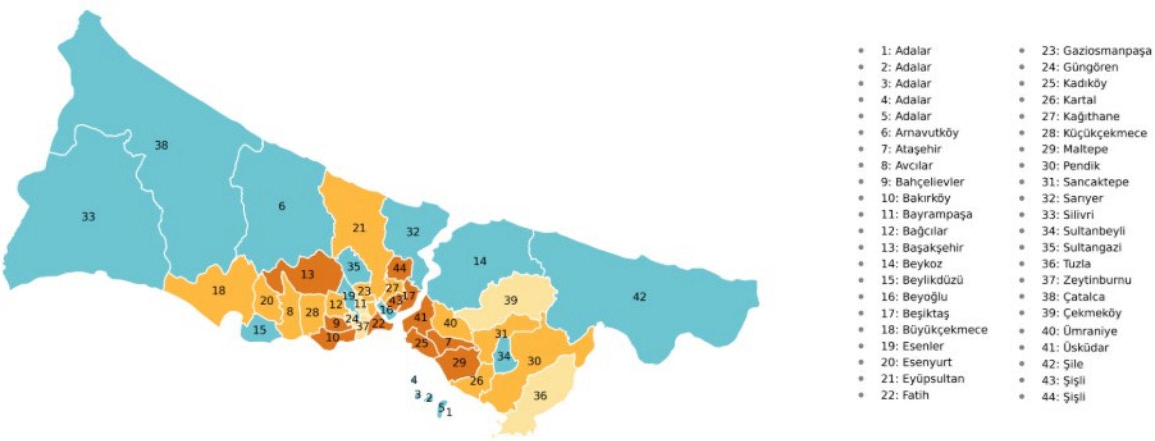


Source: Author, 2025.

However, a non-significant relationship of 0.08 was detected between the girls born and the sex ratio. This shows that the gender balance within the group is disrupted, the male population is more dominant and therefore family structures are also affected by this imbalance. Although there is a strong relationship between the number of girl births and social assistance recipients, the negative correlation of -0.37 between income level and annual average income is interesting. This relationship means that more individuals in the group need these aids than those who currently receive social assistance. Finally, the weak relationship between the number of births and health and housing resources shows that the group has limited opportunities to access these resources. When considered due to the upper group it belongs to, the elderly dependency ratio with a value of -0.66 is an important data in this group where girl births are relatively low. The increase in the elderly population means that the inadequacy of the young population means that the population structure is unbalanced, while the elderly population causes pressure on economic and social resources, it is understood that the young population that will alleviate this pressure has not joined the group with low fertility.

On the one hand, low birth rates indicate a partial increase in the chance of accessing urban resources such as education and career, while on the other hand, the relative decrease in dependency on social assistance indicates an increase in the economic adequacy of individuals and the amount of resources they collect. Thus, it can be said that this subgroup is characterized by a higher social status than its peers. Beşiktaş, Kadıköy, Bakırköy, and Şişli are the components of the subgroup.

Figure 66 – Second level subgroups



Source: Author, 2025.

Within this cluster, subgroup 1.1.1. with Beşiktaş and Kadıköy (Figure 66) are distinguished by relatively lower literacy rates and smaller healthcare facility areas per capita (threshold: <= 0.48). It can be thought that the density of buildings and commercial land uses resulting from their central locations cause a decrease in the number of healthcare facility areas per capita. It is likely that public healthcare institutions are being replaced by private healthcare institutions or that existing facilities only serve the local population. Although they are relatively more socio-economically developed municipalities, the fact that their literacy rates are low indicates the presence of foreign immigrants.

Bakırköy and Şişli (subgroups 1.1.2.) exceed the threshold value of 0.48 in terms of the mentioned characteristics. This subgroup draws a profile opposite to the previous one. The relatively high number of health facility areas per capita may indicate that services are provided to individuals other than the local population. This situation may also be due to the health service needs arising from the slightly older age of the resident population. The high literacy rates may be due to hosting fewer immigrants or greater access to educational resources.

As a result, these contrasts between the same subgroup show that social stratification can occur even within groups with common values. Beşiktaş and Kadıköy reflect the results of educational inequalities and draw a more heterogeneous profile. Bakırköy and Şişli, on the other hand, host a more homogeneous group, while this group has access to more urban resources. Thus, it is seen that intra-group competition occurs between these two groups in obtaining resources.

When subgroup 1.1 is examined in general, it can be said that low birth rates and economic stability are related to urban concentration. This group consists of more high-income individuals who prioritize professional life over traditional family life compared to other groups with whom it competes within the metropolitan area. However, even within the group, there are divisions arising from the intra-group struggle for obtaining education and health resources. While individuals with high incomes choose areas where service quality is better, others may face exclusion as a result of this competition for space. Ultimately, intra-group and inter-group competition results in segregation, which is a determinant of social and economic mobility both in Istanbul as a whole and within the borders of the above-mentioned municipality.

4.2.2.1.2 Subgroup 1.2

The second subgroup is determined by higher female birth rates exceeding the value of -0.43 and a greater number of social assistance recipients (Table 18). At this point, higher birth rates may be the result of a traditional family structure, or they may result in women having less access to educational and professional career resources. However, greater dependence on social assistance is also a reflection of the fact that individuals in this group struggle with relatively more severe economic difficulties. In this case, the tendency to form a family can be evaluated as a reflection of in-group solidarity as a strategy. This solidarity is aimed at meeting basic needs for survival. On the other hand, the competition to access limited resources maintains its intensity.

Table 18 - First level subgroup profiles in the Metropolitan Istanbul according to the most determining indicators

	1.1	1.2	2.1	2.2
Population	1151518	1854980	1189409	11266545
Area	109	128	546	4678
Female population	616707	937585	597835	5559489
Male population	534811	917395	591574	5707056
Married population	506200	833278	23173	5203253
Number of births	8446	18355	12121	153748
Number of deaths	9284	11487	6413	49223
Child population	182392	386532	272978	3099696
Elderly population	186080	186349	103599	661582
Number of households	441760	601372	372252	3181035
Single person household	134078	133650	72550	485179
Primary school female	58973	137499	87261	913266
College female	184670	193092	109821	742714
Masters degree female	40624	30022	14874	68662
Primary school male	36124	90574	58347	598051
Secondary school male	51033	127151	86079	996854
Masters degree male	38468	31003	16248	85036
Higher education total	445014	452362	254787	1677235
Number of clinics	3848	958	284	1499
Number of medical centers	62	41	22	121
Social assistance recipients	15605	45063	27982	377102
Population registered other cities	520800	886078	527098	5584587
Population registered Istanbul	547950	861334	592542	5144612
Foreign population	43697	116971	47631	766992
Population density	10564,38	14492,03	2178,405	2408,411
Gender ratio	0,867	0,978	0,990	1,027
Birth to death ratio	0,910	1,598	1,890	3,123
Population growth rate	-19,509	-30,020	-5,428	3,016
Child dependency ratio	18,790	23,949	27,073	33,380

Table 18 - First level subgroup profiles in the Metropolitan Istanbul according to the most determining indicators - continues

	1.1	1.2	2.1	2.2
Elderly dependency ratio	23,977	14,017	12,514	9,051
Average household size	2,501	2,962	3,106	3,449
Literacy ratio	99,143	98,339	98,393	98,190
Annual average income	197469,347	136665,516	113725,712	74511,261
Health facility area per capita	1,562	0,515	0,214	0,234
Homeowners to tenants ratio	1,229	1,014	1,002	1,133
Average duration of residence	11,682	12,711	15,084	10,832

Source: Author, 2025.

Sub-group 1.2.1 consists of the municipalities of Ataşehir, Üsküdar, Fatih, and Maltepe. Within this cluster, Ataşehir and Üsküdar are distinguished by lower proportions of single-person households and men with only primary education (threshold: <= 0.13). Values below this threshold cause a relative excess of family-centered individuals. In addition, it can be said that the group is dominated by middle-income individuals (Table 19).

Although the residents with only primary education sub-group is low compared to other municipalities, it should not be forgotten that it is higher than other economically disadvantaged groups. While the institution of marriage can be seen as a strategy for solidarity, the low number of single-person households can also be evaluated as individuals being successful in their struggle to access economic and social resources that can support their family structure. The dominance of family structures within the group will also lead to tighter social networks. Less access to educational resources also complicates the struggle for quality employment opportunities. Fatih and Maltepe (sub-group 1.2.2.) draw a different profile with higher proportions of single-person households and men with only primary education (threshold: > 0.13). It can be said that settled individuals in these areas generally face more socio-economic challenges. The increase in the number of single-person households indicates a more transient population and a population deprived of the opportunities to support the family institution. This deprivation is due to economic pressures and educational inequality. Fatih and Maltepe host more individuals from the working class. Upward mobility for individuals is restricted (Table 19).

Table 19 - Second level subgroup (1.1.1 to 1.2.2) profiles in the Metropolitan Istanbul according to the most determining indicators

	1.1.1	1.1.2	1.2.1	1.2.2
Population	658496	493022	943365	911615
Area	43	66	60	68
Female population	359357	257350	481988	455597
Male population	299139	235672	461377	456018
Married population	296690	209510	440396	392882
Number of births	4493	3953	9396	8959
Number of deaths	5654	3630	5330	6157
Child population	94783	87609	203926	182606
Elderly population	121702	64378	89761	96588
Number of households	265137	176623	302559	298813
Single person household	82083	51995	61016	72634
Primary school female	29380	29593	66782	70717
College female	120360	64310	107533	85559
Masters degree female	28757	11867	17790	12232
Primary school male	15819	20305	42374	48200
Secondary school male	23683	27350	62714	64437
Masters degree male	27292	11176	18130	12873
Higher education total	294900	150114	253582	198780
Number of clinics	1596	2252	573	385
Number of medical centers	27	35	23	18
Social assistance recipients	5672	9933	21992	23071
Population registered other cities	307251	213549	458049	428029
Population registered Istanbul	308146	239804	452564	408770
Foreign population	17892	25805	16665	100306
Population density	15313,860	7470,030	15722,750	13406,100
Gender ratio	0,832	0,916	0,957	1,001
Birth to death ratio	0,795	1,089	1,763	1,455
Population growth rate	-10,265	-31,857	-14,236	-46,353
Child dependency ratio	17,175	20,538	24,832	22,963
Elderly dependency ratio	26,783	18,672	13,360	14,627
Average household size	2,390	2,669	3,027	2,897
Literacy ratio	99,383	98,823	98,427	98,248

Table 19 - Second level subgroup (1.1.1 to 1.2.2) profiles in the Metropolitan Istanbul according to the most determining indicators - continues

	1.1.1	1.1.2	1.2.1	1.2.2
Annual average income	208292,624	183013,430	150170,817	122689,847
Health facility area per capita	0,664	2,761	0,675	0,350
Homeowners to tenants ratio	1,398	0,974	0,975	1,053
Average duration of residence	10,412	13,377	13,104	12,305

Source: Author, 2025.

It is likely that settled individuals use informal support networks and social assistance as supportive tools in their struggle. Due to limited access to education and employment opportunities, in-group solidarity is limited to family and close social networks rather than professional networks, while competition is relatively fierce.

As a result, socio-economic segregation is also seen within subgroups 1.2. While Ataşehir and Üsküdar provide upward mobility for the middle class, more individuals are trapped in the working class in Fatih and Maltepe. This situation is a reflection of the fact that individuals settled in Fatih and Maltepe can obtain fewer job and education opportunities as a result of their struggle. The high number of those in need of social assistance can also lead to the stigmatization of these individuals within the group. Although the groups settled in the municipalities mentioned above have more resources than other municipalities in Istanbul, spatial segregation of advantaged and disadvantaged individuals within the group is possible.

4.2.2.2 Main group 2

The second main group consists of municipalities with lower elderly dependency ratios combined with fewer healthcare clinics equal to or below the threshold of -0.19. It has a demographic profile with relatively more young and working-age individuals. The negative correlations of the elderly dependency ratio variable with total population (-0.54), female population (-0.51), and male population (-0.56) support this profile. Areas with lower elderly dependency ratios tend to have higher young populations. In addition, the positive correlation between elderly dependency ratio and clinic numbers (+0.40) suggests that the municipalities in this group host fewer health clinics than the first group.

The positive correlation between the elderly dependency ratio and the annual average income (0.61) shows that, unlike the previous group, individuals in the group dominated by the young population have lower incomes on average. In addition, as the young population increases, the number of births, child population, and child dependency ratio also increase. Thus, individuals in this group compete in job opportunities, education, and housing. It can be expected that these areas, where more working-age populations settle, offer more economic opportunities. Therefore, individuals who cannot be included in the first group due to economic reasons constitute this group and its subgroups.

The negative correlations between the total number of households (-0.39) and the average household size (-0.86) and the elderly dependency ratio indicate that the preferences of this group create household rights that accommodate more individuals compared to the first group. This means that young individuals prioritize relatively larger households when they have sufficient opportunities. This may indicate a solidarity strategy that begins with the family. The increase in household sizes is also confirmed by water consumption amounts.

As the elderly dependency rate increases, the decrease in housing sales (-0.33) means that sales will increase as the young population increases, and vice versa, so it is possible to say that the housing market is more active in the areas where this group settles. Thus, it is possible to say that the competition between individuals within the group is shaped around obtaining affordable housing that will guarantee shelter and long stays. As the elderly dependency rate decreases, the population density also increases. For this reason, it can be understood that the areas where this group settles have higher densities. In addition to a dynamic housing market, high densities support that intra-group competition between in-groups and sub-groups is about affordable housing.

Again, unlike the first group, due to the correlations between the elderly dependency ratio and primary education (-0.69 for males, -0.68 for females) and secondary education (-0.67 for males, -0.64 for females), it can be said that there is a strong presence of individuals subject to formal education in this group. At the same time, these values are also indicators of competition among individuals in accessing educational opportunities. It can be assumed that economic obstacles or infrastructural deficiencies have intensified this competition. The correlations between higher education (higher education female: +0.08, higher education total: +0.04) and the elderly population show that this group, dominated by young people, cannot include highly educated individuals to a considerable extent.

The negative correlation between the elderly dependency rate and social assistance recipients (-0.63) indicates that municipalities with a lower number of elderly individuals are more dependent on social assistance. It is possible to say that this is due to the economic difficulties faced by low-income young individuals who have recently joined the competition. The increase in the demand for social assistance can be associated with the more intense intra-group and in-group competition in obtaining various urban resources. As the young population increases, private vehicle ownership also decreases. Although this situation is manifested by a weak correlation coefficient, it still shows the trend of dependency on public transportation. Dependency on public transportation also shows that individuals' movements, which are an important factor in reaching jobs and services, are restricted. This restriction further worsens inequality.

As the elderly dependency rate decreases, the number of people per family doctor also increases. When health services are considered as a resource, the relative lack of clinics and doctors obtained by the group indicates that it is at a disadvantage in the competition with the first main group. Access to limited health services is also supported by the weakness of the negative correlation (-0.21) between the elderly dependency rate and emergency medical service stations. Thus, it is possible to say that this group is at a disadvantage in terms of health services compared to the first main group, while it is also possible to infer that the young population needs less service.

As a result, this second main group, which has a younger demographic profile compared to the first main group, is engaged in intra-group and in-group competitions that are intense around health, housing, job opportunities and education. It is possible to say that the competition is more intense due to its dynamic structure compared to the first group, also based on the abundance of resource types that are competed. For this reason, it is seen that more sub-groups are formed within the group. The spatial separation between the first group becomes more diverse within the group.

4.2.2.2.1 Subgroup 2.1

Under sub-group 2, a lower number of married individuals combined with a lower homeowners-to-tenants ratio is formed by municipalities with values equal to or less than the threshold of -1.46. A negative correlation of 0.22 was found between the number of married individuals and the ratio of home-ownership to tenancy. Thus, it can be interpreted that home-ownership decreases slightly as the number of married individuals increases. The population consisting mostly of single individuals and tenants is the profile of this sub-group. A population that is frequently on the move with a dynamic housing market means lower residential stability. This situation causes social ties to not be strengthened. Beykoz, Beylikdüzü, Beyoğlu, Adalar, and Sarıyer have this profile.

The profile of the group can be understood more deeply by considering the correlation values between the variables. In this group where the marriage rate is lower than the peer group, although there is a high correlation with the total female population and male population, the gender ratio has a value of -0.04, which suggests that the gender balance does not have a significant effect on marriage decisions. The fact that there are more single individuals in this group compared to the general population is also supported by the relationship between these variables. This low number of marriages is also related to the total births and child population. However, this relationship should be weaker due to the decrease in the number of married couples. In addition, the number of deaths is significantly affected with a value of 0.73. It can be said that the number of births and deaths fluctuates less among unmarried individuals. With the decrease in the marriage rate, a decrease in the number of nuclear families, families with children and an increase in the number of single-parent families, single-person households and extended families should be expected. The negative correlation of -0.19 with the annual average income indicates a slightly lower income level in the group where the number of married couples is low. However, groups where the number of marriages decreases have more individuals benefiting from social assistance (0.81). Some of the unmarried individuals need more economic support if they establish a household on their own.

In this group, where the number of married individuals is low compared to the peer group, the ratio between home ownership and renters shows a negative correlation of 0.34. Thus, it is understood that singles either have difficulties in acquiring property or do not prefer to acquire property. As a result, unmarried individuals generally live in rented houses and have a mobile profile. In addition to personal preferences, relatively low income levels and the decrease in marriages may reduce the possibility of home ownership. Both women and men are affected by these difficulties. While the homeowner-renter ratio and the gender ratio show a weak and positive correlation of 0.16, the female and male populations show a negative correlation of 0.34. This situation reflects the difficulties of women in this regard, as well as men. These values also indicate gender inequality. In addition, the rates of nuclear families and single-parent households in the group also appear low. Thus, it can be said that unmarried individuals are generally in relatively unstable household structures. This situation also reduces the capacity to acquire property. Finally, it has been observed that the education levels of individuals in the group, especially women, are generally low. Lack of education naturally restricts upward mobility and limits access to economic opportunities.

Table 20 - Second level subgroup (2.1.1 to 2.2.2) profiles in the Metropolitan Istanbul according to the most determining indicators

	2.1.1	2.1.2	2.2.1	2.2.2
Population	838078	351331	1936885	9329660
Area	358	188	3311	1367
Female population	420267	177568	933465	4626024
Male population	417811	173763	1003420	4703636
Married population	383	22790	906016	4297237
Number of births	9068	3053	29420	124328
Number of deaths	4569	1844	8442	40781
Child population	201842	71136	580112	2519584
Elderly population	68004	35595	103594	557988
Number of households	257288	114964	501369	2679666
Single person household	47486	25064	64072	421107
Primary school female	62505	24756	184922	728344
College female	72217	37604	80135	662579
Masters degree female	8004	6870	4217	64445
Primary school male	40996	17351	131425	466626
Secondary school male	62514	23565	206846	790008

Table 20 - Second level subgroup (2.1.1 to 2.2.2) profiles in the Metropolitan Istanbul according to the most determining indicators - continues

	2.1.1	2.1.2	2.2.1	2.2.2
Masters degree male	9437	6811	7005	78031
Higher education total	165163	89624	183127	1494108
Number of clinics	221	63	140	1359
Number of medical centers	12	10	16	105
Social assistance recipients	21130	6852	75171	301931
Population registered other cities	368018	159080	982876	4601711
Population registered Istanbul	418924	173618	911939	4232673
Foreign population	38909	8722	130432	636560
Population density	2341	1868,78	584,98	6824,91
Gender ratio	0,994	0,979	1,075	1,017
Birth to death ratio	1,985	1,656	3,485	3,049
Population growth rate	5,294	-31,005	14,949	0,539
Child dependency ratio	28,50	23,01	37,39	32,45
Elderly dependency ratio	11,45	14,54	9,72	8,92
Average household size	3,173	2,958	3,743	3,39
Literacy ratio	98,3	98,48	97,79	98,27
Annual average income	94057,25	160643,5	51540,18	79280,17
Health facility area per capita	0,181	0,293	0,194	0,242
Homeowners to tenants ratio	0,858	1,325	1,302	1,101
Average duration of residence	13,462	18,954	13,299	10,319

Source: Author, 2025.

Beykoz, Beylikdüzü and Beyoğlu (subgroup 2.1.1) are distinguished from Adalar and Sarıyer by relatively lower marriage rates and the average duration of residence (threshold: <= -1.72). The population of these three municipalities is characterized by younger individuals, unmarried households, or new migrants. The shorter duration of individuals living in their current residences, in other words, the more frequent movement, draws attention to the fluidity of the housing market, the determinant nature of rents, and the nature of the job held. This situation, in turn, creates obstacles to the establishment of strong social ties and networks. Thus, the necessary conditions for in-group solidarity are not created. On the other hand, the dynamics mentioned can also be evaluated as reflections of intense in-group and intra-group competition at the metropolitan area scale in access to affordable housing, jobs, and social services.

Competing for the same resources as this group (Table 20), Adalar and Sarıyer (subgroup 2.1.2.) have relatively higher marriage rates and longer average residential duration (>-1.72). This means that more individuals in the population constituting the group are married and spend relatively long periods in their current residence. The individuals in this relatively stable group will have the opportunity to develop stronger ties and therefore a social fabric among themselves. Thus, social harmony and in-group cooperation will take shape. It can be expected that the harmony and solidarity that the family institution contributes to the increase in its existence will reduce the intensity of in-group competition compared to subgroup 2.1.1. Group solidarity will also affect acting together against common threats and problems. As a result, Adalar and Sarıyer exemplify the role of the joint effect of the institution of marriage and residential stability in the formation of a more cooperative and less competitive group. Thus, it should be expected that social stratification will be seen at a lower level compared to the peer group.

4.2.2.2.2 Subgroup 2.2

This group, which has a more stable population where family units and home ownership are more common than subgroup 2.1., is defined by areas where the marriage rates and the homeownership-to-tenancy ratio together exceed the threshold value of -1.46. The municipalities where the group chooses to reside are characterized by long-term residents with more permanent housing arrangements. When the permanent accommodation that home ownership brings is considered together with the relatively high marriage rates, it can be predicted that this group will form stronger social ties. In-group cooperation among group members will be encouraged in this way. Stronger solidarity also means reduced individual competition.

Within this subgroup, municipalities where the rates of single-person households and males with master's degrees fall below the threshold value of -0.55 are also clustered (subgroup 2.2.1). In this group, the traditional family structure is relatively more dominant, and the number of male individuals with higher education is low among this group. This group, where family institution is preferred instead of education and career development, is more stable compared to other subgroups in the competition. It can also be said that there are relatively strong social ties. On the other hand, the low number of highly educated individuals confirms the economic obstacles against individuals. Individuals of the group have difficulty in accessing job opportunities and educational resources as a result of intense group competition.

Esenler and Sile (subgroup 2.2.1.1) have a different character in this group with female death and population growth values remaining below 0.31. Compared to Arnavutköy, Çatalca, Silivri, Sultangazi and Sultanbeyli, it draws a more stable and aging graph demographically. Relatively low female mortality may mean that individuals in the group have healthier living spaces or better health opportunities than their peers. This creates an added value in that households have better socio-economic conditions. In addition, low population growth rates indicate a relatively long-term resident population with lower influxes. This stability allows individuals to focus more on community relations and to build relatively stronger in-group solidarity. Stability also puts less pressure on the total resources that all groups in the subgroup compete for. In-group cooperation can also be expected to be milder than its peers.

On the other hand, Arnavutköy, Çatalca, Sultanbeyli, Silivri and Sultangazi (sub-group 2.2.1.2) together show a profile opposite to the above sub-group due to female death and population growth values exceeding the 0.31 threshold. This group, which has witnessed population expansion due to migration and urbanization, is also divided into two based on household size and male educational attainment.

With both the average household size and the numbers of males with master's degrees values, Arnavutköy, Çatalca, and Sultanbeyli (subgroup 2.2.1.2.1) with a threshold value of <= -0.91 and Silivri and Sultangazi (subgroup 2.2.1.2.2) with a threshold value of > -0.91 are also grouped among themselves. Arnavutköy, Çatalca, and Sultanbeyli have a structure where males with relatively lower levels of education are again formed by smaller households. This structure presents a profile that points to the influx of more mobile and smaller family structures, faced with economic constraints and early entry into the workforce. In contrast, Silivri and Sultangazi attract larger family structures established by men with relatively higher levels of education. As a result, the population that all these municipalities attract puts pressure on urban resources such as job opportunities, housing and social assistance. The struggle for limited resources will also lead to an intensification of group competition due to different levels of education and therefore differences in access to high-paying jobs. The amount of in-group solidarity provided in the ratio of family size to the competition is a determining factor. At the same time, when the fragmented structure of these subgroups and the supergroups they belong to is taken into account, the difficulty of achieving social harmony can be seen. This can be seen as an obstacle to the construction of a solid social network and a stable social fabric.

Municipalities where the value of single-person households and the number of males with master's degrees exceeds -0.55 (subgroup 2.2.2) present an environment where especially men with higher education degrees are present and live alone. When the relatively high number of single-person households is evaluated together with the level of education, it is understood that the members of the career-oriented group are included in this group at a higher rate than in the peer group. The potential for upward mobility is higher. However, the in-group competition that will take place between these individuals will also be more intense than in the peer group. Contrary to competition, solidarity will also be at a higher level thanks to professional and academic networks.

This group gains a more fragmented structure according to the 0.11 threshold value of the female population and the numbers of males with secondary school education characteristics. The group equal to or below this value (subgroup 2.2.2.1.1) has fewer females and males with secondary school education than the group exceeding the threshold value (subgroup 2.2.2.1.2). The difference in the female population can be explained by the fact that migration patterns and economic conditions may have affected these individuals more. The decrease in the number of males with secondary school education can also be attributed to economic constraints. All these characteristics lead to an educational and gender imbalance in the group population. The weakening of solidarity and further intensification of competition are inevitable.

It is seen that educational inequality is further aggravated for Subgroup 2.2.2.1.1.1. This group is determined by the fact that the value of the primary school education levels for males squared feature falls below the threshold value of -0.14. The relative majority of individuals with a primary school degree indicates that economic, educational infrastructure and other systematic problems create strong barriers to accessing resources. These barriers will have increasing effects on the future of the current separation. As a result, healthy social development is prevented, in-group solidarity is damaged and competition is intensified. In cases where the square of the primary school male values exceed the threshold of -0.14, Eyüp Sultan, Kağıthane and Kartal (subgroup 2.2.2.1.1.2) form a group. It has a profile opposite to the peer group. Therefore, stronger social ties and solidarity and less intense in-group cooperation should be expected. Intra-group cooperation will continue to exist between these two groups.

Subgroup 2.2.2.1.1.1 also differentiates within itself. Çekmeköy, Güngören, and Tuzla (subgroup 2.2.2.1.1.1.1) are distinguished from their peers, where the effect of health facility area per capita and the foreign population together remains below -0.53. The character of this group is formed by increasing problems in accessing health services and the small number of foreign population. It is understood that in the areas where this group is settled, where homogeneity is relatively high, less attention is paid to health services. In this context, subgroup 2.2.2.1.1.1.2, which draws an opposite portrait to Çekmeköy, Güngören, and Tuzla, is again clustered within itself. Bayrampaşa and Zeytinburnu (subgroup 2.2.2.1.1.1.2.1) and Avcılar and Büyükçekmece (subgroup 2.2.2.1.1.1.2.2) are differentiated by the number of females with a collage and master's degree they have (threshold: -0.47). In other words, as we move through the layers determined by social dynamics, we encounter even more urban resource inadequacy. When considered together with the common point of health facility areas, it is seen how impressive the differentiation of only certain values is in the separation.

Subgroup 2.2.2.1.2., the female population and male with secondary school education metrics exceed the threshold value of 0.11. It has a more balanced demographic and educational structure compared to subgroup 2.2.2.1.2. It consists of individuals with more urban resources compared to its peer. A more detailed separation under this group occurs with the total number of deaths and the number of clinics value and the threshold value of 0.10. Gaziosmanpaşa, Sancaktepe, Bağcılar, Esenyurt and Pendik are clustered with values equal to or below the threshold value, Küçükçekmece and Ümraniye are clustered with values above it. Female with primary school attainment and medical center amounts lead to clustering again according to the value of 1.17. Gaziosmanpaşa and Sancaktepe (subgroup 2.2.2.1.2.1.1.) form a new cluster with values equal to or below the threshold value, while Bağcılar, Esenyurt and Pendik (subgroup 2.2.2.1.2.1.2.) are positioned opposite them with figures above the threshold value. When the diversity of resources fought for is considered, it is seen that these are the groups where social solidarity is at its lowest and cooperation is at its most intense. While in-group and out-group cooperation continues to exist by increasing its intensity, the opportunities that provide the basis for wider solidarity and healthy social fabric have been damaged.

Finally, Bahçelievler and Başakşehir form sub-group 2.2.2.2. The character of this group is that when the threshold value of 0.01 is exceeded, both the child dependency ratio and the number of clinics, more families with children will have relatively more health resources. The increase in child dependency will create more pressure on education and health resources, as well as increasing in-group solidarity among these families. Although intra-group cooperation, which is inevitable with the peer group sub-group 2.2.2.1., is seen as more advantageous, it is inevitable that this situation will intensify the competition.

4.3 Configurational features of cases

Through the social logic of space, configurational analysis has been used to interpret spatial dimensions of social competition, cooperation, territoriality, and centrality within and between social groups by quantifying the relational structure of the layouts. The analyses start with the interpretation of summary statistics derived from the segment maps representing the entire systems (Table 21).

Table 21 - Segment statistics of the study areas

Segment Statistics	Metropolitan São Paulo	Metropolitan Istanbul
Number of segments	1151424	853732
Mean segment length	292227,73	62,12
Standard deviation	182895,04	65,64
Variance	33450596140,04	4308,71
Median	291589	44,56
Minimum segment length	1	2,07
Maximum segment length	5756790	2822,16
First quart (Q1)	128802	23,61
Third quart (Q3)	456024,25	77,47
IQR	327222,25	53,86
GINI	0,36	0,46

Source: Author, 2025.

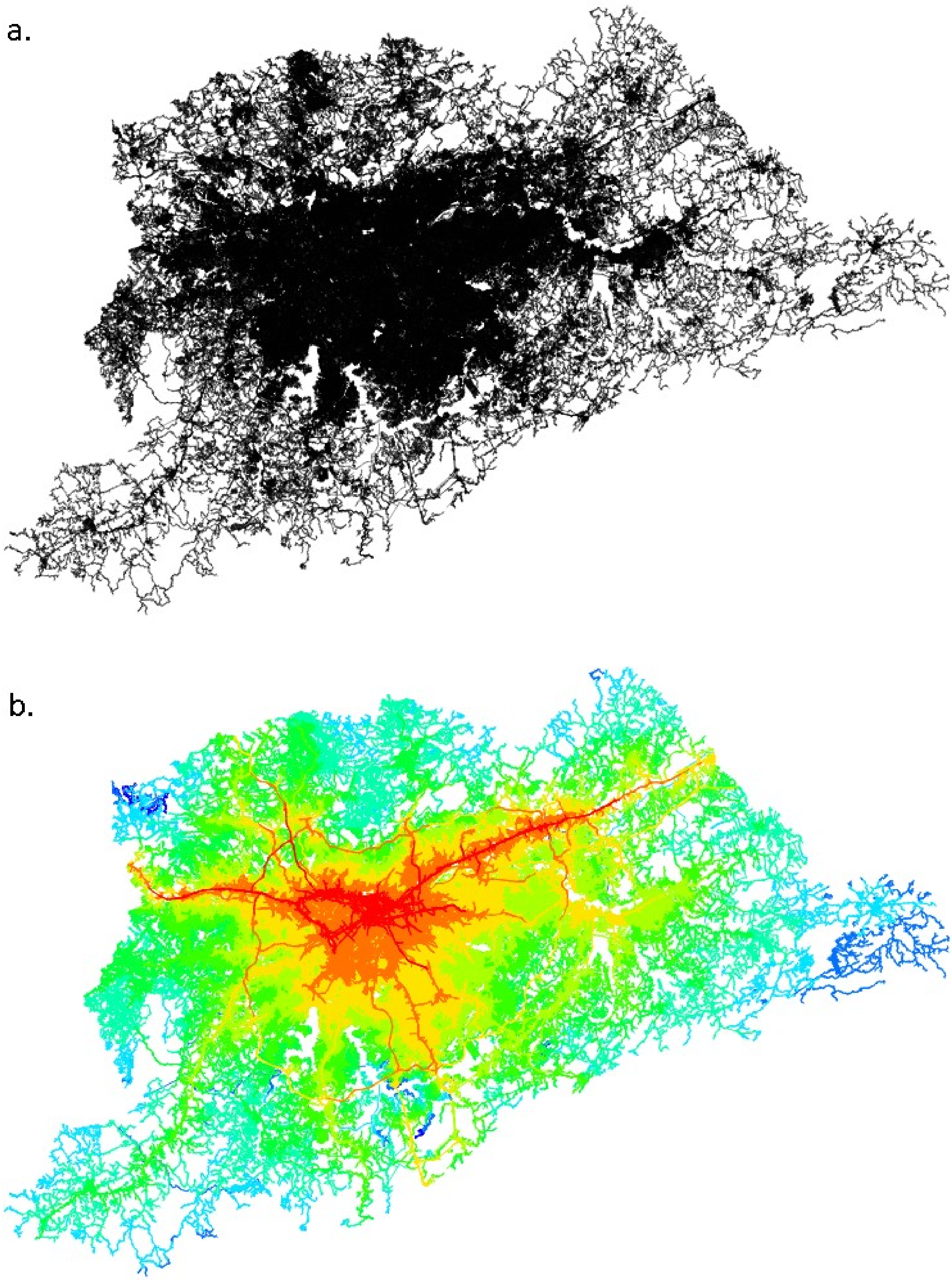
Using QGIS, spatial boundaries corresponding to each defined social group were delineated and spatially overlaid onto the segment map. This procedure enables the extraction of configurational characteristics specific to each group's territorial extent. For each area, key spatial metrics were calculated, including total system area, segment number, average and mean segment lengths, maximum and minimum segment lengths. Furthermore, Normalized Angular Integration (NAIN) values were computed to assess the global integration of each territory. These values provide an indicator of how spatial configuration facilitates or restricts movement potential, contributing to the understanding of accessibility, spatial centrality, and potential socio-spatial interaction across different group territories within the metropolitan areas.

4.3.1 Configurational features of Metropolitan São Paulo

The statistical overview of the entire segment map pictures a complex and hierarchical system (Figure 67). The network exhibits not only a sort of connectivity with 1,151,424 segments in total but also some disparities in segment lengths. The mean length is 292,227.73 meters and the standard deviation (182,895.04 meters) suggests a wide variation. While many roads are relatively short, others extend significantly. This range is caused by some dominant mobility corridors alongside fragmented local streets. The interquartile range further emphasizes the disparity in road lengths. The structure has a strong hierarchy. Major roads serve as the primary axes of movement. On contrary, numerous smaller ones provide local connectivity. In addition, the high variance suggests that some areas are well integrated. These areas must have benefited from efficient movement potential while others remain isolated. This is also supposed to influence the access to economic opportunities, social mobility, and resources, thus, reinforce territorial inequalities (Figure 68).

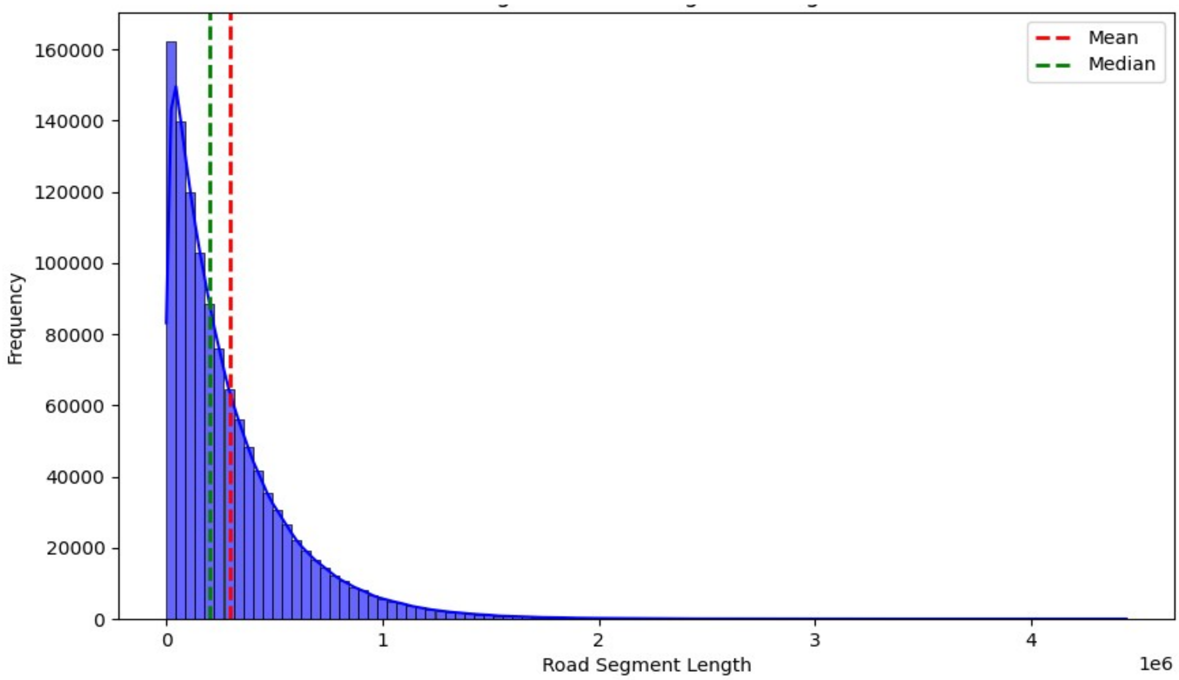
The Gini coefficient (0.3609) supports the idea of inequality in the distribution of segment lengths (Figure 69). This moderate level of inequality means some areas benefit from well-connected and extensive networks while others may experience more fragmented infrastructure that leads to reduced accessibility and mobility. When the longest roads are concentrated in cetain territories, a competitive spatial advantage could be provided to certain social groups. On the other hand, areas with more fragmented segments might create spatial barriers.

Figure 67 – Segment map and NAIN analysis of Metropolitan São Paulo



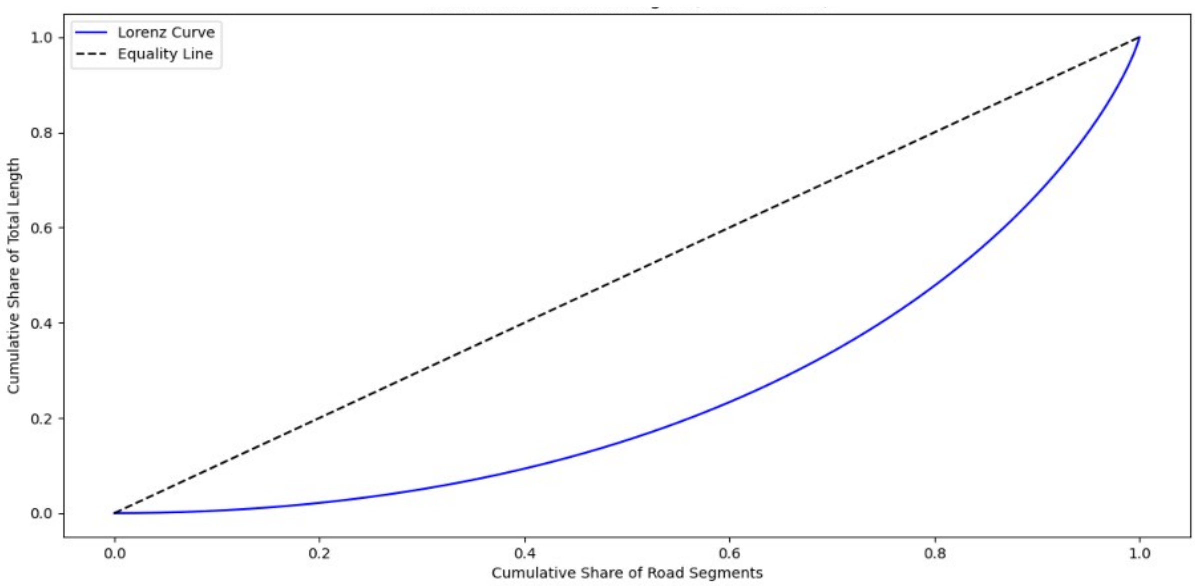
Obs. Representation of Metropolitan São Paulo (a) and global NAIN analysis (b) of the system
Source: Oliveira, B. K. A., 2024.

Figure 68 – Segment lenght histogram of Metropolitan São Paulo



Obs. The distribution is right-skewed. The mean is higher than the median which confirms the skewness. A significant portion of the roads are shorter while a few exceptionally long roads extend the range. The long tail proves the existence of a hierarchical network. Within the hierarchy, a small number of dominant roads host most of the flow. Source: Author, 2025.

Figure 69 – Segment length lorenz curve of Metropolitan São Paulo



Obs. The curve deviates from the equality line, indicating an unequal distribution of segment lengths. The Gini coefficient (≈ 0.36) reflects moderate inequality. The lower portion of the curve shows that many segments contribute little to total network length. The upper portion points to a few very long roads. This inequality suggests the existence of main corridors dominating connectivity while smaller ones host localized movement. Source: Author, 2025.

Naturally, this is expected to limit movement and reinforce socio-economic divisions. Furthermore, the majority of road segments fall within the range of the first quartile (128,802 meters) and the third quartile values (456,024.25 meters). This shows that most of the segments are relatively short while a few dominant corridors extend beyond the average. These long segments serve as essential routes for economic and social activity.

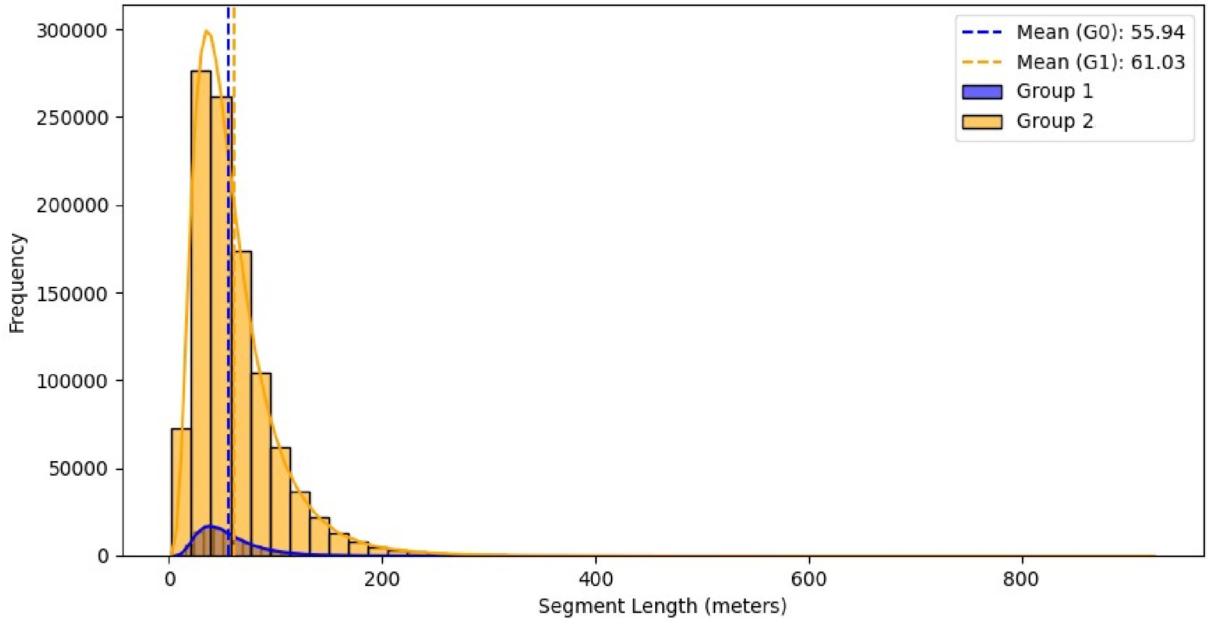
Furthermore, the majority of road segments fall within the range of the first quartile (128,802 meters) and the third quartile values (456,024.25 meters). This supports the idea that most of the segments are relatively short while a few dominant corridors extend beyond the average. These long segments serve as essential routes for economic and social activity. Moreover, areas containing predominantly shorter segments are supposed to form enclosed or territorially distinct spaces. This potentially limits the connectivity between different social groups.

The two main social groups have distinct configurational characteristics (Figure 70). With a compact network and localized movement, the area of first group contains 103,948 segments. The areas has a relatively lower network density compared to second group. The mean and average road lengths (49.32 meters) are also shorter than those of Group 2. Additionally, the standard deviation (42.77 meters) suggests some variation but within a controlled range. The maximum road length of 1,179.36 meters, together, indicates the presence of few very long segments.

Despite having limited extreme disparities in lengths, the network appears to be evenly distributed. The relatively shorter average segment length implies a better grained street structure with local accessibility rather than long-distance movement. The pattern with a structure supporting localized interactions reflects a more cooperative spatial dynamic. Furthermore, the absence of extremely long roads suggests a lesser degree of hierarchy without a few dominant corridors with concentrated movement flows.

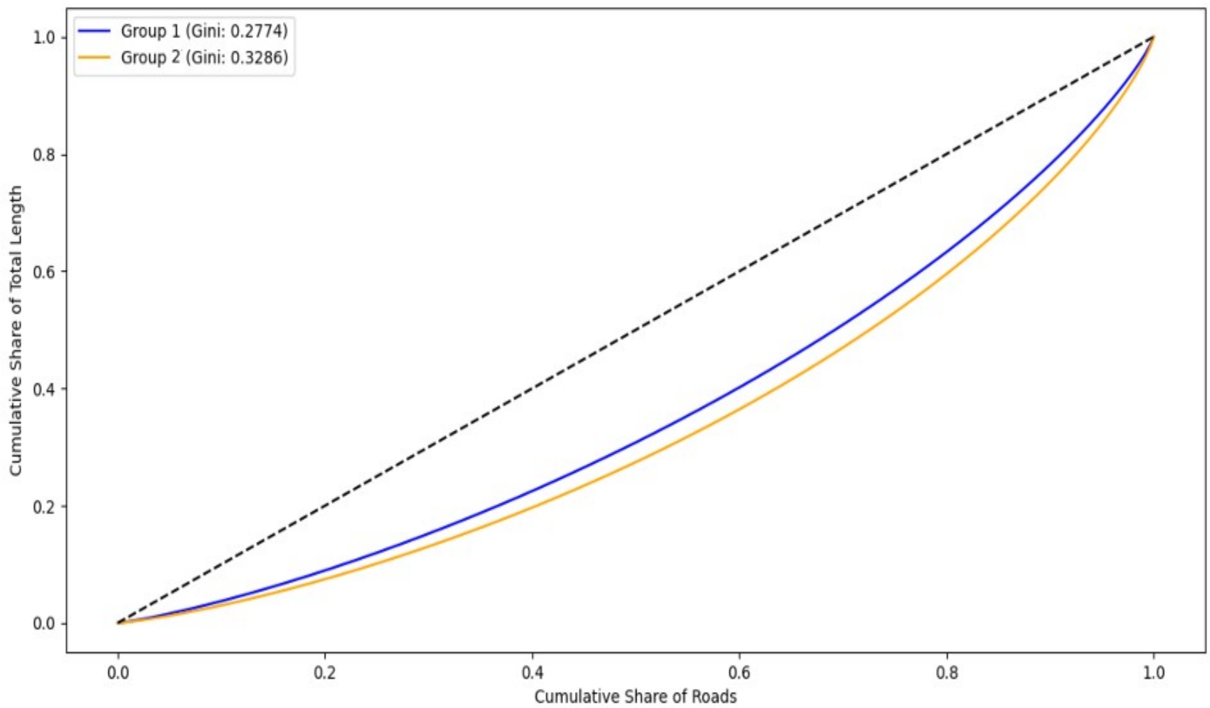
Containing a relatively extensive and hierarchical network with high variation, Group 2 settles on a significantly larger area. This area contains 1,047,597 segments, indicating a denser and expansive network. The mean and average segment lengths (51.05 meters) are slightly longer than in Group 1.

Figure 70 – Main groups' segment lengths histogram for Metropolitan São Paulo



Obs. The histogram compares the distribution of segment lengths for main groups. Group 1 exhibits a more concentrated distribution. This pictures a relatively uniform network. In contrast, Group 2 has a broader spread with a longer tail. This suggests the presence of short local and significantly longer arterial segments together, reflecting a more hierarchical structure. Source: Author, 2025.

Figure 71 – Main groups' lorenz curves for Metropolitan São Paulo



Obs. The curve illustrates the inequality in segment lengths within each group. A steeper curve for Group 2 indicates higher disparity. This means dominated movement over a few segments which is expected to reinforce centrality and competition for key routes. The calculated Gini coefficients quantify this inequality. Higher values suggest a more uneven distribution of connectivity and accessibility. Source: Author, 2025.

However, the standard deviation (47.69 meters) is higher. This reveals a greater variability in lengths. Furthermore, the maximum length (2,627.82 meters) is more than twice as long as the longest one in the first group. This proposes the idea of a strongly hierarchical network with clear differentiation between local and major roads.

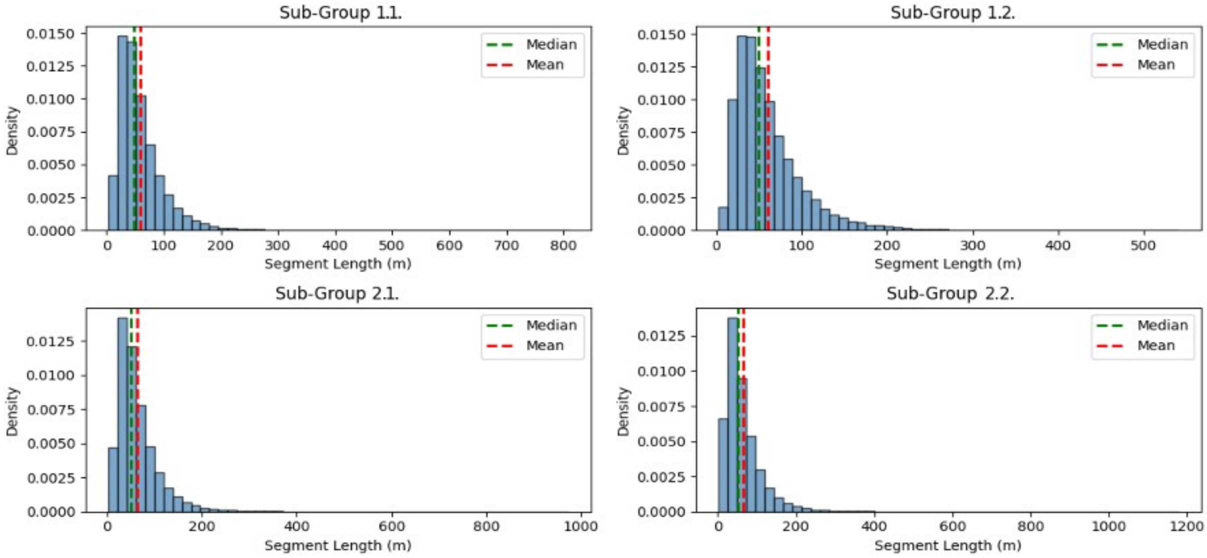
The existence of very short segments points to the fragmented urban elements. These must have served specific functions such as dead-end streets or small-scale access routes rather than contributing to overall connectivity. On the other hand, the longest roads in the system serve as dominant mobility corridors.

As a result, this is expected to create a centralized structure where movement is directed over specific routes. This configuration presents a more competitive spatial dynamic. Certain roads play a significant role in directing the movement. This role also leads to unequal accessibility and spatially segregated environment.

In summary, second group, with a much larger area, settles on a denser network. This makes it structurally more complex than the first group. The higher number of segments suggests more urbanized spaces. Additionally, second group exhibits greater variation in road lengths, suggesting a hierarchical structure. Within the second group's area, major roads must have dominated mobility patterns. This supports the idea of reinforced spatial inequality in terms of accessibility. On the other hand, with its more uniform network, first group likely facilitates a more balanced distribution of movement (Figure 71). As a result, the cooperative structure of Group 1 contrasts with the competitive organization of Group 2. This differentiation suggests different forms of territorial organization.

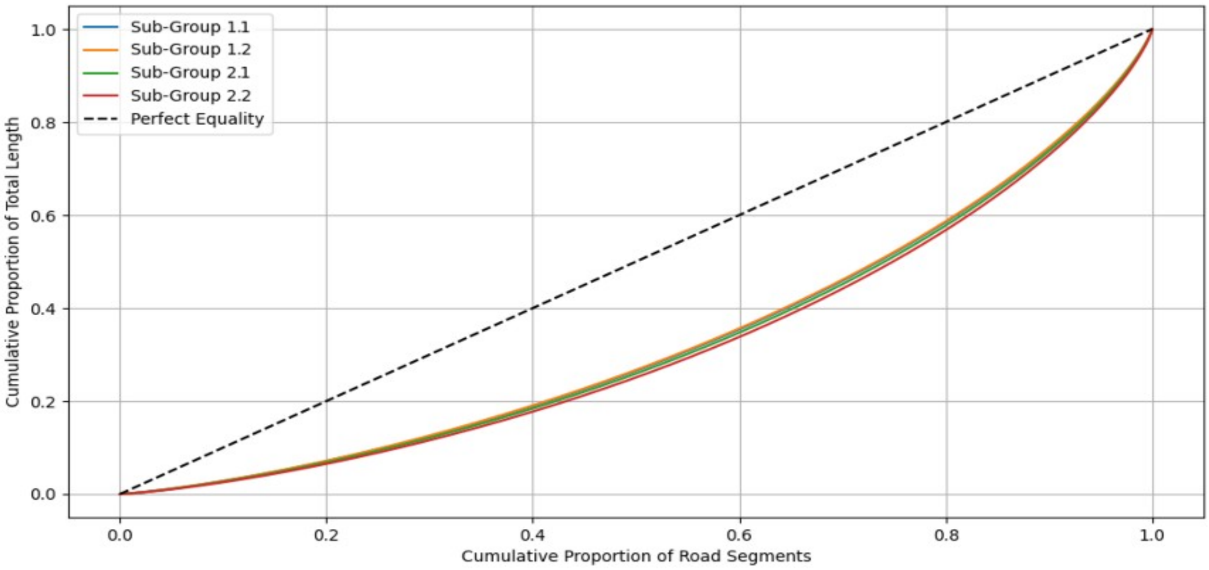
Considering first level subgroups (Figure 72 and 73), Sub-group 1.1 has 51,790 segments. The mean and average length (48.47 meters) suggests a fine-grained structure. Furthermore, the standard deviation (42.37 meters) shows moderate, however, within a controlled range variation. The shorter average road length and relatively low standard deviation suggest localized mobility and accessibility. As a result, walkability and community integration must have been promoted. The maximum segment length (1,179.36 meters), on the other hand, indicates that while there are a few longer roads, the network remains balanced and decentralized. Finally, this sub-group's structure likely supports a cooperative spatial dynamic. The network is seen to be less hierarchical, movement dominating road.

Figure 72 – 1st level subgroups’ segment length histograms for Metropolitan São Paulo



Obs. The histograms reveal distinct distribution patterns among the sub-groups. Sub-Group 1.1 has mostly short segments with a right-skewed distribution. Sub-Group 1.2 pictures a broader spread with minimal skewness and slightly longer segments on average. Sub-Group 2.1 has a right-skewed and wider range with a noticeable tail extending toward longer segments. With a high standard deviation, Sub-Group 2.2 exhibits high variability, resulting in a more dispersed distribution. Source: Author, 2025.

Figure 73 – 1st level sub-groups’ segment length lorenz curves for Metropolitan São Paulo



Obs. The Lorenz curves highlight varying degrees of inequality in segment length distribution among the sub-groups. Sub-Group 1.1 has a curve close to the equality line which indicates a relatively balanced network. Sub-Group 1.2 shows greater deviation, suggesting a stronger hierarchical structure, containing a few dominant longer segments. Sub-Group 2.1’s steeper curve reflects a more unequal distribution. Here long roads are supposed to centralize movement. Finally, with a sharp initial rise Sub-Group 2.2 exhibits the highest inequality. Here a few long segments account for most of the total length. Source: Author, 2025.

This suggests a territorial configuration against the concentration of movement through specific mobility corridors. With a slightly smaller area, Sub-group 1.2 has 52,227 segments. However, the area still has a relatively dense road network. Although the difference is not substantial, the mean and average segment lengths (50.21 meters) are slightly longer than those in Sub-group 1.1. The standard deviation (43.17 meters) is also relatively low. It shows some variation but the network still remains uniform. The maximum segment length of 803.56 meters suggests fewer long corridors compared to Sub-group 1.1. This reinforces the idea of a more balanced and localized structure.

Similar to previous sub-group, the network's relatively even segment distribution and the moderate standard deviation suggest that movement is distributed fairly across the network. The absence of significant outliers in length implies that the structure likely favors cooperative interaction and minimizes the competition for key routes. Thus, Sub-group 1.2 is likely to support a cooperative territorial dynamic where areas are connected by a variety of access routes and the competition for key corridors is limited. However, the presence of more roads compared to Sub-group 1.1 may indicate slightly more complex spatial arrangements and accessibility.

Sub-group 2.1 covers an area with 467,127 segments, indicating a denser and more expansive network than Sub-group 1.1. The mean and average lengths (51.15 meters) are also longer and the standard deviation is 46.4 meters which is a considerable variation. Thus, Sub-group 2.1's network is more heterogeneous, featuring a mix of fragmented roads and long corridors. The maximum segment length (1,888.9 meters) is also higher than that of Sub-group 1.1 and Sub-group 1.2. This is a sign of a more hierarchical network with long dominant segments. The dominance of longer segments is supposed to lead to relatively more centralized movement with competition for access to key mobility corridors, as well. However, the relatively better-grained network could still provide some localized access with more uneven compared to Sub-groups 1.1 and 1.2. This structure provides a competitive territorial organization. As a result, sub-group 2.1 may experience spatial segregation based on proximity to the key routes. The areas far from the dominant roads have a risk of suffering from reduced accessibility.

Sub-group 2.2 settles on an area with 581,980 road segments. This indicates a denser and more expansive network. The mean and average segment lengths (51.01 meters) are slightly shorter than Sub-group 2.1's. However, they are still longer than those in Sub-group 1.1. In addition, the standard deviation (48.77 meters) is the highest among the sub-groups but still shows considerable variation. Finally, the maximum segment length (2,627.82 meters) is the longest in all the sub-groups, as well. This highlights the presence of major mobility corridors.

The highest standard deviation and the longest maximum length suggest that Sub-group 2.2 possibly exhibits a strongly hierarchical structure. Within this structure long roads form the backbone of movement. This must have created a centralized movement flow and concentrate activities along key corridors. On the other hand, this must have caused peripheral areas less connected and more isolated. Thus, this sub-group's network structure likely reflects competitive dynamics. During the competition, access to the longest roads becomes a key factor in determining spatial hierarchy. Similar to Sub-group 2.1, it is expected to observe spatial inequality in terms of accessibility while more centrally located areas enjoy better connectivity compared to peripheral zones.

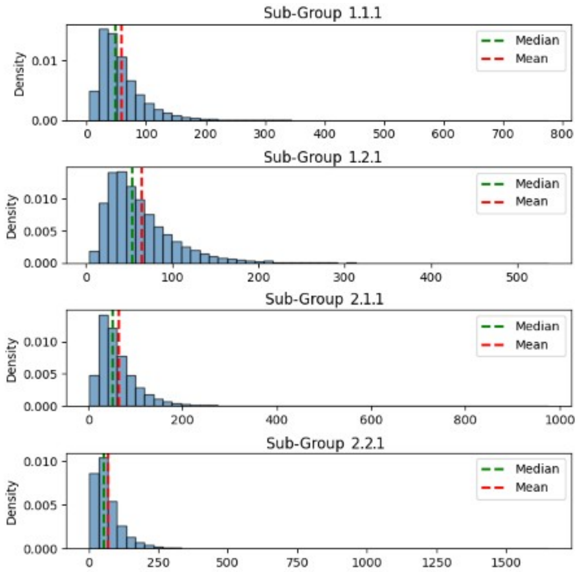
As a summary, since being parts of larger areas, sub-groups 2.1 and 2.2 have higher segment counts compared to Sub-groups 1.1 and 1.2. This indicates denser networks which points to higher degrees of infrastructure complexity and differentiated spatial patterns. In addition, Sub-groups 2.1 and 2.2 show greater variation in segment lengths, with a few long ones dominating the movement. These hierarchical networks are supposed to provide more unequal access and spatial segregation. In contrast, the networks of Sub-groups 1.1 and 1.2 shows more even distributions of movement where more localized and cooperative dynamics are supposed to occur. However, sub-groups 2.1 and 2.2 are seem to be more competitive due to centralized movement and key corridors. These might lead to territorial inequalities in access. In conclusion, the four sub-groups demonstrate a range of spatial dynamics from the cooperative, localized structures (Sub-groups 1.1 and 1.2) to the more competitive, hierarchical ones (Sub-groups 2.1 and 2.2.) These differences point to varying degrees of territorial centrality, causing segregation.

Considering the second level subgroups (Figure 74 and 75), sub-group 1.1.1 settles on 20,344 segments. The average road segment length is 47.56 meters and the standard deviation is 41.18 meters within a controlled range. Furthermore, the longest segment is 1,179.36 meters which is comparatively long. However, the majority of the road segments remain relatively short within this group's area, suggesting an optimized network for local movement that fosters local interactions and cooperation. Consisting of 31,487 segments, sub-group 1.1.2 has slightly longer average segments (49.08 meters) compared to the previous sub-group. The standard deviation of 43.33 meters indicates the existence of some longer segments. Additionally, the longest segment in this sub-group is 1,089.51 meters. These values point to a network that may support local and moderate-distance movement at the same time. Despite being relatively balanced, it seems that there is a shift towards a more competitive network.

With 22,590 segments, sub-group 1.2.1 has a more specialized pattern. The average segment length (52.49 meters) together with a high standard deviation of 45.87 meters, proves that the network is more varied, in the sense of both short and long segments. Moreover, the maximum segment length is 536.43 meters. Thus it is possible to say that there are some main roads playing a central role in movement. As a result, there is an increasing tendency for longer segments that might dominate the flow without neglecting the local movement. Consisting of 29,637 segments, the network of sub-group 1.2.2 exhibits an average length of 48.47 meters while the standard deviation is 40.9 meters. Furthermore, the longest segment here is 803.56 meters and notably shorter than in some of the previous sub-groups. Thus, this sub-group supposed to has a more localized network with fewer long, dominant roads. There is a relatively balanced structure letting the movement to be distributed across multiple routes and supporting local and medium-distance accessibility.

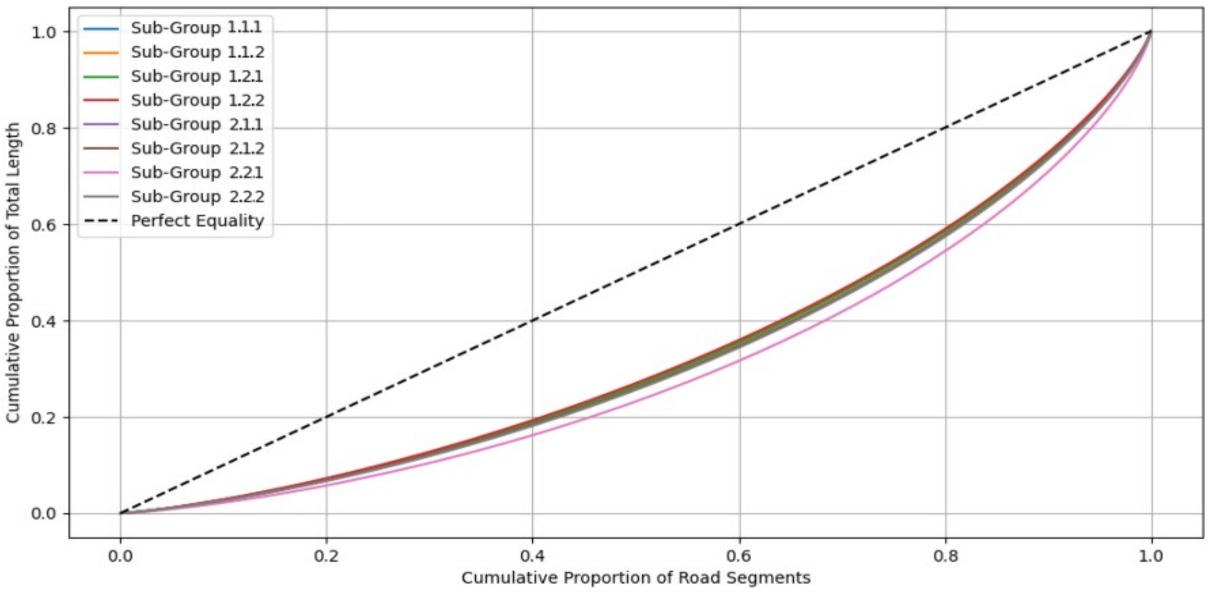
The sub-group 2.1.1 contains a significantly larger number of segments (426,262), with an average road segment length of 51.24 meters. In addition, the standard deviation is relatively low (46.54 meters). While being notably long, the longest segment in this network (1,888.9 meters) is not the longest seen across these sub-groups. The network of this sub-group is more hierarchical. The presence of longer and a dense network of segments together points to a system that hosts local and longer-distance movement at the same time. This structure must have fostered a more competitive spatial dynamic, where central corridors carry more movement than the peripheral streets.

Figure 74 – 2nd level sub-groups' segment length histograms for Metropolitan São Paulo



Obs. The histograms for each sub-group reveal the varying density and spread of segments. The red dashed line represents the mean segment length while the green dashed line indicates the median. The presence of shorter segments is common across all sub-groups. However, the distribution shape varies based on the mean and standard deviation. In general, higher standard deviations signify greater variability in lengths, contributing to a more spread-out distribution, as seen in some sub-groups. Source: Author, 2025.

Figure 75 – 2nd level sub-groups' segment length lorenz curves for Metropolitan São Paulo



Obs. The Lorenz curves illustrate the cumulative distribution of segment lengths relative to the cumulative proportions. Each curve demonstrates the inequality in length distribution, with steeper curves indicating greater disparity between a few long segments and numerous shorter ones. The black dashed line represents the perfect equality, where every road segment contributes equally to the total length. A steeper curve means a more unequal distribution, highlighting the dominance of certain segments in the network, while a gentler curve suggests a more evenly distributed road network. Source: Author, 2025.

Covering a smaller area, with 40,918 road segments, Sub-Group 2.1.2 has an average segment length of 50.3 meters. Followingly, the standard deviation is 45.42 meters. The maximum segment length (1,278.18 meters) indicates some long ones beside the predominance of shorter segments. The relatively high number of segments in this small area proposes a more localized network and potentially a more cooperative structure. The routes must have promoted accessibility for close-knit interactions.

With 107,697 road segments, sub-group 2.2.1 has the longest average segment length (53.56 meters) and a standard deviation of 57.93 meters. These values together reflect a variable network with considerable disparity between short and long roads. The longest segment (2,627.82 meters) also supports the presence of major corridors that dominate movement. Thus, this sub-group's network structure appears to be more competitive. Since the long roads are expected to be central to accessibility, likely leading to greater spatial inequality.

Finally, the sub-group 2.2.2 has a substantial number of road segments (474,356). In addition, the average segment length is 50.45 meters while the standard deviation is 46.7 with a moderate variation. Notably, the longest road is 2,627.82 meters and similar to previous sub-group. This sub-group, like sub-group 2.2.1, likely features a competitive network structure due to few dominant long roads playing an important role in determining movement patterns. This must have led to more unequal spatial dynamics.

To sum up, these eight sub-groups present a range from relatively more localized and cooperative systems (Sub-Groups 1.1.1, 1.1.2, 1.2.2, and 2.1.2) to more hierarchical and competitive structures (Sub-Groups 1.2.2, 2.1.2, and 2.2.1). Networks with shorter average segment lengths and less variation between them are supposed to be more cooperative because of supporting local movement and interaction. On the other hand, networks with longer segments and higher variability are expected to be more competitive due to concentrated movement along central corridors. These dual dynamics potentially lead to spatial inequality and segregation (see figure 75).

Considering normalized angular integration (NAIN), at the main group level, values also support the previous findings. There are distinct differences in overall network connectivity. The first main group (Table 22), with an integration value of

0.615, shows a more coherent and accessible structure compared to second group's 0.589. This suggests that first group's relatively compact network may facilitate more uniformly distributed movement.

Table 22 - Configurational profiles of groups of Metropolitan São Paulo

Group	ID	Area (km²)	Segments	Mean (m)	Max (m)	NAIN	Key Characteristics
Main Group	1	2163,83	103,95	49.32	1179,36	0,615	Localized, Cooperative, Fine-Grained
	2	5783,12	1,047,597	51.05	2627,82	0,589	Hierarchical, Competitive, Centralized
Sub Group (Level 1)	1.1	1451,03	51,79	48.47	1179.36	0,355	Localized, Balanced, Fine-Grained
	1.2	712,8	52,23	50.21	803.56	0,615	Localized, Balanced
	2.1	3468,01	467,13	51.15	1888.9	0,343	Hierarchical, Extensive, Competitive
	2.2	2315,11	581,98	51.01	2627.82	0,589	Centralized, Hierarchical, Competitive
Sub Group (Level 2)	1.1.1	611,45	20,34	47.56	1179.36	0,177	Localized, Even, Fine-Grained
	1.1.2	839,58	31,49	49.08	1089.51	0,355	Moderate, Slightly Hierarchical
	1.2.1	300,47	22,59	52.49	536.43	0,186	Moderate, Slightly Hierarchical
	1.2.2	412,33	29,64	48.47	803.56	0,615	Localized, Uniform
	2.1.1	3372,33	426,26	51.24	1888.9	0,343	Extensive, Hierarchical
	2.1.2	95,69	40,92	50.3	1278.18	0,665	Fragmented, Dense
	2.2.1	728,21	107,7	53.56	2627.82	0,688	High Variation, Dominant, Competitive
	2.2.2	1586,9	474,36	50.45	2627.82	0,589	Centralized, Competitive, Unequal

Source: Author, 2025.

On the other hand, a slightly lower value of second group, reflects a more hierarchical configuration. Within this network connectivity is concentrated along dominant corridors. Followingly, within the sub-groups, the variation is even more pronounced. Sub-group 1.2 (0.615) and 2.2 (0.589) exhibit comparatively higher integration. Their value indicate better-connected networks with centralized movement. However, sub-group 1.1 (0.355) and 2.1 (0.343) show lower values, suggesting a more decentralized, locally fragmented structure.

At the second-level sub-group scale, the heterogeneity in normalized angular integration deepens. Extremely low integration values, such as 0.177 in sub-group 1.1.1 and 0.186 in 1.2.1, means significant fragmentation and limited connectivity. These values points to isolated movement patterns within these areas. In contrast, higher values observed in sub-group 2.1.2 (0.665) and 2.2.1 (0.688) suggest networks where long, dominant roads effectively integrate the system. These roads are supposed to direct movement along their routes and foster centralized access. As a result, these disparities underscore the idea that the entire network simultaneously exhibit competitive and cooperative dynamics with more evenly distributed, accessible layouts on one hand and the concentration of movement along a few critical corridors on the other hand.

Eventually, the correlation matrix shows the multifaceted interplay between demographic, socioeconomic, and infrastructural variables as a proof of how urban configuration both shapes and is shaped by social dynamics. The high correlations (ranging from about 0.91 to 0.98) between the number of segments and population, area, and various demographic measures show that urban expansion and infrastructural growth are closely intertwined.

As the population increases, the road network expands considerably. This expansion is not just in terms of quantity but also in the spatial complexity. As seen in the high correlations with measures like total households and formal employment, a higher number of lines may facilitate improved accessibility, which in turn supports economic activity and the provision of public services. Naturally, larger urban areas develop extensive infrastructural systems to support increased mobility. This expansion, on one hand, facilitates cooperative interactions. On the other hand, it intensifies the competition over access to key resources.

At the same time, the average and mean road segment lengths exhibit moderate positive correlations with demographic indicators (around 0.31–0.20). This implies that larger or more populous areas tend to have slightly longer road segments. Additionally, the overall change in segment length is less than the increase in network density. Furthermore, a lower average length may point to a more locally accessible network often associated with higher connectivity at the neighborhood level. The moderate correlations of these measures with socio-economic variables such as nominal average salary and healthcare expenditure suggest that more finely meshed networks can foster closer interactions, potentially reducing travel times and improving access to services. These are conducive to better economic outcomes.

The standard deviation of segment lengths is also moderately correlated with demographic growth. This supports the idea that as the urban area gets larger, the network becomes more heterogeneous due to the mix of many short and a few very long roads. This heterogeneity is characteristic of hierarchical urban structures where central corridors become dominant, reinforcing centrality and creating focal points for movement and economic activity.

The contrasting behaviors of the minimum and maximum lengths further underline this dual dynamic. Negative correlations between minimum road length and demographic variables suggest that as settlements expand, the prevalence or relative importance of local roads diminishes. In contrast, the strong positive correlations observed for maximum road length shows the emergence of dominant arterial roads that serve as major conduits for movement. Besides increasing the connectivity in central areas, these key corridors also contribute to territorial stratification. Since a few major roads carry the most of movement, access to these corridors becomes an important resource, intensifying social competition and fostering spatial segregation.

Finally, Normalized Angular Integration (NAIN) emerges as a particularly revealing configurational metric. It exhibits mixed relationships with both demographic and infrastructural measures by showing mild positive correlations. They suggest that increased population density and infrastructural expansion can enhance overall network accessibility. Moreover, its positive correlations with socio-economic measures such as nominal average salary and total healthcare expenditure per inhabitant also suggest that better-integrated networks are linked with higher economic prosperity and potentially better quality of life. Higher integration implies that residents have more direct and varied access to services and job opportunities, which can stimulate local economies and even attract investments.

Overall, the correlations suggest that urban configuration is a critical factor in mediating social competition, cooperation, territoriality, centrality, and segregation. As settlements grow and diversify, the expansion of road networks not only supports cooperative interactions by enhancing local accessibility but also sets the stage for competitive struggles over control of major mobility corridors. This multifaceted dynamic ultimately shapes patterns of social stratification, where well-connected areas attract investment and prosperity, while more fragmented regions may become marginalized.

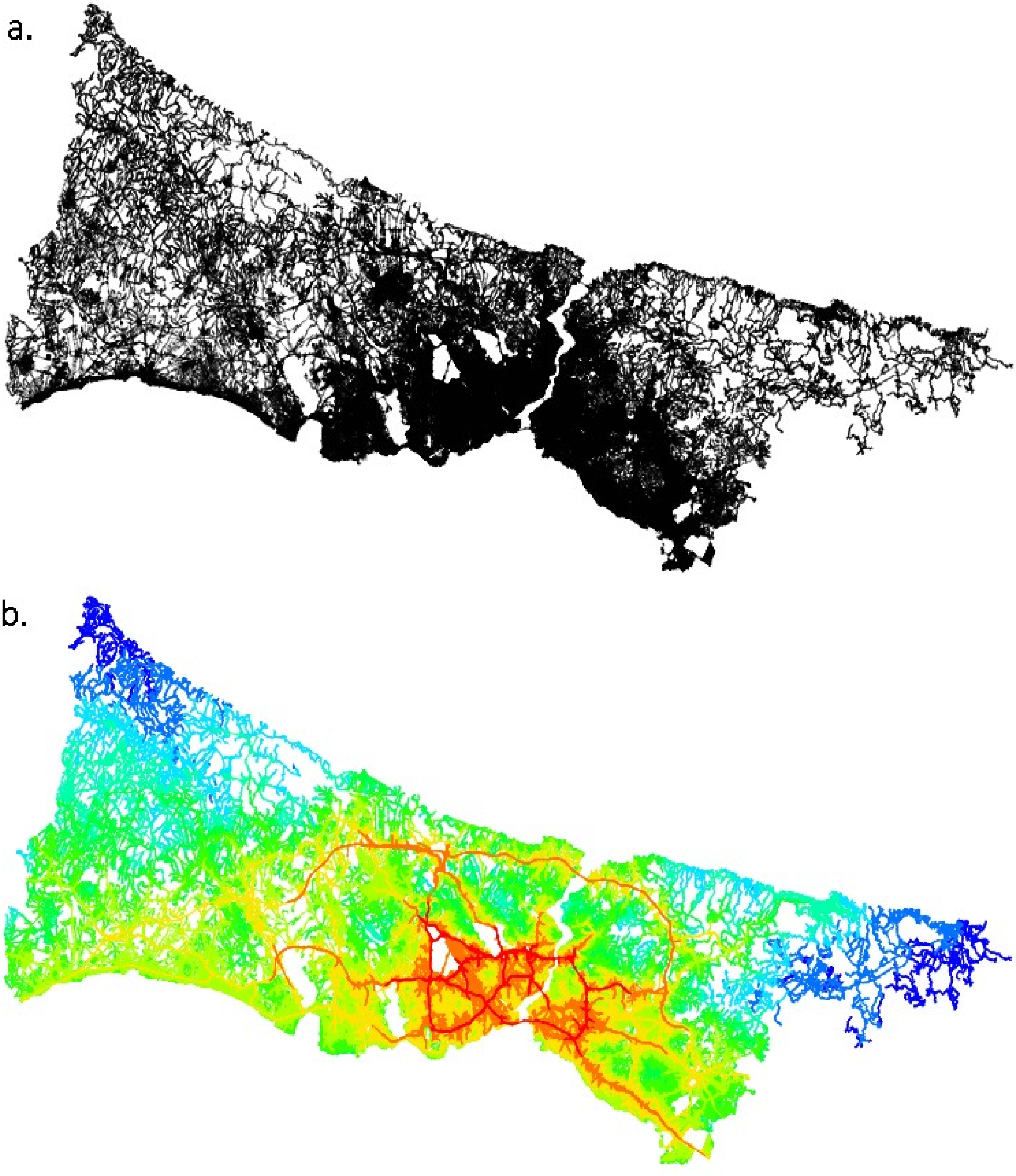
4.3.1 Configurational features of Metropolitan Istanbul

The Istanbul metropolitan area road network has a total of 853,732 segments (see figure 75). This dense network with a high number of segments is an indicator of a complex urban texture, just like statistical data. The average segment length of the network is 62.12 meters, while the standard deviation is 65.64 meters. This amount of variability indicates the coexistence of both fine-textured and large-scale urban structures. In addition, the maximum segment length is 2822.16 meters, while the minimum segment length is 2.07 meters. This gap emphasizes the presence of fragmented local roads (short segments) as well as main arteries (long segments). The inner quartile range (IQR) value of 53.86 meters indicates that the segment lengths have a medium distribution and shorter segments are generally dominant (Figure 77).

This structure exhibited by the network is due to the existence of a hierarchical urban organization. Some areas within the metropolitan area are well connected by long, continuous roads, while others are relatively fragmented. The large variance and high range indicate that some areas are due to major streets and arterial roads, while others may be quite fragmented. The median (44.56 meters), which is lower than the mean, indicates that the distribution is skewed to the right. In other words, while most segments are short, the presence of a small number of very long segments raises the mean.

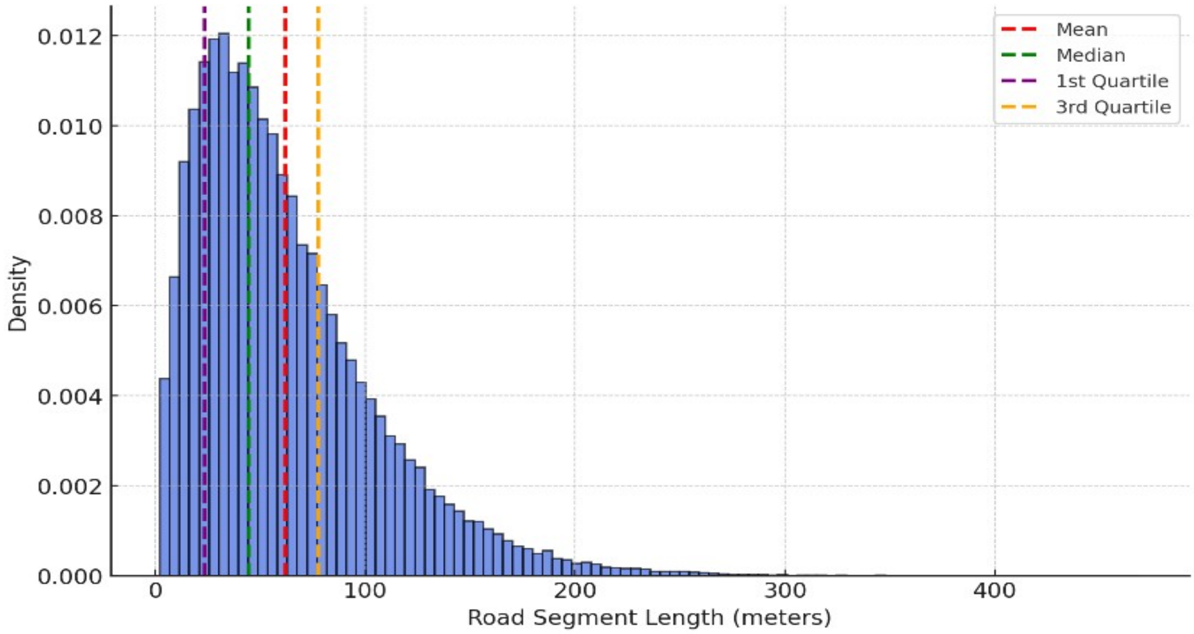
The Gini coefficient, which is an indicator of spatial inequality and accessibility in the network structure, was calculated as 0.457. This value indicates a moderate level of inequality in segment lengths (Figure 78). While there are large and continuous roads in some regions, there is a shorter and fragmented road structure in other regions. It is normal for such a structure to create inequalities in mobility and access to infrastructure. If long road segments overlap with areas where some settled social groups are located, this may lead to a more advantageous position in terms of mobility and connectivity.

Figure 76 – Segment map and NAIN analysis of Metropolitan Istanbul



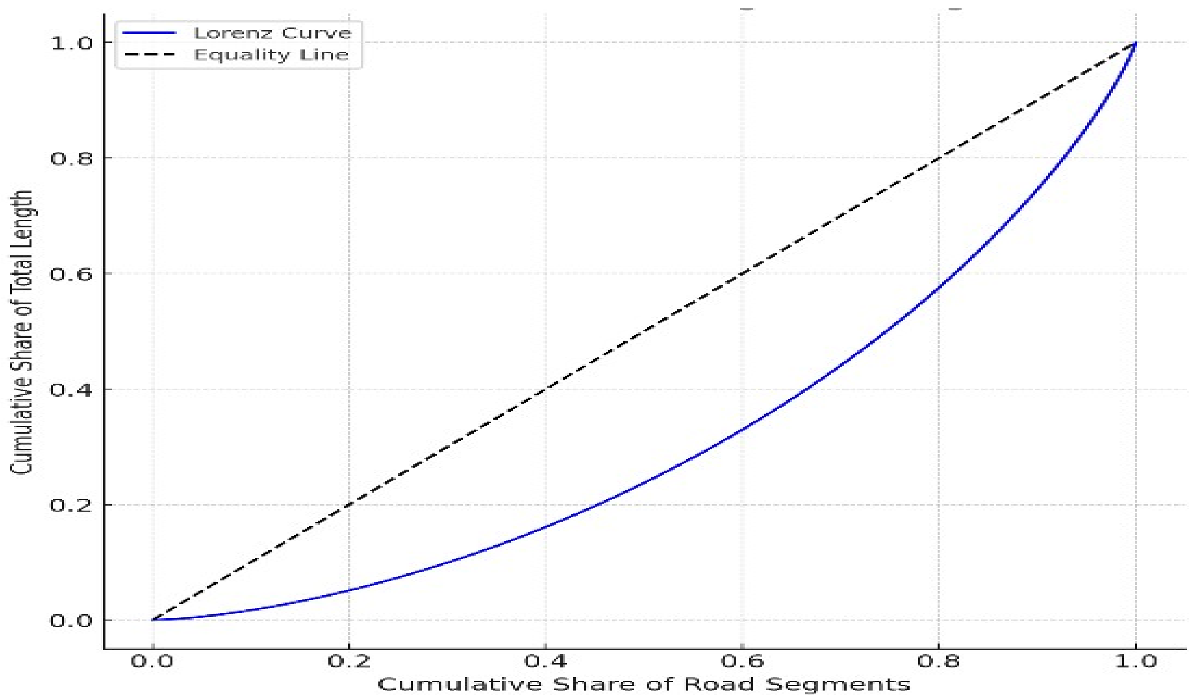
Obs. Representation of Metropolitan Istanbul (a) and global NAIN analysis (b) of the system. Source: Author, 2025

Figure 77 – Segment length histogram of Metropolitan Istanbul



Obs. The distribution is right- skewed. Most segments concentrated in shorter lengths, while a few very long segments widen the range. The median being lower than the mean confirms that the distribution is skewed. The Inner quartile range (IQR), indicates that most segments are shorter than 80 m. The long tail indicates a hierarchical structure, with a few dominant roads having segment lengths significantly above the mean. Source: Author, 2025.

Figure 78 – Segment length lorenz curve of Metropolitan Istanbul



Obs. The more the curve deviates from the equidistant line, the greater the inequality in the distribution of lengths. Since the Gini coefficient is 0.457, a moderate level of inequality is observed within the network; some segments are very long, while the majority consists of shorter segments. Source: Author, 2025.

Conversely, if shorter segments are concentrated in areas where low-income or marginalized groups are settled, this may indicate social segregation and mobility restrictions. Thus, it is inevitable that this situation determines spatial division and social hierarchies. In terms of centrality and mobility in the network, the first quarter was calculated as 23.61 meters and the third quarter as 77.47 meters. Half of the road segments are located between these two values. The median being lower than the mean indicates the presence of many short streets and few extremely long segments, supporting previous findings. In terms of centrality and spatial affiliation, the presence of very long street segments indicates the main axes of social and economic activities. The areas where shorter segments are dominant may be relatively local and have low connectivity, thus defining spatial boundaries.

When the configurational characteristics of the regions where the two main social groups are located in the settlement area are compared, different spatial structures and accessibility levels are observed. The first region has 125,504 road segments within an area of 237 km². The average segment length is 56.44 meters, while the standard deviation value is 55.98 meters. There is a relatively low variability in segment lengths. The shortest segment is 5.5 meters, while the longest segment is 2,110.18 meters. Thus, it is seen that the region has a more homogeneous road network compared to the metropolitan area. In addition, the low standard deviation means that the segment lengths are close to each other, indicating a more balanced and accessible road structure. Finally, the dominance of short and medium-length segments also indicates a more local circulation network and a denser urban fabric.

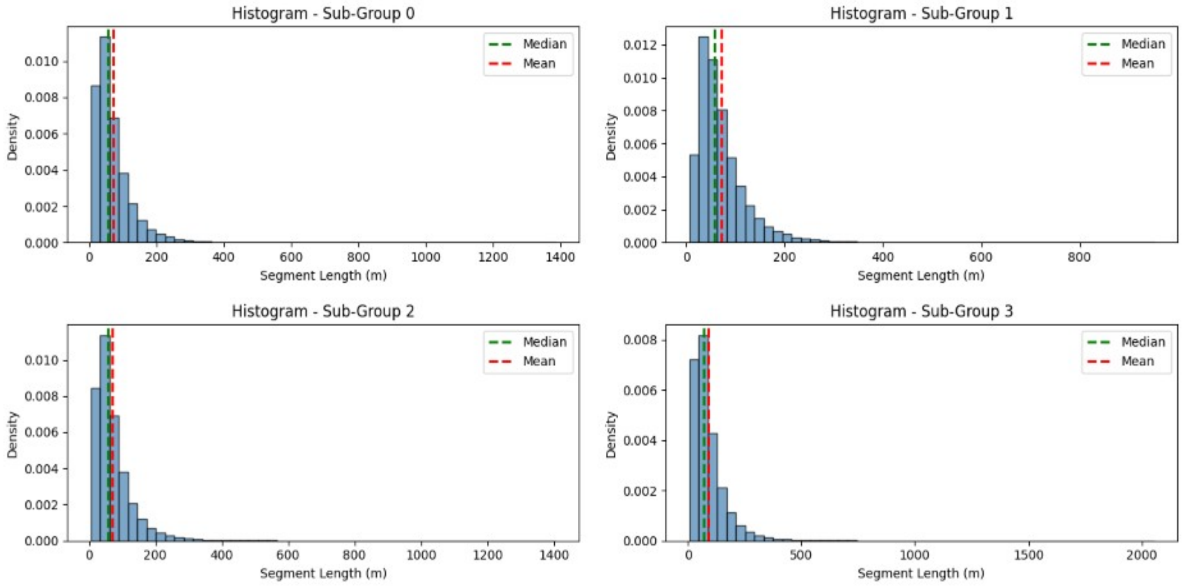
The second region covers a much larger area of 5,224 km². This area includes 685,271 segments. The average segment length is 66.4 meters, while the standard deviation is 70.96 meters. A higher variability is observed between segment lengths. The shortest segment is 5.09 meters and the longest segment is 3,456.17 meters. The high standard deviation value and wide range of lengths encountered indicate a more pronounced hierarchy and differentiation in the road network. The presence of long segments suggests that main arteries and large-scale transportation corridors play an important role. On the other hand, the presence of small segments supports a structure consisting of more fragmented and different sub-regions.

When the areas where the two main social groups are settled are compared (Figure 79), it is seen that the first region has a more compact, balanced and local circulation-friendly structure, while the second region has a configuration with wider diameters, more diverse road lengths and a clear road hierarchy. It is clear that these differences will reflect the spatial distribution of social groups, mobility access and different social dynamics in terms of land use. While the road structure in the first region reflects an area with dense population and intense social interactions, the structure in the second region represents less dense but interconnected regions with extensive transportation networks. As a result, it should be expected that these spatial characteristics will directly affect social competition and cooperation mechanisms, interactions between groups and access advantages.

The four sub-groups, under these two main groups, also present variations (Figure 80). These variations also support the existence of differences in accessibility, territorial organization, and spatial competition. Sub-Group 1.1 with 54,384 segments has an average segment length of 55.28 meters. A moderate standard deviation of 58.19 meters indicates some variation but not extreme differences in lengths. In addition, the maximum segment length is 2110.18 meters. This suggest the presence of a few long roads. However, the overall distribution is relatively balanced. Thus, it can be said that the network likely supports localized movement with moderate connectivity. This structure must have enabled the ease of access within neighborhoods. On the other hand, the presence of some long roads still points out to a hierarchy, where certain streets dominate movement while others serve more localized functions. Additionally, the compact size and dense segmentation suggest an area optimized for short-distance travel. This is supposed to foster cooperation and high levels of social interaction within the group.

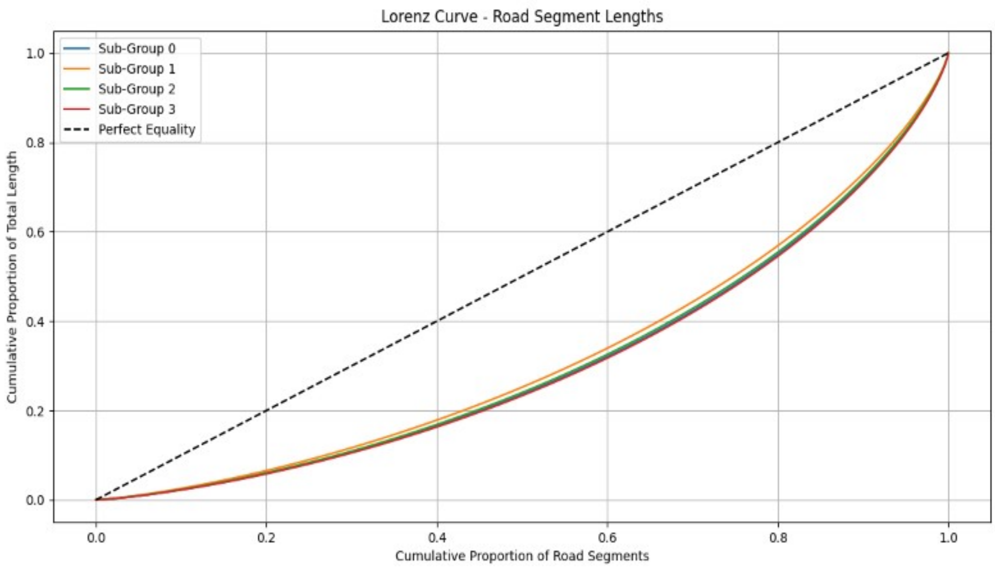
Sub-Group 1.2 (71,264 segments) exhibits a more uniform road network than Sub-Group 1.1 with a slightly higher mean segment length of 57.45 meters and a lower standard deviation of 54.6 meters. The maximum segment length is 1221.27 meters. This is significantly shorter than the ones in other areas and indicates that very long roads are less prevalent. With a more evenly distributed, non-hierarchical network, the movement in the area is supposed to be decentralized and accessibility is expected to be relatively uniform. Finally, the less pronounced hierarchy suggests lower competition for road access, potentially resulting in a relatively just area. This structure also should be expected to present an urban form that promotes local movement and reinforces cooperative dynamics rather than competitive dominance.

Figure 79 – 1st level sub-groups' segment length histograms for Metropolitan Istanbul



Obs. The histograms show that Sub-Groups 1.1 and 1.2 have a more uniform distribution, indicating balanced accessibility and cooperative movement structures. In contrast, Sub-Groups 2.1 and 2.2 exhibit long-tailed distributions, suggesting hierarchical road networks where a few dominant corridors centralize movement, reinforcing spatial inequalities. Source: Author, 2025.

Figure 80 – 1st level sub-groups' segment length lorenz curves for Metropolitan Istanbul



Obs. The Lorenz curves further highlight these disparities. Sub-Groups 1.1 and 1.2 have gentler curves, showing more equal distribution of road lengths, while Sub-Groups 2.1 and 2.2 have steeper curves, indicating high inequality in movement potential. As territorial scale increases, competition for access to well-connected roads intensifies, shaping urban segregation and spatial hierarchy. Source: Author, 2025.

The area of Sub-Group 2.1 has 104,185 road segments in total. The mean segment length is 55.96 meters and the standard deviation is 57.47 meters. The results make it structurally similar to Sub-Group 1.1. However, the maximum segment length is much higher (3076.98 meters). This indicates the presence of very long roads that significantly extend connectivity beyond the local level. There is a dual network structure with a mix of dense, local streets and long arterial roads. The resulting hierarchy in lengths implies a stronger competition-based spatial organization. Accessing to the main roads must have been critical for mobility. As a result, the presence of a more extended road system suggests a greater territorial control potential by dominant social groups. This could facilitate broader regional integration and reinforce inequalities when access to key infrastructure is unevenly distributed.

Finally, Sub-Group 2.2 (581,560 segments) is by far the largest sub-group with a much higher mean segment length of 68.3 meters. The standard deviation is also significantly larger (73.07 meters). This value indicates a highly varied network with both short local and very long arterial segments. The maximum segment length reaches 3,456.17 meters. These results reinforces the presence of a highly hierarchical network. In this structure major roads are supposed to serve as dominant corridors for movement. As a result, a strong competition-driven urban configuration is expected. Mobility advantages concentrated along primary roads must have led to deep spatial inequalities. The hierarchy means that movement is likely dictated by access to these main roads. This is supposed to result in fragmented territoriality where some social groups benefit from better connectivity, while others remain constrained within local networks.

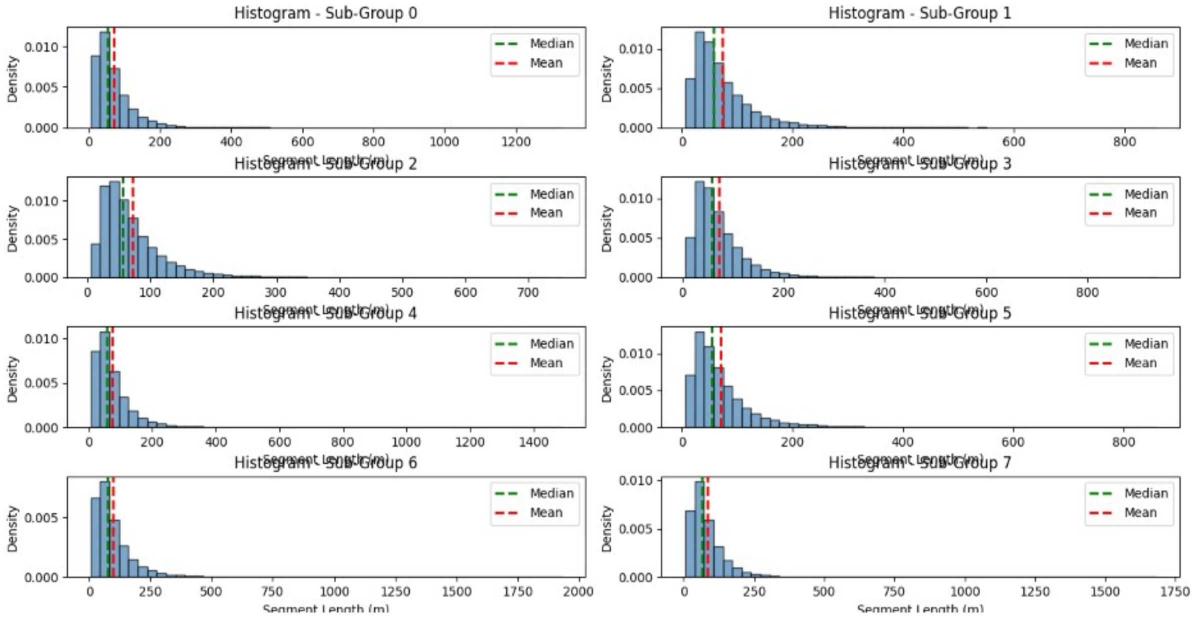
In summary, with relatively uniform segments (Figure 80), Sub-Groups 1.1 and 1.2 exhibit a more balanced and localized spatial configuration. The relatively lower standard deviations (58.19m and 54.6m) indicate that these areas likely facilitate cooperative movement patterns. The consistent street structure is expected to enhance localized accessibility. Thus, it is possible to say that there is a more evenly distributed road hierarchy. This potentially fosters internal cohesion and localized interaction rather than competition for movement. Furthermore, the moderate maximum segment lengths (2110.18m and 1221.27m) confirm the lack of extreme hierarchical differentiation. Thus, based on movement potential, they are less prone to spatial segregation.

In contrary, Sub-Groups 2.1 and 2.2 demonstrate a highly hierarchical structure. They present greater variance in segment lengths and with extremely long ones (3076.98m and 3456.17m). Also, higher standard deviations (57.47m and 73.07m) suggest unequal access to movement opportunities. Some roads act as dominant corridors while others are highly fragmented. This pattern implies that these areas serve as major mobility corridors. Some certain roads facilitate long-distance movement while others remain functionally isolated. These correspond to strong territorial divisions as groups with better access to well-connected roads gain strategic advantages in mobility. On the other hand, some others remain constrained within less connected spaces.

Finally, the relationship between territorial expansion and hierarchy becomes evident when comparing all sub-groups. As the area size increases, the network becomes more competition-based with disparities in movement potential. It is seen that territorial expansion is accompanied by increasing spatial inequality. During this process dominant roads become strategic assets that certain groups can leverage for economic and social advantages. The road networks are not only infrastructural elements but also mechanisms of social control and competition. They shape the level of access to urban resources and influence broader patterns of urban segregation.

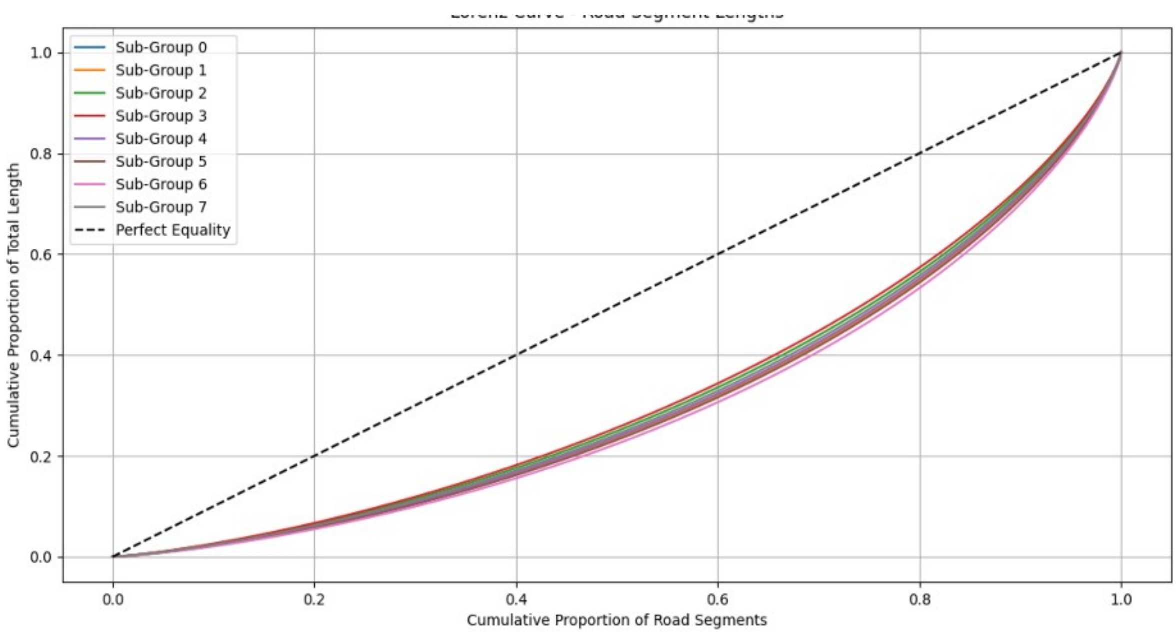
The eight second level sub-groups further reveals more detailed differences (Figure 81). The first six sub-groups (1.1.1 to 2.1.2) are characterized by relatively smaller territorial areas and moderate segment lengths. The average segment length ranging between 53.62m and 58.6m. In addition, the networks within these sub-groups' areas exhibit a certain uniformity. This can be seen in the relatively low standard deviations (ranging from 5.5m to 6.01m). Thus, it is possible to say that movement across these sub-groups is likely to be more evenly distributed. This uniformity proposes a cooperative spatial structure. Individuals within these areas are expected to experience more equal access to the resources by the roads. At the same time, the potential for collaboration between social groups must have been heightened. This is expected because of the easier localized movement and lack of significant barriers or inequalities that individuals or groups may face in terms of mobility.

Figure 81 – 2nd level sub-groups' segment length histograms for Metropolitan Istanbul



Obs. The smaller sub-groups generally show a more concentrated distribution, around a narrower range. This suggests more uniformity and cooperative accessibility. In contrast, the larger sub-groups display wider distributions with some outliers, indicating a more hierarchical structure with longer roads. This reflects potential territorial inequalities and a competition-based spatial organization. Source: Author, 2025.

Figure 82 – 2nd level sub-groups' segment length lorenz curves for Metropolitan Istanbul



Obs. Some sub-groups show curves, suggesting a dominance of longer segments that concentrate mobility. This implies that these sub-groups have more territorial control and potentially restricted access to resources. In contrast, others have flatter curves, indicating a more even distribution of lengths and cooperative accessibility, with more balanced access across segments. Source: Author, 2025.

On the other hand, the variation in maximum segment lengths ranging from 1143m to 3076m reveals the presence of key roads serving as primary access points within these areas. These longer road segments are likely the signs of subtle hierarchies despite the overall uniformity. The existence of these segments, serve as critical connectors, is supposed to create uneven patterns of access. It is expected that these roads lead to areas with better access to resources or infrastructure. This shifts the competitive dynamics within these otherwise cooperative sub-groups.

In addition, the last two sub-groups (2.2.1 and 2.2.2) stand out because of their significantly larger territorial areas. There are more pronounced hierarchical structure within their networks. The average segment lengths are 73.81m for Sub-group 2.2.1 and 64.62m for Sub-group 2.2.2. They both are higher than those of the smaller sub-groups. Furthermore, the standard deviations are notably higher such as 83.82m for Sub-group 2.2.1 and 65.06m for Sub-group 2.2.2. This proposes a greater variability in segment lengths suggesting less uniform road networks. According to these larger standard deviations, there are differentiated levels of accessibility with some areas showing higher connectivity and others more peripheral.

In these larger sub-groups, the longer segments (3456m in Sub-group 2.2.1 and 2393m in Sub-group 2.2.2) points to the existence of main corridors. They are likely to channel movement across wide territories. Thus, these key roads are typically with the highest mobility potential. The sub-groups must have been organized to promote a deeper hierarchical access to mobility. Moreover, the dominance of a few central roads leads to spatial stratification since the movement is concentrated along these primary corridors bypassing less connected areas. The result is expected to be a competition-based spatial organization. Accessing to the dominant roads becomes a critical factor in determining mobility, access to resources, and territorial control.

Hence, the creation of territorial inequalities occur. Some areas, especially those near the primary corridors must have had better access to transportation, infrastructure, and other urban resources. This likely reinforces socio-economic disparities. In contrast, more peripheral areas far to these main roads is expected to face limitations in mobility leading to relative exclusion or even marginalization. Various levels of access creates a competitive environment where groups or individuals with better access to these key roads hold a relative advantage potentially leading to competition over resources, opportunities, and social influence within the settlement.

By comparing the sub-groups that are smaller and more uniformly structured (1.1.1–2.1.2) and those that are larger and more hierarchically organized (2.2.1–2.2.2), it is seen that the larger sub-groups provides more complexity into the social dynamics of the settlement (see figure 82). In the smaller sub-groups, the uniformity of the road networks is expected to facilitate individual cooperation since there is relatively easy and equitable mobility. In contrary, the larger sub-groups provoke more competition and reinforce spatial inequalities and social stratification. Furthermore, access to primary mobility corridors must have been a critical factor for securing social standing, economic opportunities, and even political influence. The social groups or individuals who have the best access to these roads may benefit increased mobility and better access to urban resources.

As a result, urban segregation, the movement economy, and the dynamics between social groups appear to be intertwined with spatial configuration. Hierarchical differentiation in the road network reinforces existing social hierarchies, while patterns of fragmentation or continuity signal how different groups interact, compete, or cooperate within the city (Table 23). Having access to movement emerges as an important component of controlling urban resources, thus playing a critical role in spatial power and resource distribution.

The NAIN (Normalized Angular Integration) values for the two main groups provide insights into the spatial accessibility and movement potential within the urban network. Main Group 1, with a NAIN value of 0.44, suggests a lower degree of spatial integration, indicating that movement is more localized and the road network is less interconnected. This lower accessibility level aligns with a cooperative spatial structure, where movement opportunities are relatively evenly distributed, and there are fewer dominant roads that dictate access. Such a network likely facilitates localized interactions and reduces competition for access to key mobility corridors.

On the other hand, Main Group 2, with a slightly higher NAIN value of 0.458, demonstrates a more integrated network with improved overall connectivity. This higher level of integration suggests a more hierarchical structure, where certain roads act as dominant mobility corridors.

Table 23 - Configurational profiles of groups of Metropolitan Istanbul

Group	ID	Area (km²)	Segments	Mean (m)	Max (m)	NAIN	Key Characteristics
Main Group	1	237	125,5	56.44	2,110.18	0,44	Dense, uniform, cooperative network
	2	5224	685,27	66.40	3,456.17	0,46	Extensive, hierarchical, competitive network
1st Level Subgroup	1.1	109	54,38	55.28	2,110.18	0,44	Localized, uniform, cooperative
	1.2	128	71,26	57.45	1,221.27	0,58	Balanced, accessible, localized
	2.1	546	104,19	55.96	3,076.98	0,46	Mixed, slightly hierarchical
	2.2	4678	581,56	68.30	3,456.17	0,49	Extensive, hierarchical, competitive
2nd Level Subgroup	1.1.1	43	26,65	53.67	2,110.18	0,67	Compact, local, uniform
	1.1.2	66	27,89	57.01	1,512.89	0,58	Small-scale, balanced
	1.2.1	60	39,31	56.58	1,221.27	0,39	Moderately uniform, localized
	1.2.2	68	32,04	58.60	1,143.44	0,44	Consistent, accessible
	2.1.1	358	68,69	57.29	3,076.98	0,39	Extensive local network, moderately hierarchical
	2.1.2	188	35,5	53.62	3,076.98	0,58	Fragmented, mixed
	2.2.1	3311	238,68	73.81	3,456.17	0,46	Dominant, highly connected, hierarchical
	2.2.2	1367	343,84	64.62	2,393.30	0,49	Broad, diverse, accessible

Source: Author, 2025.

As a result, movement is likely more centralized, reinforcing competition for access to key roads and potentially contributing to spatial inequalities. The increased integration level may indicate a greater emphasis on major roads that serve as primary access routes, creating a competitive advantage for individuals or social groups located near these critical infrastructure points.

Although the difference in NAIN values between the two groups appears small, it holds significant implications for spatial organization. Main Group 1's more evenly distributed network suggests a more balanced and cooperative urban structure, where access to resources is less dependent on proximity to dominant corridors. In contrast, Main Group 2's slightly higher integration level points to a more competition-driven configuration, where mobility advantages are more concentrated along primary roads, leading to a higher potential for social and territorial stratification. This distinction underscores the relationship between road network hierarchy and urban inequalities, highlighting how spatial organization influences patterns of access, competition, and segregation.

The evaluation of the four sub-groups within the two main groups based on their NAIN (Normalized Angular Integration) values provides further insights into the spatial accessibility and hierarchical organization of the urban network (see table 4). Sub-Group 1.1, with a NAIN value of 0.44, maintains the same integration level as its parent group, Main Group 1. This suggests a relatively uniform and decentralized road network, where movement is more evenly distributed. The spatial configuration in this sub-group likely fosters cooperative movement dynamics, as there is no strong hierarchy concentrating access in specific locations. The lack of dominant roads reduces competition for key mobility corridors, resulting in a more balanced territorial structure with fewer mobility-based inequalities.

Sub-Group 1.2, however, exhibits a significantly higher NAIN value of 0.582, indicating a much more integrated network compared to the other sub-groups. This suggests the presence of key corridors that enhance connectivity and centralize movement. The high integration level points to a more hierarchical spatial structure, where access to certain roads becomes a critical factor in mobility. Such a configuration is expected to generate competition for movement opportunities, potentially leading to spatial inequalities. Social groups with better proximity to the primary roads in this sub-group are likely to experience advantages in accessing urban resources, reinforcing territorial stratification.

Sub-Group 2.1, with a NAIN value of 0.458, mirrors the integration level of its parent group, Main Group 2. This suggests a moderate level of hierarchy, where a balance exists between local and regional movement. The presence of key roads may create some degree of spatial stratification, but overall, movement is not excessively centralized. The structure is likely characterized by a mix of cooperative and competitive dynamics, where access to infrastructure is somewhat balanced, but disparities may emerge in areas with stronger connectivity.

Sub-Group 2.2, with a NAIN value of 0.491, shows a slightly higher integration level than Sub-Group 2.1. This suggests a more pronounced spatial hierarchy, where movement is more concentrated along specific roads. The increase in integration implies that accessibility is less uniform, leading to potential territorial advantages for groups near well-connected corridors. This configuration supports stronger competition for access to high-mobility areas, reinforcing spatial inequalities. The structure of this sub-group likely promotes strategic control over key roads, influencing patterns of economic and social advantages.

Overall, the variation in NAIN values among the sub-groups reveals increasing spatial inequalities as integration rises. While Sub-Groups 1.1 and 2.1 exhibit more balanced movement patterns that encourage cooperation, Sub-Groups 1.2 and 2.2 display more hierarchical structures that promote competition for mobility. This reinforces the broader trend that higher integration levels correlate with more pronounced territorial advantages, shaping urban segregation and social stratification.

The analysis of the eight second-level sub-groups based on their NAIN (Normalized Angular Integration) values provides deeper insights into the spatial hierarchy and accessibility patterns within the urban network. These values reveal the extent to which each sub-group fosters either cooperative or competitive movement dynamics. Sub-Group 1.1.1, with a NAIN value of 0.668, exhibits the highest integration among all second-level sub-groups. This suggests a highly connected and centralized network where movement is efficiently channeled through dominant corridors. Such a structure fosters competition for access, as key roads hold significant strategic value. The strong hierarchy in this sub-group likely reinforces territorial advantages for groups with privileged locations, intensifying spatial inequalities. Sub-Group 1.1.2, with a NAIN value of 0.583, remains relatively well-integrated but shows slightly lower connectivity than 1.1.1. This indicates a structured yet somewhat decentralized network, where accessibility is still uneven but less extreme. While competition for movement may still play a role, there is a greater potential for localized cooperation due to the less rigid spatial hierarchy.

Sub-Group 1.2.1, with a NAIN value of 0.394, displays the lowest integration in its category. This suggests a less connected and more fragmented road network, where movement remains primarily local. The lack of strong hierarchical organization likely fosters cooperative dynamics, as accessibility is more evenly distributed. This sub-group is expected to experience lower levels of competition for mobility, reducing spatial inequalities. Sub-Group 1.2.2, with a NAIN value of 0.44, shows slightly higher integration than 1.2.1 but remains relatively decentralized. This suggests a structure that balances local and regional movement, with moderate accessibility disparities. While competition for movement is not a dominant factor, certain roads may still act as key connectors, influencing mobility patterns.

Sub-Group 2.1.1, with a NAIN value of 0.389, has one of the lowest integration levels among all sub-groups. This implies a highly localized network where accessibility is more uniform, reducing territorial inequalities. The decentralized movement structure likely promotes cooperative dynamics, as no significant hierarchy dictates spatial advantages. Sub-Group 2.1.2, with a NAIN value of 0.582, contrasts sharply with 2.1.1, indicating a far more integrated and hierarchical network. This suggests a structure dominated by key mobility corridors, where competition for access is higher. The presence of dominant roads likely results in spatial segregation, as certain areas gain superior connectivity advantages over others.

Sub-Group 2.2.1, with a NAIN value of 0.459, presents moderate integration, reflecting a semi-hierarchical network. The balance between local and regional connectivity suggests a mixed spatial organization where both cooperative and competitive movement dynamics may emerge. While disparities in accessibility exist, they are not as pronounced as in more integrated sub-groups. Sub-Group 2.2.2, with a NAIN value of 0.492, shows slightly higher integration than 2.2.1, reinforcing the presence of spatial hierarchy. This suggests a more competition-driven movement pattern, where certain roads serve as dominant corridors. The resulting territorial stratification can lead to disparities in mobility opportunities, affecting access to urban resources.

Overall, the variation in NAIN values among the second-level sub-groups highlights the intricate relationship between spatial structure and social dynamics. Highly integrated sub-groups, such as 1.1.1 and 2.1.2, foster competitive mobility patterns and territorial inequalities, while less integrated sub-groups, such as 1.2.1 and 2.1.1, support more cooperative and evenly distributed accessibility. These patterns reveal the extent to which road networks shape urban segregation, reinforcing the role of spatial hierarchy in social and economic disparities.

The results indicate that demographic and socio-economic variables are intricately linked with the configurational features of the urban road network. For instance, total population, area, and the various population subcategories (such as female, male, married, child, and elderly populations) show extremely high positive correlations with configuration metrics like the number of lines, average length, and mean segment length. This suggests that as the overall urban population increases, the road network becomes denser and more extensive, likely as a response to the increased demand for connectivity and mobility. The strong correlations indicate that larger and more populous urban areas tend to have a more complex road infrastructure, which could be a reflection of historical growth patterns and the need to service diverse urban functions.

Conversely, population density reveals a different relationship when compared with other configuration measures. Although total population and area are positively related to metrics such as Number of Lines, the negative correlation between population density and some of these network features implies that high-density areas often have more compact urban forms. In these areas, the road network might be designed to maximize connectivity within a limited spatial extent, leading to different network characteristics compared to sprawling urban forms where extensive road systems serve lower densities.

Socio-economic indicators such as annual average income, literacy ratios, and social assistance recipients also display notable relationships with road network configuration. The negative correlations observed between income and several road metrics suggest that higher-income areas might have more planned or less fragmented road networks, perhaps as a result of targeted urban planning policies. Similarly, lower social assistance recipient ratios in areas with certain network characteristics could indicate that more integrated and well-connected urban environments provide better access to services and opportunities, thereby reducing social vulnerability.

Furthermore, indicators of stability and residential patterns, such as the homeowners-to-tenants ratio and average duration of residence, exhibit moderate correlations with the configurational features. This points to a potential link between the structure of the road network and the social fabric of a community. Areas characterized by a more stable residential population and higher home-ownership might benefit from a road network that supports both accessibility and localized connectivity, thereby reinforcing community cohesion.

Lastly, the Normalized Angular Integration (NAIN) values, although showing lower correlations with many demographic and socio-economic variables, still provide a nuanced picture of accessibility. Lower NAIN values in some areas may correspond to more decentralized networks that promote localized movement and cooperative dynamics, while higher NAIN values indicate more centralized, hierarchical configurations that could lead to competitive advantages in mobility. Overall, the interplay between these variables suggests that urban form, as expressed through road network configuration, is both a driver and a reflection of underlying demographic and socio-economic conditions, highlighting the complex dynamics of urban segregation and social stratification.

4.4 Comparison of socio-spatial dynamics

Both São Paulo and Istanbul exhibit urban dynamics that reveal common underlying principles of social competition, cooperation, territoriality, and segregation, even the specific drivers and expressions of these dynamics differ in some points (Table 23). First of all, similar and differing correlations between demographic, socioeconomic and spatial variables provide a deeper understanding of the different urbanization patterns and socioeconomic structures. In both cases, population size is strongly correlated with basic demographic indicators such as area, number of households, and male and female populations. Urban growth in both metropolises follows a predictable pattern. Naturally, geographical expansion is accompanied by an increase in household formation and demographic density. As expected, the number of births and deaths in each city exhibits near-perfect correlations with population size, as well.

Additionally, employment and economic activity show significant correlations with population size. In São Paulo, formal employment and the number of companies display strong associations with population growth. This reflects the economic pull of the region. Similar patterns emerge also in Istanbul. However, there is an emphasis on household and educational variables. The number of highly educated individuals has a high correlation with total population. This supports the idea that urbanization is closely tied to educational attainment.

Another common pattern is the inverse relationship between gender ratio and population size. In both cases, a higher population correlates with a lower male-to-female ratio. This underlines the fact that migration and urban labor market structures influence gender distribution. This result must have caused by the sectors that attract more female workers.

Although the correlations vary, household characteristics and demographic density also exhibit notable relationships in both cases. In São Paulo, household size and total dependency ratios are inversely related to urbanization. As population grows, average household size decreases and dependency burdens shift. In Istanbul, elderly dependency ratios play a more important role. This indicates that aging demographics contribute differently to urban population structures.

When examining economic and social variables, distinctive patterns emerge. São Paulo exhibits stronger correlations between economic indicators and population size. For example, average nominal salary and healthcare expenditure per inhabitant show significant associations with urbanization. In this case, economic prosperity scales with population growth. Nevertheless, Istanbul presents a more diversified correlation structure with highly relevant education levels and social assistance programs. The number of social assistance recipients is significantly correlated with population. There is a strong relation between urbanization and the welfare system. In São Paulo, where economic disparities seem to influence access to public services more than formal welfare mechanisms, this pattern is less evident.

Healthcare infrastructure also follows different patterns. In Istanbul, healthcare facility area per capita exhibits meaningful correlations with demographic indicators as a sign of planned distribution of healthcare resources in response to urban growth. In São Paulo, however, the relationship seems to be more focused on financial aspects. Healthcare expenditure per inhabitant is a key variable. Thus, it is possible to assume that economic inequalities play a stronger role in determining healthcare access in São Paulo compared to Istanbul's more spatially structured healthcare system.

Thus, both cities exhibit strong correlations between population growth and key indicators such as household formation, employment, and economic activity. However, São Paulo's urbanization appears to be more closely linked to economic variables, while Istanbul's development trajectory appears to be more related to education and social assistance. In addition, dependency ratios and household composition trends also differ, reflecting differences in demographic aging and family structures.

In Metropolitan São Paulo, despite minor variations, the gender location quotients (LQ) are relatively balanced across municipalities. However, municipalities such as São Caetano do Sul (LQ = 1.038) and the city of São Paulo (LQ = 1.010) host female concentration slightly. This may be associated with higher employment opportunities for women or a larger elderly female population due to longevity differences. Istanbul also presents a similar gender balance. Nevertheless, some municipalities like Bakırköy (LQ = 1.068) display a stronger female presence. In this case, it must have been linked to the higher socio-economic status and aging population.

Considering racial and ethnic identities, São Paulo's municipalities exhibit significant disparities. For example, Mogi das Cruzes (LQ = 2.300) and Biritiba Mirim (LQ = 2.264) indicate strong ethnic clustering for yellow-skinned population. This is obviously linked to historical migration patterns. Additionally, lower LQ values for white and black populations in several municipalities highlight ongoing racial segregation while brown-skinned populations are over-represented in Francisco Morato (LQ = 1.377). On the other hand, Istanbul demonstrates strong patterns of internal migration. For instance, municipalities with high LQ values for individuals registered in other cities such as Avcılar (LQ = 1.648) highlight Istanbul's role. Furthermore, Arnavutköy, where LQ coefficient of social assistance recipients is 1.334, shows economic disparities and the clustering of lower-income, migrant communities. Finally, there are notable concentrations in certain municipalities like Adalar (LQ = 0.230).

Household structures also provides important insights into the degree of social cooperation and urban centrality. Considering LQ coefficients of married population, in São Paulo, municipalities like Poá (LQ = 1.475) and Ribeirão Pires (LQ = 1.570) indicate strong traditional family structures. In addition, Carapicuíba (LQ = 0.303) and Taboão da Serra (LQ = 0.230) exhibit lower private household concentrations. These values possibly shaped by economic constraints leading to cohabitation or extended family arrangements. On the other hand, Istanbul shows contrasting household structures. For example, while Adalar hosts a notable proportion of single-person households (LQ = 2.061), Bağcılar (LQ = 1.187) highlights the dominance of nuclear family. Moreover, with the presence of non-traditional households, Arnavutköy (LQ = 0.442) reflects different urban survival strategies. This strategy, based on shared housing solutions, is possibly shaped due to economic hardship.

Considering economic segmentation and employment patterns, São Paulo exhibits notable disparities. Barueri has the highest formal employment concentration (LQ = 2.785), pointing to its role as an economic center. In contrast, Carapicuíba (LQ = 0.248) and Francisco Morato (LQ = 0.167) do not provide enough accessibility. These examples highlights economic centrality by presenting certain municipalities with concentrated employment opportunities. Meanwhile, Istanbul follows a similar pattern. However, a higher education component accompanies. For example, Bakırköy (LQ = 1.862) and Ataşehir (LQ = 1.384) exhibit high concentrations of highly educated individuals. Conversely, individuals in Bağcılar (LQ = 0.563) have a struggle of access to higher education. These reinforce socio-economic divide and exacerbate urban inequalities.

Demographic age structures reveal more information. In São Paulo, São Caetano do Sul (LQ = 1.579) and Guararema (LQ = 1.112) host larger elderly populations, reflecting aging trends. In contrast, high LQ values for child population in municipalities like Cajamar (LQ = 1.180) and Francisco Morato (LQ = 1.231) points to younger communities with higher fertility rates. Istanbul, on the other hand, exhibits a sharper contrast. Adalar has an aging population with and LQ value of 2.678. This is possibly linked to wealthier retirees and their environmental chose. Meanwhile, Arnavutköy (LQ = 1.335) and Bağcılar (LQ = 1.155) show higher child population concentrations. These values indicate younger and growing families with limited economic means.

The concept of centrality further deepens the understanding of urban dynamics. In São Paulo, central municipalities such as the city of São Paulo have higher concentration of formal employment and educational attainment due to the role of being the center of economic activity and cultural exchange. As peripheral municipalities face reduced access to the urban core’s benefits, this concentration of resources and opportunities reinforces social stratification. In Istanbul, beside economic and educational terms, centrality is manifested in the spatial distribution of demographic groups, as well. With high concentrations of elderly populations, Adalar and Bakırköy point to a centrality defined by quality of life and residential desirability. On the other hand, most of the economic and social pressures resulting from high migration flows are experienced in peripheral municipalities

It is important to consider that these values serve as proxies for the relative concentration or scarcity of specific demographic and socio-economic characteristics within the areas of municipalities compared to metropolitan areas. Thus, in both cases, higher values can be seen as the signs of concentrated social capital and the resources accessibility potential. They may also point to segregated areas with intensified competition for limited resources. On the other hand, lower values might indicate areas of relative isolation and marginalization. Within these areas cooperative social networks, which counterbalance systemic disadvantages, are expected to be absent or insufficient. Thus, the observed spatial patterns help to interpret multifaceted processes in which social competition and cooperation intersect with historical patterns of territorial struggle and urban centrality.

In conclusion, the comparison of the LQ data pictures that urban segregation in Metropolitan São Paulo is dominated by racial and economic divisions within a context of historical labor market dynamics and familial configurations. On the other hand, segregation patterns in Istanbul is strongly defined by internal migration, educational disparities, and the spatial ordering of socio-economic opportunities. However, both cases exhibit a form of territoriality, limiting the social mobility. This limitation reinforces settled urban hierarchies that are shaped by long-standing structural forces (Table 24).

Table 24 - The structural differences and similarities between two cases

Dimension	Metropolitan São Paulo	Metropolitan Istanbul
Gender Distribution	Generally balanced. Municipalities such as São Caetano do Sul, São Paulo show a slight female concentration that may be linked to higher employment or aging patterns.	Generally balanced. Municipalities such as Bakırköy display a stronger female presence, which can be associated with higher socio-economic status and aging demographics.
Racial/Ethnic Composition	Exhibits significant racial clustering. High LQs for different populations in specific municipalities point to long-term spatial differentiation, reflecting historical and socio-economic segregation.	Segregation is primarily defined by internal migration patterns, with groups clustering in different municipalities based on economic opportunity and historical settlement trends.
Migration and Population Registration	Historically shaped by migration and economic shifts, with racial stratification playing a major role. Marginalized groups are often confined to peripheral areas, reinforcing a long-standing hierarchy.	Internal migration result in distinct population clusters with notable differences in residents both within Istanbul and from other cities. Notable foreign populations in some areas, as well.
Household Structures and Social Cooperation	Traditional family structures prevail in many municipalities, with high LQs for married populations and nuclear families in central areas. Peripheral areas sometimes exhibit lower private household LQs, suggesting extended or collective living arrangements as an adaptive form of cooperation.	Household compositions are diverse. Affluent municipalities have high proportions of single-person households, while other areas feature strong nuclear family patterns. Non-traditional living arrangements are more common in economically pressured or migrant-heavy municipalities.
Employment and Economic Opportunity	A notable divergence in formal employment. Economic centers like Barueri have very high employment LQs, while peripheral municipalities such as Carapicuíba and Francisco Morato show very low formal employment, indicating spatial and economic inequalities.	Economic opportunities are unevenly distributed. Municipalities with high higher-education LQs like Bakırköy and Ataşehir correspond to better employment prospects and wealth, whereas areas like Bağcılar exhibit high social assistance dependency and lower education levels.

Table 24 - The structural differences and similarities between two cases - continues

Dimension	Metropolitan São Paulo	Metropolitan Istanbul
Educational Attainment	Higher education and formal employment tend to be concentrated in central municipalities, reinforcing socio-economic centrality. Peripheral areas often experience reduced access to quality education and formal job opportunities.	A clear divide. Central municipalities display high LQs for higher education, while areas with large migrant populations (e.g., Bağcılar) show lower educational attainment, reinforcing socio-spatial inequalities and limiting upward mobility.
Demographic Age Structure	Variation across municipalities. Some areas (e.g., São Caetano do Sul) have higher concentrations of elderly populations, whereas other municipalities register higher child population LQs, suggesting younger, potentially lower-income communities.	Sharper contrasts. Affluent districts such as Adalar and Bakırköy tend to attract older, wealthier residents, while districts with high migration inflows (e.g., Arnavutköy, Bağcılar) exhibit a younger demographic, indicating rapid population growth and economic pressures.
Centrality and Spatial Dynamics	Urban centrality is marked by higher formal employment, education, and resource concentration in central municipalities, while peripheral zones lag behind in economic and social opportunities.	Defined by economic affluence, access to education and quality of life. Central areas are characterized by high educational attainment and a concentration of resources, while peripheral areas, often populated by migrants, face intense socio-economic competition.

Source: Author, 2025.

The social groupings obtained from random forest analysis details common underlying principles and genuine social processes shaped by different historical, cultural, and socio-economic factors. In both cases, the separation of the population into main groups, sub-groups, and second-level sub-groups reflects a process in which different social groups compete for and cooperate around vital resources. From demographic to economic indicators, the variables that define groupings act as proxies for access to opportunities and urban resources, revealing the structural forces underlying spatial segregation.

In São Paulo, as mentioned above, the grouping dynamics are strongly influenced by traditional household configurations and racial backgrounds. Variables such as married population counts, private to collective household ratios, and specific racial indicators such as the Indigenous and brown- populations are central to group differentiation. Groups that has high married population are associated with stable, nuclear family structures. These features serve as an important mechanism of social cooperation in an environment facing high level of economic competition. These households also tend to indicate a strong degree of social stability. In turn, this stability correlates with higher levels of formal employment and nominal average salaries. In several groups, the same interplay is also evident in other social indicators such as life expectancy and healthcare expenditure per inhabitant. The more successful groups with higher average salaries and formal employment figures have better access to healthcare and show higher life expectancies. Thus, this pattern points to a clear territoriality. Historically marginalized groups, which are delineated along racial lines, are kept in peripheral zones with fewer economic resources and opportunities, reinforcing entrenched urban hierarchies.

In contrast, Istanbul's grouping dynamics are effected by a greater emphasis on educational attainment, migration patterns, and the social services accessibility. The grouping process includes education-related variables from primary and secondary school enrollments to college and masters degree achievements. The human capital aspect of education also reflects pathways to economic centrality since they increase the capacity to obtain better-paying jobs and have upward mobility. Additionally, migration-related indicators are key drivers of territoriality and social segregation. For instance, groups with a higher proportion of residents registered in other cities tend to have different household compositions. Higher single-person household ratios indicates a shift from traditional family structures toward more fluid living arrangements. Moreover, healthcare infrastructure provide insights into the public services availability for different groups. Thus, it is seen that within the economic and social aspects of urban competition, access to education and healthcare is as vital as access to jobs.

Despite the differences above, both metropolitan areas also demonstrate common principles in their social dynamics. In each case, the most successful groups are the ones that achieve a favorable balance between competition and cooperation. In São Paulo, groups with higher formally employed members and better economic indicators cluster in more central territories with optimized access to resources. Similarly, in Istanbul, groups that have high levels of education and benefit from superior healthcare infrastructure also occupy more central positions. The dependency ratios offer additional insights. Both cases exhibit ratios indicating the relative pressure on the working-age population. These ratios, in turn, affects social cooperation mechanisms within groups, reflecting the balance of demographic pressures that all groups need to manage.

To sum up, the grouping results shows that the fundamental drivers of urban segregation, social competition, cooperation, territoriality, and centrality, are evident in each case. Nevertheless, the specific indicators that define group performance deviate significantly. What is common to both cases is that successful group formation, and hence social mobility, depends on the ability to secure vital resources. However, the varying ways of achievement reflect the unique historical contexts and current urban challenges of each metropolitan area.

These two metropolitan areas display distinct but thematically comparable urban structures when analyzed through their road network characteristics and underlying socio-economic drivers, as well. In São Paulo, the network configuration is defined by a contrast between compact, cooperative areas and extensive, competitive ones. The cooperative first main group suggests a localized network with a mean segment length of 49.32 meters and a high NAIN of 0.615. Here, short segments and better-grained connectivity is expected to facilitate equitable access and social cohesion because of reduced physical barriers. Thus, it may help to mitigate urban segregation and also can be the result of more uniformly distributed resources and mobility. In contrast, despite having a slightly lower NAIN (0.589), the competitive second main group settles on a far larger area with a much higher maximum segment length (2627.82 meters). This points to the dominant arterial roads that concentrate movement and create focal points for economic activity and mobility. As a result of this hierarchical arrangement, social competition is supposed to intensified due to privileged areas adjacent to these major corridors. This potentially reinforces territorial enclaves, thus, contributes to spatial inequalities.

Istanbul's network configuration, although also divided into cooperative and competitive areas, operates at a different scale and intensity. First of all, the cooperative first main group covers a relatively small area (237 km²). This area has a mean segment length of 56.44 meters and a NAIN of 0.44. As a result, it is characterized by a dense and uniform network. This configuration reflects a highly integrated layout where localized movement is emphasized, thus, social interactions are facilitated through evenly distributed connectivity. On the other hand, the competitive second main group covers an area of 5224 km². It also has a longer mean segment length (66.40 meters), a slightly higher NAIN (0.458), and a maximum segment length of 3456.17 meters, reflecting a more hierarchical network structure. Within this structure dominant corridors serve as primary conduits for long-distance movement and segments the entire settlement. This possibly exacerbates territorial competition among different social groups.

At the first sub-group level in both cases, the contrast gets deeper. In São Paulo, for instance, Sub-Groups 1.1 and 1.2 represent smaller and localized networks. These networks predominantly have shorter segments and relatively low variability. These areas are likely to promote cooperative dynamics. The residents are supposed to benefit from even access and reduced spatial segregation. However, Sub-Groups 2.1 and 2.2 settle on larger territories and incorporate longer and dominant roads. This differentiation fosters competitive dynamics and create hierarchies. Access to major roads likely provide strategic advantages. As a result, territorial inequalities occur. On the other hand, the picture of Istanbul's corresponding sub-groups is similar. The magnitude of differences in NAIN values and mean segment lengths indicates that even within competitive areas, Istanbul maintains a balanced mix between extensive connectivity and localized access compared to São Paulo. In Istanbul, the urban fabric seems to temper the extremes of centralization likely due to geographical features and historical growth patterns. It must have been also the results of planning policies that have promoted denser and more interconnected networks even in peripheral areas.

At the most granular level, the interplay between configuration and socio-economic dynamics becomes even more telling. São Paulo's second-level sub-groups reveal that areas with low NAIN values are associated with localized and uniform networks, facilitating cooperative spatial outcomes. The movement is distributed evenly in these pockets This suggests reduced spatial segregation and enhanced accessibility within the areas. Conversely, sub-groups with higher NAIN values (up to 0.688) picture areas where the network is dominated by long corridors that channel movement centrally. As a result, these competitive zones experience greater social stratification since access to key infrastructure is a decisive factor in territorial control and resource allocation. In Istanbul, the second-level sub-groups show similar trends, as well. However, the range of NAIN values is generally less extreme. With dominant corridors and higher centrality, certain areas exhibit competitive characteristics but the overall integration of the network maintains some sort of uniformity. This likely mitigates extreme segregation.

In addition, the relationships between demographic and socio-economic variables and structural criteria in both settlements highlight the mutual influence of urban growth and road network evolution. In São Paulo, the relatively more pronounced hierarchical segmentation in competitive areas can be seen as both a driver and a reflection of underlying socio-economic disparities. Dominant roads create zones of concentrated wealth and power while isolating peripheral communities. Nevertheless, despite the current hierarchical elements in Istanbul, the overall dense and uniform configuration in cooperative areas suggests a more integrated urban environment. This must have promoted social cohesion, even as competitive dynamics emerge at larger scales.

Thus, the two cases supports the idea that foundational socio-economic elements drive urban growth, which in turn shapes the road network's configurational features. Moreover, these features direct urban accessibility, movement patterns, and the degree of territoriality. Eventually, in São Paulo, the interplay between extensive competitive networks and compact cooperative zones highlights sharp spatial segregation, whereas in Istanbul, the balance between dense local connectivity and broader hierarchical corridors points to a more moderated but still complex interaction between social cooperation and competition.

Considering the social groupings that settle on these areas, both cases points to a common principle. Formation of groups is driven by the interactions among economic activity, network connectivity, and social capital. None of the group distinctions based on raw population counts. The quality and distribution of services, education and infrastructure are the base of competitive and collaborative dynamics.

In the case of Metropolitan São Paulo, economic and infrastructural features are dominant. The areas with concentrated technical and innovation sectors are pivotal in shaping urban competition. They must have attracted specialized employment, boosting local economies. This is expected to amplify competition among neighboring areas for further investment and connectivity, as well. In addition, formal employment and educational organizations structure economic environments that foster distinct social groups. These groups likely benefit from dominant infrastructural elements such as arterial roads and better-connected networks.

Table 25 - Common features and distinct characteristics of settlements

Domain	Principles	Metropolitan São Paulo	Metropolitan Istanbul
Social Competition	Dominant corridors concentrate resources, drive competitive dynamics through strategic nodes.	Extensive, hierarchical corridors with contrasts between cooperative and competitive networks reinforce territorial enclaves and spatial segregation.	Competitive zones exist, yet overall integration tempers extreme centralization; competitive areas are balanced with a dense network.
Social Cooperation	Uniform, decentralized networks promote equitable resource distribution and localized access.	Compact, cooperative zones with better-grained connectivity in smaller areas, enhancing localized interactions but contrasting with more hierarchical areas.	Dense and uniform networks in the core facilitate widespread cooperation with equitable access, despite larger territorial extents.
Centrality	Central hubs emerge around key nodes, reinforcing economic and social activity via feedback loops.	Dominant corridors form strong central nodes that create strategic advantages and territorial enclaves, leading to pronounced spatial inequalities.	Central nodes arise organically over time, resulting in a moderated centrality that is integrated within a dense urban fabric with less stark segregation.
Territoriality	Delineation and control of space are universal, reflecting socio-economic disparities and resource concentration.	Territorial boundaries are evident between competitive and cooperative zones, resulting in marked spatial fragmentation and territorial segregation.	Boundaries exist but are more continuous and fluid due to historical growth and planning, leading to a less fragmented territorial structure.

Source: Author, 2025.

Territoriality is also pronounced in the areas with neighborhoods that have limited connectivity, as reflected in features like households without connection to the sewage system. These areas are isolated from the better-connected areas. Hereby, this spatial segregation reinforces centrality in key corridors, creating territorial enclaves that serve as hubs of economic and social activity (Table 25).

Unlike São Paulo, Istanbul's grouping places more emphasis on social composition and the quality of human capital (Table 28). The importance of gender ratio shows that even subtle imbalances in social structure creates differences in access to opportunities. Moreover, advanced educational measures play an important role. Highly educated individuals contribute to the formation of central, well-integrated social groups. These high-skilled groups might have caused centralized services and high connectivity in certain areas. Thus, this situation reinforces a moderated form of competition. The presence of health infrastructure and housing stability also points to the importance of cooperative dynamics. In areas with stable housing and reliable access to essential services, individuals and groups may operate in a more collaborative way and facilitate more equitable resource distribution.

The mutual relationship of competition and cooperation is further reflected on territoriality and centrality in both cases. In São Paulo, the competitive areas with hierarchical networks and long dominant roads lead to territorial boundaries, separating areas of high economic activity. They also reinforce inequalities by segregating those benefiting from central connectivity from those who are marginalized by infrastructural deficits. In contrast, Istanbul's urban structure has a more continuous layout. Even within competitive zones, the presence of high educational attainment and health services suggests that territorial boundaries are less effective. This fosters a degree of integration that must have mitigated extreme segregation.

Furthermore, the groupings imply how different urban processes interact over time. In São Paulo, the dominance of technical innovation and formal employment can catalyze rapid growth in competitive areas. This also may lead to a loop where dominant corridors attract further investment and increasingly stratified spatial patterns. In Istanbul, otherwise, the role of social capital and advanced education suggests that long-term stability and gradual evolution may be more effective. Here, the persistence of cooperative networks within an entire competitive structure points to the importance of inclusive service provision and the benefits of historically dense urban core.

Table 26- Comparison of groupings

Aspect	Metropolitan São Paulo	Metropolitan Istanbul
Key Drivers of Social Group Formation	Economic activity, infrastructure, employment networks	Social composition, human capital, education, service quality
Dominant Factors	Technical and innovation sectors, formal employment, network connectivity	Gender ratio, education levels, social integration, healthcare access
Urban Competition	Driven by concentrated economic sectors, attracting specialized employment and investment	Moderated by social structure, where education and stable housing balance competitive pressures
Role of Infrastructure	Central in determining social group access and mobility; arterial roads reinforce segregation	High connectivity supports more integrated social groups and less rigid territorial divisions
Spatial Segregation	Limited connectivity in marginalized areas leads to territorial enclaves	More continuous urban layout with integration despite competitive zones
Cooperative Dynamics	Less emphasized, as infrastructure and economic hierarchies shape access to opportunities	Stronger presence in stable housing areas with healthcare access, fostering equitable resource distribution
Territoriality and Centrality	Hierarchical networks reinforce inequalities, separating economically active zones from marginalized areas	More fluid structure with high education and service presence mitigating extreme segregation
Long-Term Urban Processes	Rapid economic-driven growth in competitive areas leads to further stratification	Gradual urban evolution, sustained by social capital and inclusive service provision
Overall Urban Structure	Economic differentiation and infrastructure disparities drive territorial competition	Social factors moderate competitive pressures, leading to a more balanced urban form

Source: Author, 2025.

To sum up, in both cases social groups are not merely defined by numbers of individuals. The quality of interactions between infrastructural, economic, and social factors are the underlying drivers. São Paulo's competitive dynamics are closely tied to economic differentiation and infrastructural disparities. They lead to current territoriality and centrality along key routes. In contrast, Istanbul's social group formation appears more moderated. Despite competitive pressures, the factors of social composition, educational attainment, and service access contribute to a more integrated urban structure (Table 28).

As a result, it is seen that São Paulo's urban structure is primarily defined by economic forces. In this case, hierarchical road networks and dominant corridors intensify territorial competition and spatial inequality. Concentrated competition along key routes, infrastructure plays a central role in shaping movement and economic disparities. Conversely, Istanbul's urban dynamics are more moderated by social and educational factors. Cooperative networks, high educational attainment and healthcare distribution are directly related with a more integrated urban form. While both cities exhibit competition and cooperation, their manifestations differ. On one hand, São Paulo's spatial stratification emerges from economic differentiation and infrastructural centralization. On the other hand, Istanbul's urban fabric softens extreme spatial segregation with more homogeneous connectivity and social cohesion. These contrasts reflect the unique historical, economic and demographic contexts of each case, answering the question of how urbanization processes shape and are shaped by the interaction between competition, cooperation, centralization and territoriality.

In the end, transpatial social groups can be identified in both metropolitan São Paulo and Istanbul by tracing the underlying structural features that define the social stratifications (Table 27). Despite their different socio-historical trajectories, both cases display main and sub-groupings that reflect the interplay of social dynamics and spatial organization.

In the upper levels of both social hierarchies, the advantaged groups engage in competition for exclusive resources while forming powerful networks of cooperation. In São Paulo, advantaged groups, represented by the second main group and its subgroups, also compete internally for access to better real estate, and education. Their success is evident in high nominal average salaries and obtained formal employment figures. This also allow them to secure better healthcare and longer life expectancy. In addition, they maintain cohesion through stable and traditional household structures. This is expected to strengthen mutual support and reinforce their cultural capital. Similarly, in Istanbul, the advantaged first main and its sub-groups compete for prestigious residential areas, access to higher education, and better positions in the economic arena. Their competitive edge is highlighted by high annual incomes and superior educational credentials. They also have strong institutional ties such as high local registration. This further reinforces their stability. Despite their competitive rivalry over the resources, these groups possibly cooperate through economic and professional networks that help ensuring collective dominance in key socio-economic arenas.

Table 27 - Features of advantaged and disadvantaged groups

Group Category	Metropolitan São Paulo	Metropolitan Istanbul
Advantaged Groups and Cooperative Configuration	Competitors: Internal rivalry among elite subgroups (e.g., 2.1 vs. 2.2) competing for access to prime real estate, prestigious education, influential networks, and high-quality healthcare.	Competitors: Internal competition among high-status subgroups (e.g., 1.1 vs. 1.2) vying for high-quality employment, elite educational opportunities, stable local registration, and prime residential locations.
	Cooperations: Formal alliances through professional networks that secure favorable conditions and support.	Cooperations: Networks via professional associations, formal educational and cultural institutions that reinforce socio-economic stability.
Disadvantaged Groups and Competitive Configuration	Competitors: Internal competition among marginalized subgroups (e.g., 1.1 vs. 1.2) for scarce formal employment, affordable housing in peripheral or informal settlements, and limited access to public services.	Competitors: Internal competition among disadvantaged subgroups (e.g., 2.1 vs. 2.2) competing for limited access to formal jobs in under-resourced areas, affordable housing, and essential public services amid migratory pressures.
	Cooperations: Possible alliances through community organizations, and informal mutual aid networks to pool scarce resources.	Cooperations: Informal support systems, migrant aid organizations, local advocacy groups, and culturally based solidarity networks that help mitigate economic and social exclusion.

Source: Author, 2025.

Moving down the hierarcies, the emerging populations settle on dynamic spaces defined by both competition and cooperation. In São Paulo, these populations, situated within the upper reaches of Group 1.2 and the lower reaches of

Group 2.2, are in a competition for upward mobility. They seek to formal employment opportunities and access to better educational prospects for a transition. A similar pattern emerges in Istanbul, as well. Populations, differentiated within the advantaged and disadvantaged subgroups, seems to compete for entry into formal job markets.

Within the working class, competition and cooperation take on different contours. In São Paulo, the populations in subgroups like Group 1.2 versus Group 1.1 compete for stable, formal employment, affordable housing, public healthcare and education. This competition is supposed to be severe due to limited access to quality public services, better-paid jobs and affordable living conditions. In Istanbul, the working class similarly competes for access to stable employment, affordable housing and quality education.

For the most marginalized segments the dynamics of competition and cooperation are especially harsh. In São Paulo, the most disadvantaged groups, found within the lower-levels of Group 1.1, are condemned to compete for scarce resources in the informal economy, and struggle over limited housing opportunities. Despite the competition for these vital resources, these groups seem to develop strong informal networks based on extended family ties and community solidarity. Such cooperative arrangements must have helped them share resources and face the uncertainties of their environment. In Istanbul, the marginalized populations, also found within the lower segments of Group 2.1, face similar challenges. They compete internally for access to possibly informal employment opportunities and housing.

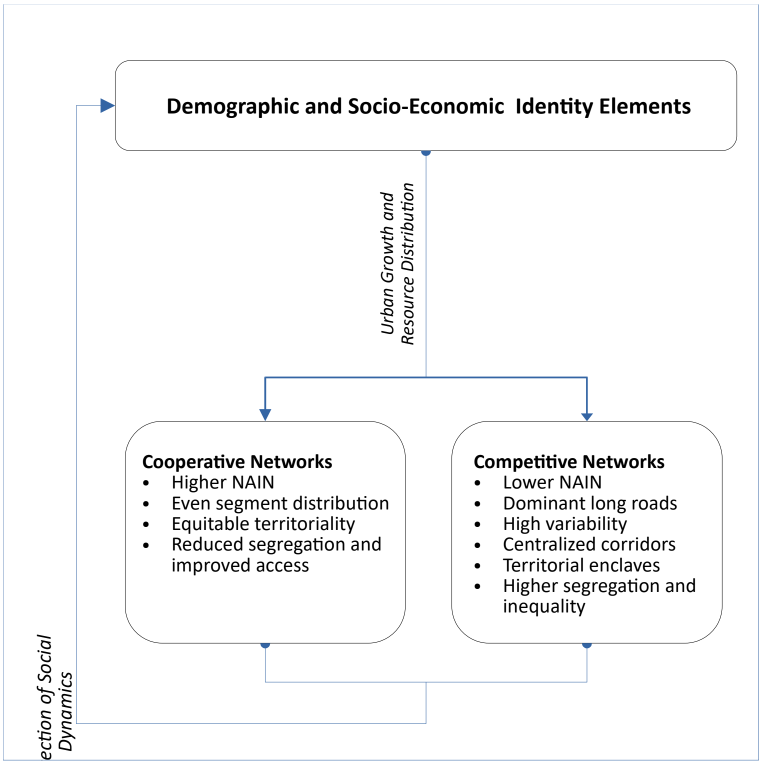
Finally, the dynamics between immigrants and ethnic minorities span both advantaged and disadvantaged groups. Additionally, they are most pronounced among the marginalized. For example, in São Paulo, ethnic minorities with high proportions of brown or indigenous people compete with both the formal workforce and other disadvantaged groups for job opportunities, housing, and public services. The situation is similar in Istanbul. Despite the absence of clear ethnic or racial categories, migrants and ethnic minorities are identified primarily by their registration status and the presence of foreign populations. They also face fierce competition with native disadvantaged groups for access to formal employment and social services.

In summary, transspatial groups in both cases engage in a complex interplay of competition and cooperation. While advantaged groups leverage formal economic power and institutional support to maintain their status, disadvantaged groups struggle with systemic exclusion. Furthermore, regardless of their economic positions, migrants and ethnic minorities seems to rely on shared cultural identities and networks to navigate the challenging socio-economic environments. Together, these dynamics demonstrate how social groups, whether advantaged or disadvantaged, are interconnected through patterns of competition and cooperation that shape the broader structure of urban segregation and transnational social stratification.

5 CONCLUSION

The study integrates concepts of social competition, cooperation, territoriality, centrality and urban segregation to provide a multidimensional analysis. Rather than handling the issue merely as an outcome of top-down socio-economic forces, this research claims that urban space is constantly reshaped by and shape interactions between individuals and social groups. During these interactions competition and cooperation play fundamental roles (Figure 83). Through a comparative analysis of Metropolitan São Paulo and Istanbul, the study examines the commonalities and differences in the socio-spatial logic of segregation.

Figure 83 – The interplay between demography, socio-economy and configuration



Source: Author, 2025.

The first research question examines the interplay between demographic profiles, socio-economic features and spatial segregation. The results indicate that in São Paulo case, long-term racial clustering and economic disparities reinforce segregation, whereas in Istanbul, internal migration and socio-economic gradients are the primary drivers. This suggests that while the mechanisms differ, the underlying human drive to secure better living conditions consistently influences urban form. The second question, regarding urban configuration's role in structuring competition and cooperation, is answered by observing that centrality in urban space is both a magnet for privileged groups and a site of exclusion for marginalized ones. The spatial clustering of resources, employment, and educational opportunities in central districts, juxtaposed with resource-poor peripheries, creates an environment where competitive dynamics are heightened, and cooperative strategies emerge as survival mechanisms in response to exclusion. The third research question, focusing on commonalities and differences in the spatial logic of segregation, is addressed through the comparative analysis: despite differing historical and cultural contexts, both cities display similar patterns of centralized advantages and peripheral disadvantages—a dynamic that is closely tied to the universal human pursuit of vital resources and the formation of group identities.

The first hypothesis posited that advantaged groups consolidate spatial advantages by leveraging their access to economic, political, and symbolic capital. The evidence supports this hypothesis, as seen in the competitive and cooperative configurations of these groups in both cities. In São Paulo, for instance, elite subgroups compete for prime urban resources, while formal alliances among them reinforce their status. The second hypothesis suggested structural similarities in segregation between the two cities despite contextual differences. The comparative findings validate this, showing that both metropolises, though different in their historical trajectories, are influenced by global economic and social dynamics that drive spatial segregation. The third hypothesis predicted that groups with higher socio-economic status concentrate in central urban areas while disadvantaged groups are relegated to fragmented peripheries. This is clearly evidenced by the spatial distribution of employment, education, and resource access in both settings. Finally, the fourth hypothesis argued that social competition is shaped by intersecting axes such as class, ethnicity, and status. The analysis confirms that these intersecting factors significantly influence intra-group dynamics, leading to complex patterns of both competition and cooperation that extend beyond a simple binary of advantaged versus disadvantaged.

The findings are evaluated through several hypotheses. First, it is argued that advantaged social groups consolidate their spatial dominance by leveraging their access to economic, political, and social capital. This allows them to possess greater control over urban configurations. Additionally, despite their distinct historical and cultural contexts, both cases exhibit structural similarities in segregation patterns due to social competition and cooperation dynamics under the effects of shared global forces. Additionally, the study highlights that relatively advantaged groups tend to concentrate in areas with higher centrality values, whereas disadvantaged groups are relegated to less central areas with limited access to urban resources. Finally, it is emphasized that social competition and cooperation in urban spaces is not a simple binary dynamic between privileged advantaged and marginalized disadvantaged groups. Instead, it is structured by multiple intersecting factors, including class, ethnicity, and status, which collectively shape the spatial organization of human settlements.

Thus, both cases pictures unequal access to economic resources and opportunities, resulting in spatial disparities. In São Paulo, economic competition is deeply intertwined with historical racial and economic divisions. Formal employment and educational resources are concentrated in central municipalities while peripheral ones, often inhabited by marginalized racial groups, experience economic disadvantages. On the other hand, in Istanbul competition is primarily structured by internal migration and socio-economic disparities. In addition, economic opportunities are highly uneven. Central municipalities offer greater access to higher education and formal employment, while peripheral ones settled by lower-income migrant populations.

Despite these inequalities, both cases seem to exhibit strong cooperative mechanisms within social groups, particularly through family and community networks. In São Paulo, the high prevalence of nuclear family structures reflects a reliance on kin-based and neighborhood-based support systems against economic hardships. In Istanbul, on the other hand, household configurations are more diverse. Many migrants adopt shared living arrangements as a means of mutual support. These cooperative strategies are supposed to be helpful to mitigate economic uncertainties and reinforce social cohesion within disadvantaged communities.

Thus, both cases display clear patterns of territoriality. Demographic groups cluster in specific urban areas based on socio-economic factors. In São Paulo, these territorial patterns are strongly linked to historical racial segregation with marginalized racial groups being confined to peripheral zones. This is a result of a long-standing spatial differentiation that persists across generations. In Istanbul, territorial clustering is primarily shaped by migration. While lower-income households and socially assisted populations concentrate in particular areas, wealthier and more stable social groups occupy well-established neighborhoods.

Centrality also plays a defining role in both metropolises. In São Paulo, central municipalities more resources and opportunities for formal employment and higher education, consolidating economic centrality. Similarly, Istanbul's central municipalities attract highly educated and affluent residents, functioning as economic and cultural centers. However, peripheral areas face rapid migration and lower socio-economic status, creating contrasts in living conditions and access to resources. Configurational analysis further reinforces these ideas. In both cases, there are correlations between integration, resource accessibility and group status.

As a result, segregation in both cases is shaped by the interaction of social competition, cooperative networks, territoriality and centrality. Built by historical exclusion and unequal resource distribution, deep racial and economic divides sustain a sharp urban hierarchy in São Paulo. On the other hand, while segregation is less explicitly racialized, it is structured by migration patterns and socio-economic stratification in Istanbul. There are significant disparities in access to education, employment, and public services. These further entrench spatial divisions and make upward mobility difficult for marginalized groups.

Therefore, the urban segregation phenomenon arises from a complex interplay of historical forces, socio-economic dynamics, and migratory patterns. During the process competition for vital resources and formal or informal alliances reinforce unequal access to employment, education, housing, and public services. It is not only a product of top-down processes such as institutional favoritism and policy decisions. It also emerges from bottom-up dynamics where individual survival struggle, group identities, in-group and inter-group relations, characterized by competition, cooperation and even conflict, shape and shaped by the configuration of urban space.

At the core of observed urban dynamics is the instinctual drive to secure resources necessary for survival and well-being. In both Metropolitan São Paulo and Istanbul, the struggle for economic opportunity, quality education, and secure housing reflects an innate human tendency to obtain vital resources. This drive fuels both competition and cooperation. While advantaged groups aggressively pursue prime real estate, prestigious institutions, and influential networks to consolidate their status, disadvantaged ones form informal networks and mutual aid systems to pool scarce resources. The dynamics underscore the duality of human instincts. While self-preservation and the desire for improved status lead to competition, the inherent need for social support fosters cooperation.

Because of this duality, the formation and reinforcement of individual and group identities gain importance. In São Paulo, the historical racial segregation creates enduring group identities. Despite defining spatial patterns, these identities also intensify competition between marginalized subgroups. Similarly, internal migration drives the formation of diverse socio-economic identities in Istanbul, influencing both competition and cooperation among groups. The dynamics within main advantaged and disadvantaged groups of both cases, where internal rivalries are observed, further highlight how group identities are fluid and often contested. These dynamics are strengthened by phenomena such as favoritism within networks and the dehumanization that occur when individuals are reduced to statistical representations based on their positions in the social hierarchy.

At this point, dehumanization is crucial to understand the persistence of urban segregation since it underpins many of the dynamics of competition and cooperation in urban settings. Instead of recognizing people as human beings with equal rights and needs, it transforms them into abstract categories. This process creates a hierarchy of worth that aligns with territorial and centrality logic by simplifying complex social identities into binary oppositions. In urban contexts, this manifests spatially. While advantaged groups claim central, resource-rich areas, marginalized groups are pushed to less valuable peripheries. Furthermore, the centrality of urban space is not only an outcome of economic forces. It is also a symbol of dominance that reinforces superiority. Advantaged groups justify their claims by dehumanizing those in the periphery and rationalize unequal access to quality education, healthcare, and economic opportunities. Dehumanization, in addition, undermines the capacity for empathy and cross-group cooperation. The struggles and needs are discounted when individuals are seen as less than human. This intensifies competition for scarce resources and prevents the formation of cooperation across groups.

Morever, internal competition can be exacerbated by the lack of external empathy even within disadvantaged communities. This, in return, reinforces isolation and makes collective action challenging because genuine cooperation requires the recognition of shared humanity and the willingness to support one another. In contrast, favoritism, serving to protect and sustain communities in harsh environments, also plays out in the urban arena. It perpetuates inequalities because privileged access to resources is maintained through formal and informal alliances. Such dynamics highlight that urban segregation is also of symbolic power, where the distribution of resources is as much about group identity as it is about economic competition.

In addition to these impulses, individual and group identities are also crucial. They are continuously negotiated and reshaped through the vital struggles for resources, recognition, and survival in urban environments. This process is especially pronounced among either internal or foreign migrants. Arriving in cities in search of better economic opportunities or refuge, they often struggle with multiple identity elements such as ethnicity, language, cultural heritage, and class. While striving to preserve their cultural distinctiveness for social cohesion, they face pressure to assimilate into existing groups to access better opportunities. This process is accompanied by the dehumanizing which inherent in urban segregation. Migrants are frequently stereotyped or marginalized. This kind of labeling also reinforces group boundaries and prevent broader social integration.

From a spatial perspective, while settlements become the scene of above-mentioned phenomena, urban configurations also serve as a tool in the dynamics of social competition and cooperation. Advantaged groups leverage financial capital and political influence to drive real estate market and reshape settlements. Public-private partnerships, a type of cooperation, also enable the implementation of large-scale projects, reinforcing socio-spatial hierarchies by reshaping layouts in favor of advantaged groups. However, these kind of transformations often causes the displacement of other groups to urban peripheries. In return, this process intensifies social segregation and limits their access to resources. By shaping laws and policies, authorities directly validate these processes and further solidify the competitive advantage of the economically powerful. Moreover, the regulatory frameworks institutionalize these dynamics.

Above-mentioned phenomena are often analyzed within the boundaries of individual settlements. Nevertheless, all the advantaged and disadvantaged groups in different contexts are belong to broader, global social groups. Far from being local phenomena, the facts that shape socio-spatial hierarchies in São Paulo and Istanbul are reflections of a worldwide socio-economic stratification process. Advantaged groups in both cases, with access to higher economic capital, more resources, and better location, form part of a transnational privileged class. They obtain similar structural benefits, regardless of geographic location. On the other hand, the disadvantaged groups such as migrants, lower-income workers, and those excluded from formal economic structures are also part of a global underclass. They all experience similar struggles despite having no direct awareness of one another.

Since globalization has reinforced this divide by standardizing economic competition and urban development trends, real estate speculation, large-scale infrastructure projects, and urban renewal efforts follow similar patterns all around the globe. Thus, the segregation forces are not totally local. They are embedded in global economic structures. As a result, though unaware of each other's existence, a professional in Istanbul and another in São Paulo share more in common in terms of lifestyle, social networks, and opportunities than they do with the lower-income residents of their own metropolis. Similarly, a worker in the periphery of São Paulo and one in Istanbul, face similar struggles shaped by global economic pressures, precarious employment, and limited access to upward mobility. Despite the lack of direct contact, members of these global super-ordinate social groups operate within the same structural constraints and advantages. The advantaged ones influence policies, shape urban layout, and consolidate wealth through shared access to markets, political influence, and elite institutions. On the other hand, the disadvantaged ones are pushed into fragmented spaces, competing for scarce resources, and even excluded from decision-making processes. This globalized structure of segregation perpetuates socio-spatial inequality across different urban contexts. It also reinforce the idea that urban competition and cooperation are embedded within a transnational social order.

Despite occasional examples of cooperation between advantaged and disadvantaged groups, efforts will not be sufficient to resolve urban segregation. In practice, struggles between groups often reinforce the status quo, as both use strategic tools to mobilize support and expand influence. Demands either for justice and equality or for development will be used to mask the underlying goal of accumulating or redistributing power rather than addressing the systemic roots of discrimination. As a result, the process of competition between advantaged and disadvantaged groups becomes self-perpetuating. As all sides seek to dominate the other, the spatial and social hierarchies that define discrimination will be restructured rather than dissolved. Moreover, without a non-human authority to mediate and balance inter-group dynamics, power dynamics will inevitably be influenced by deeply ingrained human characteristics such as self-interest, in-group favoritism, dehumanization, and survival instincts. These characteristics ensure that any temporary disruption in patterns of segregation will eventually lead to a new configuration that will continue to reflect inequalities. Thus, the possibility of overcoming urban segregation is constrained not only by market forces and institutional biases, but also by fundamental aspects of human behavior. Without an external, impartial authority that can enforce equal socio-spatial organization, the struggle for control over urban space and segregation remain a permanent feature of human life.

Despite what is mentioned in the above paragraphs, in theory, spatial segregation tendencies can be balanced by changing the structure of cities through urban planning practices. In this way, the destructive effects of competition for especially disadvantaged groups can be softened and cooperation can be encouraged between all. First of all, moving away from the single-centered urban growth models, as seen in study areas, to multi-centered ones may reduce the competition by allowing each social group to develop their own internal dynamics in the areas where they are settled. When these sub-centers provide resources such as employment, education, health and cultural opportunities within their territories, especially disadvantaged groups can also have access these services and an opportunity may be created to ease competition occurs around the only center.

In addition, regulatory tools can be used to facilitate spatial affiliation for individuals and groups. For example, mechanisms such as mandatory mixed-income housing areas and land value regulation allow low-income families to have an opportunity to settle for long terms in central or well-served neighborhoods by reducing speculative pressures on the market. In this way, the boundaries that disadvantaged groups face in the housing market can be eliminated and social groups can be provided with access to basic services regardless of their status.

Moreover, local cooperation and awareness can be nurtured through participatory design processes. Planning councils established at the neighborhood level may bring together representatives from both advantaged and disadvantaged groups and enable direct participation in urban decision-making mechanisms. This can prevent planning processes from being a power struggle. Or at least, it can provide disadvantaged groups with the opportunity to have a say.

Mixed-use green corridors, social facilities and cultural areas that increase the permeability of spatial boundaries between the territories of disadvantaged and advantaged groups can increase the opportunities for individuals from different groups to meet. In this way, social barriers can also be softened and the distinction between distinct social groups can be replaced by an urban experience where coexistence is the norm.

Finally, transparent data monitoring and independent auditing mechanisms regarding urban management and projects can prevent decisions directed by advantaged groups. From land prices to demographic changes, making information accessible to all individuals forming the society, the civil society organizations formed by these individuals and the supervisory institutions may be useful to provide opportunity to take action when necessary. In this way, the way can be paved for challenging egalitarian planning decisions.

Apart from all these, conducted at the municipality scale, the study is subject to several limitations which may pave the path for better understanding when eliminated. First, the spatial resolution of the data likely masks finer dynamics within and between municipalities. Moreover, the analysis relies on specific variables that were available and comparable across cases. However, possible inconsistencies in data collection methods and temporal variations may have introduced measurement biases. Additionally, while the comparison offers valuable insights, differences in administrative frameworks may limit the generalizability of the findings. Thus, the possible future studies need to incorporate more granular, longitudinal data and mixed-method approaches to enhance the strength and depth of the analysis. From a theoretical perspective, this study advances discussions on social conflict, competition, centrality, territoriality and urban segregation by integrating multiple dimensions into a coherent analytical framework. It therefore challenges traditional top-down models by focusing on the dual role of human instincts, namely the drive to secure vital resources and the inherent need for social support. By linking these dynamics to the spatial configuration of urban areas, the study enriches the understanding of how urban space functions as both a stage and a tool for the production of social hierarchies. Empirically, the research also contributes to the literature on globalization and urban social dynamics through its comparative analysis. It demonstrates that, despite distinct historical and cultural contexts, both metropolises exhibit similar patterns of spatial segregation driven by the interplay of mentioned social dynamics.

Therefore, future research should attempt to overcome the identified limitations by incorporating higher-resolution spatial data and longitudinal analyses to capture detailed dynamics across and within municipalities. Additionally, expanding the research to include additional metropolitan areas or conducting neighborhood-level case studies may provide deeper insights. Integrating qualitative methodologies will also provide a better understanding of lived experiences. Finally, exploring emerging technologies may provide innovative perspectives on how to address the aforementioned urban socio-spatial challenges.

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APPENDIX A – SUMMARY STATISTICS FOR METROPOLITAN SÃO PAULO

	mean	std	min	25%	50%	75%	max
Population	531587,69	1814200,14	15202	76824	158522	342874	1145199 9
Gender ratio	94,27	3,4	84,09	92505	93,97	96,43	101,17
Female population	278350,74	959719,89	7695	39234,5	80861	175623,5	6057472
Male population	253239,74	854491,51	7507	37589,5	75575	167250,5	5394536
Yellow population	8480,39	37894,58	49	384	996	2305	237890
White population	279911,92	981672,15	7566	38586,5	66203	156232	6190406
Indian population	696,23	2787,32	4	76,5	166	326	17557
Brown population	188851,64	601553,86	3276	26655,5	60419	137058,5	3798103
Black population	51387,92	182180,84	375	5901	15423	35847	1150368
Demografic density	3480,42	3941,86	35,64	680,1	1211,63	5437,05	13465,62
Married population	2768,82	8949,6	73	440	896	1734	56514
Marriage rates	6,78	1,21	5,1	6	6,6	7,25	10,1
Number of birth	6311,82	20843,06	196	881,5	2061	4412	131559
Number of death	3903,05	13766,62	105	575,5	1098	2220	86831
Birth to death ratio	1,8	0,47	0,78	1,44	1,73	2,09	3,01
Child death under one year	71	224,13	0	7,5	21	55,5	1410
Total natural deaths	3682,1	13074,31	100	524	1017	2073,5	82458
Total unnatural deaths	220,49	690,97	5	35	74	157	4359
Working age population	376634	1283844,59	10428	53944	111145	243915	8103465
Child population	95663,67	307998,85	2844	15388,5	32656	67913,5	1945308
Child dependency ratio	27,82	2,3	22,79	26915	27,92	29335	32,43
Elderly population	59290,03	222595,7	1331	6450	13951	28511,5	1403226
Elderly dependency ratio	14,07	3,28	9,39	11785	13,17	16235	26,26
Total dependency ratio	41,9	2,43	37,61	40,4	41,67	43,02	49,05
Child to elderly ratio	2,09	0,55	0,87	1,73	2,05	2,49	3,15
Life expectancy	0,69	0,04	0,61	0,67	0,68	0,71	0,8
Education level	0,52	0,06	0,41	485	0,52	0,54	0,72
Total households	224978,03	791463,06	7618	32115	63313	131304	4996529
Private households	224820,39	790772,05	7613	32085,5	63304	131222,5	4992162
Collective households	157,64	693,89	2	14	24	56,5	4367
Average number of residents in private households	2,83	0,09	2,65	2,78	2,84	2875	3,02

	mean	std	min	25%	50%	75%	max
Percentage of private households imputed	8,96	3,51	3,54	6805	8,86	10,49	17,34
Total occupied private households	195272,36	683926,48	5400	26378,5	54590	115856	4316336
Private households without water network	2835	4273,23	4	666	1246	3125	22738
Households connected to sewage system	178906,72	651040,57	2509	12283	39248	101432,5	4102035
Gross domestic product	35643660,77	132015793,97	251752	2080279,5	6854706	17299260,5	828980608
Formal employment	192363,92	807176,41	2051	11714	26870	75170	5076570
Nominal average salary	3206,9	619,75	1776	2796	3260	3530,5	4960
Companies and other organizations	22966,23	101478,9	328	1620,5	2722	9112,5	638246
Scientific and technical activities	2554,28	12311,34	12	82	164	687	77270
Educational organizations	776,28	3339,07	9	64,5	112	300	21011
Health and social services	1396,31	6789,23	5	61	100	307,5	42614
Arts culture sport recreational organizations	260,69	1191,69	2	21,5	36	101,5	7495
International organizations	1,59	9,93	0	0	0	0	62
Hospitalized people by residance	26188,49	87136,66	936	3680,5	7826	17374,5	550767
Healthcare expenditure per inhabitant	1191,02	736,49	446,84	823235	980,13	1303,95	4281,96

APPENDIX B – ADDITIONAL STATISTICS FOR METROPOLITAN SÃO PAULO

	Variance	Skewness	Kurtosis
Population	3291322144638,80	5,81	32,46
Gender ratio	11,56	-0,34	0,72
Female population	921062259599,72	5,81	32,51
Male population	730155735540,56	5,80	32,40
Yellow skin population	1435999267,93	5,91	33,28
White skin population	963680211346,18	5,81	32,49
Indian population	7769123,13	5,89	33,16
Brown skin population	361867044808,87	5,75	32,01
Black skin population	33189857218,81	5,84	32,77
Demografic density	15538243,83	1,21	0,32
Married population	80095259,99	5,77	32,13
Marriage rates	1,45	1,04	0,44
Number of birth	434433018,20	5,78	32,22
Number of death	189519791,79	5,82	32,57
Birth to death ratio	0,22	0,31	-0,23
Child death under one year	50234,95	5,68	31,42
Total natural deaths	170937637,73	5,82	32,60
Total unnatural deaths	477442,36	5,72	31,76
Working age population	1648256938764842,00	5,80	32,44
Child population	94863290250,18	5,77	32,13
Child dependency ratio	5,30	-0,35	-0,12
Elderly population	49548845211,82	5,86	32,89
Elderly dependency ratio	10,74	1,36	2,96
Total dependency ratio	5,90	0,84	0,73
Child to elderly ratio	0,30	0,18	-0,36
Life expectancy	0,00	0,73	0,40
Education level	0,00	0,78	1,89
Total households	626413779345,08	5,83	32,68
Private households	625320432205348,00	5,83	32,68
Collective households	481488,87	5,95	33,58
Average number of residents in private households	0,01	-0,09	-0,17
Percentage of private households imputed	12,30	0,65	-0,07
Total occupied private households	467755425040131,00	5,82	32,61
Private households with no connection to the general network	18260453,53	3,20	11,06

	Variance	Skewness	Kurtosis
Permanent private households with no connection to the general network	18260453,53	3,20	11,06
Permanent private households connected to general sewage system	423853824048,58	5,83	32,61
Gross domestic product	17428169858110200,00	5,78	32,23
Formal employment	651533753038,81	5,90	33,21
Nominal average salary	384093,09	0,27	0,77
Total companies and other organizations	10297966425,34	5,94	33,50
Scientific and technical activities	151569140,05	5,95	33,64
Educational organizations	11149402,63	5,93	33,43
Human health and social services	46093692,32	5,96	33,69
Arts culture sport recreational organizations	1420131,17	5,96	33,68
International organizations	98,56	6,00	34,03
Hospitalized people by residance	7592796724,84	5,81	32,48
Total healthcare expenditure per inhabitant	542417,50	2,52	7,11

APPENDIX C – LQ RESULTS FOR METROPOLITAN SÃO PAULO

Municipality	Female population	Male population	Indigenous population	Black population	Brown population	Asian population
Arujá	0,98	1,02	0,98	0,86	1,08	1,01
Barueri	0,98	1,02	0,52	0,85	1,09	0,43
Biritiba Mirim	0,96	1,05	0,67	0,63	0,94	2,26
Caieiras	0,98	1,03	1,09	0,99	1,02	0,17
Cajamar	0,98	1,03	0,61	0,90	1,15	0,21
Carapicuíba	0,98	1,02	0,83	1,15	1,20	0,18
Cotia	0,98	1,02	0,88	0,94	1,10	0,68
Diadema	0,99	1,01	0,56	1,11	1,21	0,34
Embu das Artes	0,98	1,02	0,74	1,39	1,35	0,24
Embu Guaçu	0,97	1,04	1,06	0,90	1,21	0,43
Ferraz de Vasconcelos	0,98	1,02	0,95	1,23	1,26	0,14
Francisco Morato	0,97	1,03	0,65	1,36	1,38	0,07
Franco da Rocha	0,97	1,03	0,55	1,10	1,17	0,11
Guararema	0,98	1,03	1,32	0,66	0,94	0,76
Guarulhos	0,98	1,02	0,93	0,98	1,14	0,58
Itapecerica da Serra	0,97	1,03	1,21	1,22	1,28	0,34
Itapevi	0,98	1,03	0,33	1,10	1,41	0,11
Itaquaquecetuba	0,98	1,03	1,02	1,10	1,38	0,17
Jandira	0,98	1,02	0,54	1,07	1,20	0,26
Juquitiba	0,95	1,06	0,95	0,63	1,06	0,32
Mairiporã	0,96	1,04	0,81	0,68	1,02	0,46
Mauá	0,98	1,02	0,68	0,93	1,13	0,24
Mogi das Cruzes	0,98	1,02	0,90	0,87	0,92	2,30
Osasco	1,00	1,00	0,56	0,98	1,06	0,50
Pirapora do Bom Jesus	0,97	1,04	1,41	1,02	1,36	0,17
Poá	0,99	1,01	0,58	1,21	1,08	0,32
Ribeirão Pires	0,98	1,02	1,28	0,74	0,98	0,62
Rio Grande da Serra	0,98	1,03	0,80	1,11	1,29	0,24
Salesópolis	0,97	1,04	0,20	0,26	0,61	0,44
Santa Isabel	0,97	1,04	0,52	0,60	0,89	0,58
Santana de Parnaíba	0,98	1,02	0,82	0,75	1,03	0,60
Santo André	1,00	1,00	0,63	0,66	0,76	0,81
São Bernardo do Campo	1,00	1,00	0,98	0,75	0,91	0,90
São Caetano do Sul	1,04	0,96	0,85	0,37	0,42	1,26
São Lourenço da Serra	0,95	1,05	0,52	0,63	1,06	0,81

Municipality	Female population	Male population	Indigenous population	Black population	Brown population	Asian population
Sao Paulo	1,01	0,99	1,17	1,04	0,93	1,30
Suzano	0,99	1,02	0,73	1,00	1,16	1,39
Taboão da Serra	1,00	1,00	0,94	1,28	1,13	0,56
Vargem Grande Paulista	0,98	1,02	0,52	0,73	0,96	1,30

Municipality	White population	Married population	Child population	Elderly populatio n	Formal employme nt	Number of birth
Arujá	0,98	1,42	1,10	0,86	0,86	1,25
Barueri	0,99	1,55	1,13	0,70	2,79	1,39
Biritiba Mirim	1,08	1,07	1,08	1,07	0,31	1,02
Caieiras	1,02	1,01	1,07	0,84	0,64	1,02
Cajamar	0,95	1,45	1,18	0,61	1,51	1,24
Carapicuíba	0,87	0,82	1,11	0,82	0,25	1,15
Cotia	0,96	1,03	1,16	0,75	0,81	1,12
Diadema	0,86	1,12	1,01	0,82	0,63	0,91
Embu das Artes	0,72	0,82	1,16	0,73	0,49	1,14
Embu Guaçu	0,89	1,09	1,14	0,89	0,33	0,99
Ferraz de Vasconcelos	0,81	0,96	1,15	0,73	0,31	1,12
Francisco Morato	0,72	1,04	1,23	0,70	0,17	1,31
Franco da Rocha	0,84	0,93	1,11	0,76	0,33	1,14
Guararema	1,12	1,25	1,06	1,11	0,66	0,94
Guarulhos	0,92	1,06	1,09	0,81	0,73	1,15
Itapecerica da Serra	0,79	0,93	1,17	0,76	0,41	1,09
Itapevi	0,74	0,94	1,22	0,63	0,43	1,27
Itaquaquecetuba	0,76	0,92	1,24	0,65	0,36	1,17
Jandira	0,88	1,33	1,11	0,72	0,49	0,97
Juquitiba	1,05	1,04	1,14	1,03	0,46	1,05
Mairiporã	1,06	1,02	1,08	0,98	0,47	0,87
Mauá	0,96	1,00	1,03	0,85	0,45	0,92
Mogi das Cruzes	1,04	1,18	1,09	0,95	0,63	1,00
Osasco	0,98	1,11	1,03	0,91	0,69	0,96
Pirapora do Bom Jesus	0,78	1,07	1,26	0,65	0,38	1,14
Poá	0,93	1,47	1,06	0,93	0,67	1,09
Ribeirão Pires	1,07	1,57	0,94	1,12	0,52	0,76
Rio Grande da Serra	0,81	1,13	1,10	0,82	0,21	0,89
Salesópolis	1,41	1,34	1,04	1,14	0,37	1,09
Santa Isabel	1,16	1,28	1,05	1,01	0,54	0,96

Municipality	White population	Married population	Child population	Elderly population	Formal employment	Number of birth
Santana de Parnaíba	1,04	1,15	1,18	0,81	1,02	1,19
Santo André	1,23	0,97	0,90	1,20	0,75	0,85
São Bernardo do Campo	1,12	1,01	0,95	1,05	0,90	0,84
São Caetano do Sul	1,50	1,15	0,85	1,58	1,75	0,72
São Lourenço da Serra	1,03	0,87	1,06	1,02	1,06	1,05
Sao Paulo	1,03	0,95	0,94	1,10	1,23	0,97
Suzano	0,89	1,06	1,13	0,81	0,63	1,09
Taboão da Serra	0,88	0,88	1,06	0,80	0,65	1,02
Vargem Grande Paulista	1,08	1,39	1,11	0,90	0,72	1,22

Municipality	Number of death	Private households	Collective households	Total occupied private households
Arujá	0,98	1,00	1,00	0,99
Barueri	0,97	1,00	1,61	1,02
Biritiba Mirim	1,17	1,00	0,60	0,85
Caieiras	1,00	1,00	0,70	1,02
Cajamar	0,82	1,00	0,88	0,97
Carapicuíba	0,83	1,00	0,30	1,05
Cotia	0,86	1,00	1,87	0,93
Diadema	0,85	1,00	0,21	1,03
Embu das Artes	0,89	1,00	0,39	1,00
Embu Guaçu	1,38	1,00	1,67	0,90
Ferraz de Vasconcelos	0,89	1,00	0,41	1,02
Francisco Morato	0,91	1,00	0,20	1,05
Franco da Rocha	0,90	1,00	1,11	1,00
Guararema	1,09	1,00	0,93	0,84
Guarulhos	0,99	1,00	0,50	1,01
Itapecerica da Serra	1,02	1,00	1,27	0,97
Itapevi	0,78	1,00	0,06	1,04
Itaquaquecetuba	0,81	1,00	0,24	1,02
Jandira	0,68	1,00	0,06	1,02
Juquitiba	1,24	1,00	1,25	0,67
Mairiporã	1,02	1,00	1,16	0,84
Mauá	0,88	1,00	0,41	1,03
Mogi das Cruzes	0,99	1,00	1,00	0,98
Osasco	1,03	1,00	0,36	1,04
Pirapora do Bom Jesus	0,78	1,00	0,94	0,92

Municipality	Number of death	Private households	Collective households	Total occupied private households
Poá	1,13	1,00	1,32	1,02
Ribeirão Pires	1,00	1,00	0,96	1,07
Rio Grande da Serra	0,91	1,00	1,27	1,01
Salesópolis	1,48	1,00	2,24	0,75
Santa Isabel	1,18	1,00	1,21	0,83
Santana de Parnaíba	0,64	1,00	0,14	1,02
Santo André	1,15	1,00	1,04	1,00
São Bernardo do Campo	0,93	1,00	0,51	1,04
São Caetano do Sul	1,48	1,00	1,11	1,01
São Lourenço da Serra	1,03	1,00	0,99	0,78
Sao Paulo	1,03	1,00	1,25	1,00
Suzano	0,95	1,00	0,79	0,99
Taboão da Serra	0,94	1,00	0,23	1,03
Vargem Grande Paulista	0,97	1,00	0,61	0,97

APPENDIX D – SUMMARY STATISTICS FOR METROPOLITAN ISTANBUL

	mean	std	min	25%	50%	75%	max
Area	140,03	253,72	7	17,5	38	145	1142
Population	396473,13	204591,75	16033	268371,5	396594	484880,5	957398
Population density	14518,82	13661,01	44,18	1938505	9717,38	23563145	53748,8
Gender ratio	101,04	7,38	82,87	98,55	101,03	104005	129,97
Female population	197733,74	101302,16	7675	134206,5	197445	250573,5	465555
Male population	198739,39	103601,33	8358	132797,5	199149	240686	491843
Married population	168356,52	107810,14	94436	104755	158087	229318,5	411642
Number of births	4940,26	3209,12	93	2866,5	4445	6401	15992
Female births	2410,41	1573,54	50	1388,5	2204	3151	7915
Male births	2529,85	1636,5	43	1465	2241	3250	8077
Number of deaths	1959,15	933,03	172	1343,5	1710	2802,5	4324
Female deaths	863,46	427,78	81	610,5	782	1166,5	2206
Male deaths	1095,69	513,29	91	748	976	1588,5	2118
Birth to death ratio	2,54	1,35	0,54	1,58	2,24	3,24	5,42
Population growth rate	-2,24	30,91	-110,86	-19285	-1,51	18595	50,86
Child population	101066,62	62539,21	2083	64303	98444	128256	298953
Child dependency ratio	28,69	6,88	15,58	23,67	27,91	32,72	43,57
Elderly population	29169,49	16470,03	3159	18311,5	26211	34730,5	93151
Elderly dependency ratio	11,99	6,21	5,08	7605	10,23	13,51	28,36
Total dependency ratio	40,67	3,84	33,75	38175	40,14	43495	49,97
Number of households	117856,9	58416,57	6299	77245	117044	143285,5	269482
Average household size	3,22	0,43	2,39	2,99	3,24	3,41	4,13
More than one person without nuclear family household	5176,31	3834,07	351	2508,5	4761	6992	18647
At least one nuclear family and other persons household	16801,97	8679,4	828	11395	15988	20899	39030
Nuclear family with kids household	51353,13	27858,65	1340	32815	50631	65455	119720
Nuclear family without kids	11446,18	5992,47	817	7845,5	9763	14069	29261
single nuclear family household	74713,05	38192,75	2789	48669	73775	95903,5	161499

	mean	std	min	25%	50%	75%	max
single parent with children household	11913,74	6012,3	632	7795	11038	15623	23740

	mean	std	min	25%	50%	75%	max
single person household	21165,56	12294,88	2331	12744	18442	28157	58049
number of people aged 15+ and literate	292006,51	144839,15	13402	197584	277604	373043,5	623434
literacy ratio	98,35	0,49	97,44	98,02	98,35	98615	99,39
primary education female	10526,13	7098,97	212	6590	9003	13898,5	32360
primary school female	30692,28	16319,39	1038	19432	27108	36796,5	64951
secondary school female	26050,41	15228,66	810	17291	24222	31928	69863
high school female	35250,85	17427,21	1742	24363	35014	45194	67633
college female	31546,08	18779,67	1817	19303	31099	41324,5	88640
masters degree female	3953,39	3810,45	232	1628	2748	5451,5	21080
doctorate female	634,49	802,36	29	246	359	664	4473
higher education female	36133,95	22790,23	2228	20938,5	34130	46000,5	114193
primary education male	14561,56	10216,65	281	8796	11315	20112	46305
primary school male	20079,39	10534,69	990	12348	18699	25520	42845
secondary school male	32336,33	19604,74	1163	20916	29647	40875	90986
high school male	42331,72	21317,51	2343	28849	42364	51290,5	89324
college male	31248,87	17849,18	1869	19648	27418	40099	78666
masters degree male	4378,33	3681,95	303	1810	3398	6057	20207
doctorate male	787,51	887,06	49	311	466	1032	4834
higher education male	36414,72	21796,47	2278	21719	34095	47395	103707
higher education total	72548,67	44504,92	4506	42598	68225	92382	217900
annual average income	97850,77	46261,35	44808	67086	80832	110958	233088
health facility area per capita	0,44	0,79	0,03	125	0,27	425	4,98
number of clinics	168,95	327,21	2	31,5	67	113	1677
number of medical centers	6,31	4,91	0	3	5	10	19
population per family physician	3166,69	343,5	2339	2963	3076	3427	3963
emergency medical services stations	9,23	3	4	7	9	11	16
housing sales	6794,41	5985,14	226	3474,5	5892	8134,5	36234
homeowners to tenants ratio	1,2	0,53	0,65	905	1,1	1,33	3,59

	mean	std	min	25%	50%	75%	max
average duration of residence in the current residence	12,46	3,55	7	10	12	14	22
average house net size m2	91,36	7,76	76	86	92	95	111
water consumption m3	21629854,13	10598797,06	1513070	14958827,5	20495275	26191292,5	59865610
social assistance recipients	11942,36	8813,51	164	6955	11161	16129	47930
car ownership rate	0,41	0,23	0,06	305	0,41	0,48	1,22
technological device ownership rate	12,12	22,11	1,91	2205	5,42	11,13	100,83
population registered other cities	192783,67	108665,14	7723	119881	176709	244351,5	517121
population registered istanbul	183242	87637,03	7675	123910,5	171562	232653,5	356208
population registered abroad	20447,46	17564,05	635	8638	16947	24801,5	86578
foreign population	25007,46	29099,95	233	6555	15884	33539,5	149925
distribution of foreign population to municipality	2,56	2,98	0,02	675	1,63	3,44	15,37
foreign to native population ratio	5,58	4,74	0,68	2005	3,75	7,53	23,18

APPENDIX E – ADDITIONAL STATISTICS FOR METROPOLITAN ISTANBUL

	Median	Variance	Skewness	Kurtosis
Population	396594	41857784192,69	0,58	0,56

Gender ratio	101,03	54,42	0,82	6,47
Female population	197445	10262126602,93	0,51	0,36
Male population	199149	10733235488,56	0,66	0,75
Married population	158087	11623026808,45	0,25	-0,39
Total number of births	4445	10298417,46	1,20	2,42
Number of female births	2204	2476018,20	1,24	2,65
Number of male births	2241	2678116,66	1,16	2,20
Total number of deaths	1710	870537,19	0,41	-0,21
Number of female deaths	782	182993,31	0,78	1,21
Number of male deaths	976	263469,27	0,23	-0,76
Population growth rate	-1,51	955,44	-0,91	2,70
Child population	98444	3911152370,51	1,00	1,47
Child dependency ratio	27,91	47,34	0,27	-0,31
Elderly population	26211	271261824,62	1,58	4,74
Elderly dependency ratio	10,23	38,61	1,41	1,47
Total dependency ratio	40,14	14,73	0,54	0,09
Total number of households	117044	3412495082,83	0,48	0,20
Average household size	3,24	0,19	-0,03	-0,10
More than one person without nuclear family household	4761	14700085,80	1,45	3,01
At least one nuclear family and other persons household	15988	75331951,29	0,57	0,39
Nuclear family with kids household	50631	776104476,69	0,51	0,10
Nuclear family without kids	9763	35909749,94	0,92	0,86
Single nuclear family household	73775	1458685796,47	0,40	-0,12
Single parent with children household	11038	36147708,09	0,31	-0,50
Single person household	18442	151164081,94	1,02	1,09
Number of people aged 15+ and literate	277604	20978379094,68	0,38	-0,09
Literacy ratio	98,35	0,24	0,24	0,02
Primary education female	9003	50395395,85	1,14	1,44
Primary school female	27108	266322385,52	0,50	-0,27
Secondary school female	24222	231911952,56	0,87	0,91
High school female	35014	303707537,92	0,18	-0,54
College female	31099	352676083,86	0,81	0,92
Masters degree female	2748	14519535,51	2,59	9,92
Doctorate female	359	643781,05	3,22	13,41
Higher education female	34130	519394596,63	1,12	2,27

	Median	Variance	Skewness	Kurtosis
Primary education male	11315	104379863,62	1,15	1,45
Primary school male	18699	110979671,61	0,46	-0,34

Secondary school male	29647	384345866,33	0,96	1,16
High school male	42364	454436063,73	0,41	-0,11
College male	27418	318593097,75	0,70	0,14
Masters degree male	3398	13556760,54	2,24	7,94
Doctorate male	466	786881,41	2,87	10,85
Higher education male	34095	475086105,63	0,93	1,10
Higher education total	68225	1980687432,18	1,02	1,66
Annual average income	80832	2140112451,50	1,28	1,07
Health facility area per capita	0,27	0,62	5,30	30,83
Number of clinics	67	107069,05	3,66	14,07
Number of medical centers	5	24,11	0,73	-0,19
Population per family physician	3076	117992,85	0,39	0,21
Emergency medical services stations	9	8,97	0,63	-0,51
Housing sales	5892	35821856,93	3,26	15,12
Homeowners to tenants ratio	1,1	0,29	2,69	10,14
Average duration of residence in the current residence	12	12,57	0,86	0,69
Average house net size m2	92	60,18	0,31	0,14
Water consumption m3	204952 75	1123344992129 17,00	1,13	3,41
Social assistance recipients	11161	77677936,66	1,85	6,14
Car ownership rate	0,41	0,05	1,35	3,61
Technological device ownership rate	5,42	488,75	3,43	11,52
Population registered other cities	176709	11808111595,02	0,82	1,01
Population registered istanbul	171562	7680248631,79	0,26	-0,19
Population registered abroad	16947	308495907,57	1,84	4,35
Foreign population	15884	846806920,99	2,55	8,39
Distribution of foreign population to municipality	1,63	8,90	2,55	8,38
Foreign to native population ratio	3,75	22,43	1,77	4,07
Area	38	64374,71	2,82	7,75
Population density	9717,38	186623126,50	0,98	0,36
Birth to death ratio	2,24	1,83	0,68	-0,42

APPENDIX F – LQ RESULTS FOR METROPOLITAN ISTANBUL

Municipality	Female population	Male population	Married population	Child population	Elderly population	Number of births

Municipality	Female population	Male population	Married population	Child population	Elderly population	Number of births
Adalar	0,960	1,040	1,051	0,510	2,678	0,466
Arnavutköy	0,973	1,026	1,089	1,335	0,580	1,454
Ataşehir	1,020	0,980	1,109	0,906	1,099	0,844
Avcılar	0,998	1,002	1,059	1,005	0,954	0,975
Bağcılar	0,987	1,013	1,076	1,155	0,651	1,130
Bahçelievler	0,995	1,005	1,055	0,949	1,006	0,964
Bakırköy	1,068	0,932	1,075	0,736	2,052	0,612
Başakşehir	0,996	1,004	1,021	1,272	0,530	1,130
Bayrampaşa	0,997	1,003	1,125	0,917	1,129	0,904
Beşiktaş	1,088	0,912	0,989	0,591	2,199	0,541
Beykoz	1,008	0,992	0,001	0,868	1,298	0,771
Beylikdüzü	1,025	0,975	0,001	1,056	0,975	0,943
Beyoğlu	0,971	1,029	0,001	0,848	1,098	0,854
Büyükçekmece	1,012	0,988	1,107	0,999	1,195	0,865
Çatalca	0,977	1,023	1,251	0,843	1,695	0,810
Çekmeköy	1,002	0,998	1,148	1,113	0,673	1,146
Esenler	0,975	1,025	1,087	1,113	0,650	1,162
Esenyurt	0,975	1,025	1,013	1,225	0,481	1,341
Eyüpsultan	1,001	0,999	1,121	0,963	0,948	1,009
Fatih	0,998	1,002	0,888	0,783	1,533	0,748
Gaziosmanpaşa	0,999	1,001	1,105	1,045	0,918	1,043
Güngören	0,993	1,007	1,061	0,924	1,130	0,969
Kadıköy	1,096	0,904	1,088	0,555	2,627	0,550
Kağıthane	0,992	1,008	1,067	0,912	0,796	0,929
Kartal	1,014	0,986	1,141	0,894	1,191	0,884
Küçükçekmece	1,000	1,000	1,087	1,039	0,850	1,037
Maltepe	1,005	0,995	1,113	0,788	1,369	0,820
Pendik	0,992	1,008	1,134	1,073	0,808	1,065
Sancaktepe	0,988	1,012	1,121	1,223	0,503	1,344
Sarıyer	1,016	0,984	0,110	0,808	1,315	0,708
Şile	0,962	1,037	1,267	0,686	2,473	0,686
Silivri	0,872	1,127	1,144	0,850	1,220	0,839
Şişli	1,029	0,972	0,938	0,664	1,539	0,670
Sultanbeyli	0,976	1,023	1,084	1,332	0,494	1,385
Sultangazi	0,983	1,017	1,084	1,240	0,579	1,267
Tuzla	0,983	1,017	1,136	1,077	0,715	1,150
Ümraniye	0,999	1,001	1,130	1,020	0,809	1,026

Üsküdar	1,028	0,972	1,092	0,801	1,451	0,763
Zeytinburnu	0,993	1,007	0,957	0,996	0,909	0,983

Municipality	Number of deaths	Single person household	More than one person without nuclear family household	At least one nuclear family and other persons household	Nuclear family with kids household	Nuclear family without kids
Adalar	2,171	2,061	1,269	0,922	0,488	1,336
Arnavutköy	0,790	0,698	0,442	1,300	1,164	0,867
Ataşehir	0,969	1,094	0,839	0,918	0,968	1,070
Avcılar	0,900	0,969	1,354	1,063	0,972	0,920
Bağcılar	0,815	0,622	0,650	1,249	1,187	0,783
Bahçelievler	1,081	0,930	1,219	1,110	0,981	0,924
Bakırköy	1,494	1,299	1,105	1,049	0,748	1,190
Başakşehir	0,562	0,725	1,407	0,901	1,196	0,777
Bayrampaşa	1,282	0,824	0,878	1,084	1,064	0,991
Beşiktaş	1,525	1,906	1,790	0,783	0,567	1,120
Beykoz	1,228	0,939	0,678	1,078	0,996	1,107
Beylikdüzü	0,861	0,798	1,010	0,958	1,065	1,070
Beyoğlu	1,359	1,460	1,522	0,936	0,818	0,782
Büyükçekmece	1,067	1,010	0,722	0,999	0,977	1,080
Çatalca	1,544	1,465	0,428	0,750	0,840	1,532
Çekmeköy	0,674	0,759	0,530	0,881	1,172	1,113
Esenler	0,872	0,589	0,589	1,048	1,257	0,842
Esenyurt	0,624	1,039	1,575	1,016	1,020	0,738
Eyüpsultan	0,997	0,902	0,761	0,947	1,055	1,076
Fatih	1,653	1,606	2,424	0,933	0,656	0,770
Gaziosmanpaşa	1,115	0,752	0,618	1,132	1,102	0,942
Güngören	1,159	0,877	0,982	0,988	1,049	0,967
Kadıköy	1,816	1,658	1,323	0,661	0,638	1,546
Kağıthane	0,935	1,140	1,237	0,989	0,952	0,888
Kartal	1,121	0,960	0,671	0,949	0,992	1,203
Küçükçekmece	0,897	0,918	0,894	1,070	1,031	0,955
Maltepe	1,147	1,157	0,895	0,897	0,891	1,254
Pendik	0,861	0,838	0,562	0,946	1,126	1,044

Municipality	Number of deaths	Single person household	More than one person without nuclear family household	At least one nuclear family and other persons household	Nuclear family with kids household	Nuclear family without kids
Sancaktepe	0,645	0,632	0,467	1,018	1,245	0,920
Sarıyer	1,009	1,165	0,998	0,986	0,909	1,065
Şile	2,114	1,744	0,675	0,853	0,623	1,867
Silivri	1,150	1,056	0,555	0,883	0,976	1,464
Şişli	1,487	1,895	2,159	0,852	0,582	0,887
Sultanbeyli	0,686	0,488	0,343	1,267	1,301	0,772
Sultangazi	0,787	0,557	0,457	1,327	1,218	0,773
Tuzla	0,735	0,892	0,539	0,814	1,146	1,112
Ümraniye	0,828	0,819	0,690	0,968	1,096	1,056
Üsküdar	1,285	1,146	1,143	0,944	0,895	1,104
Zeytinburnu	1,104	0,957	1,793	1,238	0,930	0,762

Municipality	Single nuclear family household	Single parent with children household	Number of people aged 15+ and literate	Higher educatio n female	Higher education male	Higher educatio n total
Adalar	0,698	0,993	1,135	1,525	1,547	1,536
Arnavutköy	1,057	0,777	0,921	0,406	0,483	0,445
Ataşehir	1,003	1,090	1,042	1,419	1,348	1,384
Avcılar	0,970	1,010	0,967	0,857	0,850	0,853
Bağcılar	1,075	0,872	0,970	0,553	0,573	0,563
Bahçelievler	0,980	1,033	1,002	0,943	0,953	0,948
Bakırköy	0,897	1,256	1,069	1,957	1,768	1,862
Başakşehir	1,072	0,823	0,882	0,956	1,010	0,983
Bayrampaşa	1,039	0,981	1,036	0,842	0,858	0,850
Beşiktaş	0,737	1,104	1,096	2,566	2,204	2,384
Beykoz	1,022	1,055	1,056	1,007	1,022	1,015
Beylikdüzü	1,066	1,069	0,971	1,277	1,279	1,278
Beyoğlu	0,848	1,043	1,028	0,792	0,848	0,820
Büyükçekmece	1,017	1,126	1,008	1,013	1,032	1,022
Çatalca	0,964	0,952	1,088	0,673	0,785	0,729
Çekmeköy	1,128	0,950	0,989	1,076	1,098	1,087
Esenler	1,134	0,885	0,990	0,507	0,529	0,518
Esenyurt	0,945	0,824	0,884	0,551	0,582	0,567
Eyüpsultan	1,056	1,042	1,025	1,051	1,020	1,035

Municipality	Single nuclear family household	Single parent with children household	Number of people aged 15+ and literate	Higher education female	Higher education male	Higher education total
Fatih	0,745	1,101	0,950	0,823	0,829	0,826
Gaziosmanpaşa	1,067	1,035	1,008	0,690	0,666	0,678
Güngören	1,039	1,066	1,026	0,828	0,844	0,836
Kadıköy	0,867	1,205	1,136	2,600	2,343	2,471
Kağıthane	0,946	0,979	1,032	0,944	0,915	0,929
Kartal	1,046	1,125	1,055	1,240	1,278	1,259
Küçükçekmece	1,015	1,001	0,992	0,903	0,914	0,909
Maltepe	0,986	1,136	1,076	1,486	1,461	1,473
Pendik	1,088	0,969	1,005	0,899	0,994	0,947
Sancaktepe	1,137	0,883	0,955	0,720	0,740	0,730
Sarıyer	0,956	1,057	1,054	1,438	1,337	1,387
Şile	0,845	0,820	1,103	0,778	1,017	0,898
Silivri	1,041	0,917	1,071	0,673	0,919	0,797
Şişli	0,699	1,027	1,049	1,579	1,413	1,496
Sultanbeyli	1,130	0,740	0,928	0,392	0,494	0,443
Sultangazi	1,090	0,840	0,953	0,438	0,445	0,441
Tuzla	1,104	0,916	1,003	1,072	1,167	1,120
Ümraniye	1,080	1,035	1,010	1,092	1,128	1,110
Üsküdar	0,961	1,111	1,076	1,553	1,524	1,538
Zeytinburnu	0,904	0,928	0,937	0,681	0,663	0,672

Municipality	Social assistance recipients	Foreign population	Population registered other cities	Population registered istanbul	Population registered abroad
Adalar	0,340	0,230	0,991	1,036	0,768
Arnavutköy	1,334	1,077	1,054	1,013	0,373
Ataşehir	0,851	0,247	1,031	1,012	0,601
Avcılar	1,049	1,648	0,995	0,894	1,993
Bağcılar	1,103	1,330	1,058	0,972	0,707
Bahçelievler	0,982	1,270	1,055	0,924	1,165
Bakırköy	0,398	0,452	0,854	1,104	1,453
Başakşehir	0,630	1,840	0,911	0,970	2,112
Bayrampaşa	1,081	0,933	0,777	1,191	1,392
Beşiktaş	0,235	0,585	0,941	0,981	1,728
Beykoz	0,655	0,282	0,848	1,209	0,566
Beylikdüzü	0,674	0,773	0,904	1,012	1,796
Beyoğlu	1,297	1,169	0,962	1,055	0,865

Municipality	Social assistance recipients	Foreign population	Population registered other cities	Population registered istanbul	Population registered abroad
Büyükçekmece	0,965	0,477	0,960	1,034	1,076
Çatalca	0,583	0,107	0,698	1,360	0,626
Çekmeköy	0,944	0,243	1,015	1,045	0,450
Esenler	1,410	1,436	1,053	1,004	0,461
Esenyurt	1,662	2,483	1,111	0,799	1,753
Eyüpsultan	0,915	0,595	0,895	1,137	0,757
Fatih	0,974	3,675	0,869	0,936	2,806
Gaziosmanpaşa	1,177	0,833	0,891	1,133	0,836
Güngören	1,151	1,203	1,041	0,967	0,906
Kadıköy	0,305	0,374	0,967	1,024	1,101
Kağıthane	1,123	0,956	0,987	1,040	0,760
Kartal	0,825	0,170	1,051	1,001	0,513
Küçükçekmece	1,033	1,184	1,013	0,976	1,096
Maltepe	0,737	0,258	1,040	0,997	0,656
Pendik	0,920	0,227	1,077	0,978	0,465
Sancaktepe	1,310	0,489	1,123	0,952	0,269
Sarıyer	0,662	0,401	0,928	1,071	1,041
Şile	0,418	0,333	0,958	1,095	0,543
Silivri	0,827	0,242	1,062	0,970	0,692
Şişli	0,899	1,150	0,922	1,009	1,651
Sultanbeyli	1,386	0,994	1,088	1,001	0,162
Sultangazi	1,432	1,297	1,049	1,011	0,442
Tuzla	0,686	0,330	1,134	0,921	0,448
Ümraniye	0,918	0,544	0,995	1,055	0,557
Üsküdar	0,712	0,307	0,973	1,059	0,732
Zeytinburnu	1,422	2,349	0,908	0,941	2,393

APPENDIX G – CORRELATIONS FOR METROPOLITAN SÃO PAULO

		1	2	3	4	5	6	7	8	9	10	11	12
1	Area	1,00	0,81	-0,01	0,81	0,81	0,80	0,80	0,80	0,79	0,79	-0,17	0,81
2	Population	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
3	Gender ratio	-0,01	-0,33	1,00	-0,33	-0,33	-0,29	-0,32	-0,30	-0,31	-0,30	-0,71	-0,34
4	Female population	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
5	Male population	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
6	Yellow population	0,80	0,99	-0,29	0,99	0,99	1,00	1,00	1,00	0,99	1,00	0,18	0,99
7	White population	0,80	0,99	-0,32	0,99	0,99	1,00	1,00	1,00	1,00	1,00	0,21	0,99
8	Indigenous population	0,80	0,99	-0,30	0,99	0,99	1,00	1,00	1,00	1,00	1,00	0,21	0,99
9	Brown population	0,79	0,98	-0,31	0,98	0,98	0,99	1,00	1,00	1,00	1,00	0,23	0,98
10	Black population	0,79	0,99	-0,30	0,99	0,99	1,00	1,00	1,00	1,00	1,00	0,22	0,98
11	Demographic density	-0,17	0,22	-0,71	0,22	0,22	0,18	0,21	0,21	0,23	0,22	1,00	0,22
12	Married population	0,81	1,00	-0,34	1,00	1,00	0,99	0,99	0,99	0,98	0,98	0,22	1,00
13	Marriage rates	-0,13	-0,17	0,11	-0,17	-0,17	-0,14	-0,13	-0,13	-0,11	-0,12	-0,19	-0,16
14	Number of birth	0,81	1,00	-0,33	1,00	1,00	0,98	0,98	0,99	0,98	0,98	0,22	1,00
15	Number of death	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
16	Birth to death ratio	-0,26	-0,10	0,11	-0,10	-0,09	-0,10	-0,11	-0,10	-0,09	-0,09	-0,02	-0,10
17	Child death under one year	0,80	1,00	-0,33	1,00	1,00	0,98	0,98	0,98	0,97	0,98	0,24	1,00
18	Total natural deaths	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
19	Total unnatural deaths	0,80	1,00	-0,34	1,00	1,00	0,98	0,98	0,98	0,98	0,98	0,23	1,00
20	Working age population	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
21	Child population	0,81	1,00	-0,34	1,00	1,00	0,98	0,98	0,99	0,98	0,98	0,22	1,00
22	Child dependency ratio	-0,21	-0,32	0,61	-0,32	-0,32	-0,29	-0,32	-0,30	-0,30	-0,29	-0,42	-0,32

		1	2	3	4	5	6	7	8	9	10	11	12
23	Elderly population	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,21	1,00
24	Elderly dependency ratio	0,31	0,15	-0,22	0,16	0,15	0,16	0,17	0,16	0,14	0,14	0,03	0,15

		13	14	15	16	17	18	19	20	21	22	23	24
1	Area	-0,13	0,81	0,81	-0,26	0,80	0,81	0,80	0,81	0,81	-0,21	0,81	0,31
2	Population	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,15
3	Gender ratio	0,11	-0,33	-0,33	0,11	-0,33	-0,33	-0,34	-0,33	-0,34	0,61	-0,33	-0,22
4	Female population	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
5	Male population	-0,17	1,00	1,00	-0,09	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,15
6	Yellow population	-0,14	0,98	0,99	-0,10	0,98	0,99	0,98	0,99	0,98	-0,29	0,99	0,16
7	White population	-0,13	0,98	0,99	-0,11	0,98	0,99	0,98	0,99	0,98	-0,32	0,99	0,17
8	Indigenous population	-0,13	0,99	0,99	-0,10	0,98	0,99	0,98	0,99	0,99	-0,30	0,99	0,16
9	Brown population	-0,11	0,98	0,98	-0,09	0,97	0,98	0,98	0,98	0,98	-0,30	0,98	0,14
10	Black population	-0,12	0,98	0,99	-0,09	0,98	0,99	0,98	0,99	0,98	-0,29	0,99	0,14
11	Demographic density	-0,19	0,22	0,22	-0,02	0,24	0,22	0,23	0,22	0,22	-0,42	0,21	0,03
12	Married population	-0,16	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,15
13	Marriage rates	1,00	-0,17	-0,17	0,07	-0,18	-0,17	-0,18	-0,17	-0,17	0,02	-0,17	-0,03
14	Number of birth	-0,17	1,00	1,00	-0,08	1,00	1,00	1,00	1,00	1,00	-0,30	1,00	0,14
15	Number of death	-0,17	1,00	1,00	-0,11	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,17
16	Birth to death ratio	0,07	-0,08	-0,11	1,00	-0,07	-0,11	-0,09	-0,10	-0,09	0,67	-0,11	-0,81
17	Child death under one year	-0,18	1,00	1,00	-0,07	1,00	1,00	1,00	1,00	1,00	-0,29	0,99	0,13
18	Total natural deaths	-0,17	1,00	1,00	-0,11	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,17
19	Total unnatural deaths	-0,18	1,00	1,00	-0,09	1,00	1,00	1,00	1,00	1,00	-0,31	1,00	0,14

		13	14	15	16	17	18	19	20	21	22	23	24
20	Working age population	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,15
21	Child population	-0,17	1,00	1,00	-0,09	1,00	1,00	1,00	1,00	1,00	-0,31	1,00	0,14
22	Child dependency ratio	0,02	-0,30	-0,32	0,67	-0,29	-0,32	-0,31	-0,32	-0,31	1,00	-0,33	-0,67
23	Elderly population	-0,17	1,00	1,00	-0,11	0,99	1,00	1,00	1,00	1,00	-0,33	1,00	0,18
24	Elderly dependency ratio	-0,03	0,14	0,17	-0,81	0,13	0,17	0,14	0,15	0,14	-0,67	0,18	1,00

		1	2	3	4	5	6	7	8	9	10	11	12
25	Total dependency ratio	0,22	-0,09	0,28	-0,09	-0,09	-0,05	-0,07	-0,08	-0,10	-0,08	-0,36	-0,10
26	Child to elderly ratio	-0,35	-0,22	0,26	-0,22	-0,22	-0,21	-0,23	-0,21	-0,20	-0,20	-0,10	-0,22
27	Life expectancy	0,15	0,05	-0,14	0,05	0,05	0,06	0,07	0,06	0,04	0,04	-0,10	0,04
28	Education level	0,12	0,08	-0,55	0,08	0,08	0,07	0,09	0,08	0,07	0,07	0,13	0,09
29	Total households	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,21	1,00
30	Private households	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,21	1,00
31	Collective households	0,82	0,99	-0,30	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,17	0,99
32	Average number of residents in private households	-0,34	-0,36	0,36	-0,36	-0,36	-0,33	-0,36	-0,35	-0,34	-0,34	-0,36	-0,36
33	Percentage of private households imputed	0,20	0,23	-0,13	0,23	0,23	0,19	0,21	0,21	0,21	0,21	0,09	0,23
34	Total occupied private households	0,81	1,00	-0,33	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
35	Households without connection to the sanitary network	0,91	0,76	-0,03	0,76	0,76	0,75	0,75	0,75	0,75	0,75	-0,15	0,76
36	Households connected to general sanitary network	0,81	1,00	-0,34	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,22	1,00
37	Gross domestic product	0,80	1,00	-0,34	1,00	1,00	0,98	0,98	0,99	0,98	0,98	0,22	1,00
38	Formal employment	0,81	1,00	-0,32	1,00	1,00	0,99	0,99	0,99	0,99	0,99	0,20	1,00
39	Nominal average salary	0,25	0,52	-0,61	0,52	0,52	0,47	0,49	0,49	0,49	0,48	0,33	0,53
40	Total companies and other organizations	0,81	1,00	-0,31	1,00	1,00	0,99	0,99	0,99	0,99	0,99	0,19	1,00

41	Scientific and technical activities	0,81	0,99	-0,30	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,18	0,99
42	Educational organizations	0,82	1,00	-0,31	1,00	1,00	0,99	0,99	0,99	0,99	0,99	0,19	1,00
43	Human health and social services	0,81	1,00	-0,30	1,00	0,99	0,99	0,99	0,99	0,99	0,99	0,18	0,99
44	Arts culture sport recreational organizations	0,81	1,00	-0,30	1,00	1,00	0,99	0,99	0,99	0,99	0,99	0,18	0,99
45	International organizations	0,81	0,99	-0,26	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,17	0,99
46	Hospitalized people by residence	0,81	1,00	-0,34	1,00	1,00	0,99	0,99	0,99	0,98	0,99	0,23	1,00
47	Total healthcare expenditure per inhabitant	0,00	0,06	-0,38	0,06	0,06	0,07	0,07	0,06	0,06	0,05	0,10	0,08

		13	14	15	16	17	18	19	20	21	22	23	24
25	Total dependency ratio	-0,02	-0,10	-0,08	-0,46	-0,11	-0,08	-0,11	-0,09	-0,10	0,04	-0,07	0,71
26	Child to elderly ratio	0,03	-0,20	-0,23	0,85	-0,19	-0,23	-0,21	-0,22	-0,21	0,82	-0,24	-0,92
27	Life expectancy	-0,06	0,03	0,05	-0,26	0,02	0,05	0,03	0,05	0,04	-0,38	0,07	0,60
28	Education level	0,16	0,07	0,09	-0,49	0,05	0,09	0,07	0,08	0,07	-0,71	0,09	0,63
29	Total households	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
30	Private households	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
31	Collective households	-0,14	0,99	1,00	-0,11	0,99	1,00	0,99	0,99	0,99	-0,30	1,00	0,17
32	Average number of residents in private households	0,20	-0,34	-0,36	0,59	-0,34	-0,36	-0,36	-0,36	-0,35	0,76	-0,37	-0,60
33	Percentage of private households imputed	-0,16	0,23	0,22	0,18	0,24	0,22	0,23	0,23	0,23	0,00	0,22	-0,11
34	Total occupied private households	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
35	Households without connection to the sanitary network	-0,14	0,76	0,76	-0,20	0,75	0,76	0,75	0,76	0,76	-0,14	0,76	0,20
36	Households connected to general sanitary network	-0,17	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
37	Gross domestic product	-0,13	1,00	1,00	-0,09	0,99	1,00	1,00	1,00	1,00	-0,32	1,00	0,15
38	Formal employment	-	1,00	1,00	-	0,99	1,00	0,99	1,00	1,00	-	1,00	0,16

		13	14	15	16	17	18	19	20	21	22	23	24
		0,13			0,10						0,31		
39	Nominal average salary	0,02	0,52	0,51	0,17	0,52	0,51	0,53	0,52	0,52	-0,31	0,51	-0,11
40	Total companies and other organizations	-0,15	1,00	1,00	-0,10	0,99	1,00	0,99	1,00	1,00	-0,31	1,00	0,18
41	Scientific and technical activities	-0,14	0,99	1,00	-0,10	0,99	1,00	0,99	0,99	0,99	-0,30	1,00	0,18
42	Educational organizations	-0,15	1,00	1,00	-0,11	0,99	1,00	0,99	1,00	1,00	-0,31	1,00	0,18
43	Human health and social services	-0,14	0,99	1,00	-0,11	0,99	1,00	0,99	1,00	0,99	-0,31	1,00	0,18
44	Arts culture sport recreational organizations	-0,14	0,99	1,00	-0,10	0,99	1,00	0,99	1,00	0,99	-0,30	1,00	0,18
45	International organizations	-0,13	0,99	0,99	-0,10	0,98	0,99	0,98	0,99	0,99	-0,27	0,99	0,16
46	Hospitalized people by residence	-0,16	1,00	1,00	-0,10	1,00	1,00	1,00	1,00	1,00	-0,32	1,00	0,16
47	Total healthcare expenditure per inhabitant	0,33	0,07	0,07	0,05	0,04	0,07	0,06	0,06	0,06	-0,24	0,07	0,24

		25	26	27	28	29	30	31	32	33	34	35	36
25	Total dependency ratio	1,00	-0,46	0,45	0,18	-0,09	-0,09	-0,05	-0,09	-0,15	-0,09	0,14	-0,09
26	Child to elderly ratio	-0,46	1,00	-0,53	-0,65	-0,22	-0,22	-0,22	0,67	-0,01	-0,22	-0,25	-0,23
27	Life expectancy	0,45	-0,53	1,00	0,39	0,05	0,05	0,06	-0,35	-0,01	0,05	0,07	0,05
28	Education level	0,18	-0,65	0,39	1,00	0,08	0,08	0,09	-0,48	0,01	0,08	0,08	0,09
29	Total households	-0,09	-0,22	0,05	0,08	1,00	1,00	1,00	-0,36	0,23	1,00	0,76	1,00
30	Private households	-0,09	-0,22	0,05	0,08	1,00	1,00	1,00	-0,36	0,23	1,00	0,76	1,00
31	Collective households	-0,05	-0,22	0,06	0,09	1,00	1,00	1,00	-0,35	0,21	1,00	0,78	1,00
32	Average number of residents in private households	-0,09	0,67	-0,35	-0,48	-0,36	-0,36	-0,35	1,00	0,13	-0,36	-0,23	-0,37
33	Percentage of private households imputed	-0,15	-0,01	-0,01	0,01	0,23	0,23	0,21	0,13	1,00	0,23	0,23	0,22
34	Total occupied private households	-0,09	-0,22	0,05	0,08	1,00	1,00	1,00	-0,36	0,23	1,00	0,76	1,00
35	Households without connection to the sanitary network	0,14	-0,25	0,07	0,08	0,76	0,76	0,78	-0,23	0,23	0,76	1,00	0,76

		25	26	27	28	29	30	31	32	33	34	35	36
36	Households connected to general sanitary network	-0,09	-0,23	0,05	0,09	1,00	1,00	1,00	-0,37	0,22	1,00	0,76	1,00
37	Gross domestic product	-0,09	-0,22	0,04	0,10	1,00	1,00	0,99	-0,35	0,22	1,00	0,75	1,00
38	Formal employment	-0,07	-0,22	0,05	0,10	1,00	1,00	1,00	-0,35	0,21	1,00	0,76	1,00
39	Nominal average salary	-0,44	0,05	-0,08	0,28	0,51	0,51	0,49	-0,17	0,18	0,52	0,29	0,52
40	Total companies and other organizations	-0,06	-0,23	0,07	0,10	1,00	1,00	1,00	-0,35	0,22	1,00	0,76	1,00
41	Scientific and technical activities	-0,05	-0,23	0,08	0,10	1,00	1,00	1,00	-0,35	0,22	1,00	0,76	1,00
42	Educational organizations	-0,06	-0,23	0,07	0,10	1,00	1,00	1,00	-0,36	0,22	1,00	0,77	1,00
43	Human health and social services	-0,05	-0,23	0,07	0,09	1,00	1,00	1,00	-0,35	0,21	1,00	0,77	1,00
44	Arts culture sport recreational organizations	-0,05	-0,23	0,07	0,09	1,00	1,00	1,00	-0,35	0,22	1,00	0,77	1,00
45	International organizations	-0,04	-0,21	0,06	0,06	0,99	0,99	1,00	-0,33	0,21	0,99	0,77	0,99
46	Hospitalized people by residence	-0,09	-0,23	0,05	0,10	1,00	1,00	1,00	-0,37	0,22	1,00	0,76	1,00
47	Total healthcare expenditure per inhabitant	0,10	-0,15	0,17	0,63	0,06	0,06	0,08	-0,13	-0,10	0,06	-0,03	0,07

		38	39	40	41	42	43	44	45	46	47
25	Total dependency ratio	-0,07	-0,44	-0,06	-0,05	-0,06	-0,05	-0,05	-0,04	-0,09	0,10
26	Child to elderly ratio	-0,22	0,05	-0,23	-0,23	-0,23	-0,23	-0,23	-0,21	-0,23	-0,15
27	Life expectancy	0,05	-0,08	0,07	0,08	0,07	0,07	0,07	0,06	0,05	0,17
28	Education level	0,10	0,28	0,10	0,10	0,10	0,09	0,09	0,06	0,10	0,63
29	Total households	1,00	0,51	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,06
30	Private households	1,00	0,51	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,06
31	Collective households	1,00	0,49	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,08
32	Average number of residents in private households	-0,35	-0,17	-0,35	-0,35	-0,36	-0,35	-0,35	-0,33	-0,37	-0,13
33	Percentage of private households imputed	0,21	0,18	0,22	0,22	0,22	0,21	0,22	0,21	0,22	-0,10
34	Total occupied private households	1,00	0,52	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,06
35	Households without connection to the sanitary network	0,76	0,29	0,76	0,76	0,77	0,77	0,77	0,77	0,76	-0,03

36	Households connected to general sanitary network	1,00	0,52	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,07
37	Gross domestic product	1,00	0,55	1,00	0,99	1,00	0,99	0,99	0,99	1,00	0,12
38	Formal employment	1,00	0,52	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,11
39	Nominal average salary	0,52	1,00	0,50	0,50	0,50	0,49	0,50	0,46	0,52	0,50
40	Total companies and other organizations	1,00	0,50	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,09
41	Scientific and technical activities	1,00	0,50	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,09
42	Educational organizations	1,00	0,50	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,08
43	Human health and social services	1,00	0,49	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,08
44	Arts culture sport recreational organizations	1,00	0,50	1,00	1,00	1,00	1,00	1,00	1,00	1,00	0,08
45	International organizations	0,99	0,46	1,00	1,00	1,00	1,00	1,00	1,00	0,99	0,06
46	Hospitalized people by residence	1,00	0,52	1,00	1,00	1,00	1,00	1,00	0,99	1,00	0,09
47	Total healthcare expenditure per inhabitant	0,11	0,50	0,09	0,09	0,08	0,08	0,08	0,06	0,09	1,00

APPENDIX H – CORRELATIONS FOR METROPOLITAN ISTANBUL

		1	2	3	4	5	6	7	8	9	10
1	Population	1,00	-0,10	1,00	1,00	0,92	0,94	0,94	0,94	0,79	0,72
2	Gender ratio	-0,10	1,00	-0,14	-0,05	-0,04	0,09	0,09	0,09	-0,37	-0,43
3	Female population	1,00	-0,14	1,00	0,99	0,92	0,93	0,92	0,93	0,81	0,75
4	Male population	1,00	-0,05	0,99	1,00	0,92	0,95	0,95	0,95	0,77	0,69
5	Married population	0,92	-0,04	0,92	0,92	1,00	0,88	0,88	0,88	0,73	0,67
6	Total number of births	0,94	0,09	0,93	0,95	0,88	1,00	1,00	1,00	0,57	0,48
7	Number of female births	0,94	0,09	0,92	0,95	0,88	1,00	1,00	1,00	0,57	0,48
8	Number of male births	0,94	0,09	0,93	0,95	0,88	1,00	1,00	1,00	0,57	0,48
9	Total number of deaths	0,79	-0,37	0,81	0,77	0,73	0,57	0,57	0,57	1,00	0,99
10	Number of female deaths	0,72	-0,43	0,75	0,69	0,67	0,48	0,48	0,48	0,99	1,00
11	Number of male deaths	0,84	-0,30	0,86	0,82	0,77	0,63	0,63	0,63	0,99	0,97
12	Population growth rate	-0,07	0,32	-0,08	-0,06	0,01	0,10	0,10	0,11	-0,40	-0,41
13	Child population	0,95	0,06	0,94	0,96	0,88	0,99	0,99	1,00	0,59	0,50
14	Child dependency ratio	0,43	0,30	0,40	0,45	0,41	0,64	0,64	0,65	-0,06	-0,13
15	Elderly population	0,57	-0,55	0,60	0,53	0,52	0,29	0,28	0,29	0,91	0,95
16	Elderly dependency ratio	-0,54	-0,31	-0,51	-0,56	-0,47	-0,66	-0,66	-0,66	-0,11	-0,02
17	Total dependency ratio	-0,10	0,04	-0,10	-0,10	-0,01	0,08	0,08	0,08	-0,28	-0,26
18	Total number of households	0,97	-0,23	0,98	0,96	0,89	0,85	0,85	0,85	0,88	0,84
19	Average household size	0,44	0,33	0,41	0,47	0,41	0,62	0,61	0,62	0,03	-0,05
20	More than one person without nuclear family household	0,64	-0,31	0,65	0,62	0,53	0,51	0,51	0,50	0,72	0,71
21	At least one nuclear family and other persons household	0,99	-0,11	0,99	0,99	0,90	0,92	0,92	0,92	0,81	0,73
22	Nuclear family with kids household	0,99	-0,05	0,98	0,99	0,92	0,95	0,95	0,95	0,72	0,65
23	Nuclear family without kids	0,80	-0,37	0,82	0,77	0,75	0,59	0,59	0,59	0,89	0,89
24	Single nuclear family household	0,98	-0,15	0,99	0,98	0,91	0,89	0,89	0,90	0,81	0,75

		1	2	3	4	5	6	7	8	9	10
25	Single parent with children household	0,89	-0,36	0,91	0,87	0,81	0,69	0,69	0,69	0,94	0,92
26	Single person household	0,66	-0,45	0,69	0,64	0,59	0,45	0,45	0,45	0,87	0,89
27	People aged 15+ and literate	0,99	-0,15	0,99	0,98	0,92	0,90	0,89	0,90	0,84	0,78
28	Literacy ratio	-0,23	-0,44	-0,20	-0,26	-0,20	-0,38	-0,38	-0,38	-0,03	0,04
29	Primary education female	0,91	0,17	0,89	0,93	0,86	0,97	0,97	0,97	0,54	0,44
30	Primary school female	0,94	0,07	0,93	0,95	0,89	0,92	0,92	0,92	0,72	0,63
31	Secondary school female	0,96	0,06	0,95	0,97	0,90	0,98	0,98	0,98	0,66	0,57
32	High school female	0,93	-0,31	0,95	0,91	0,84	0,77	0,77	0,77	0,89	0,85
33	College female	0,69	-0,55	0,72	0,65	0,63	0,44	0,44	0,44	0,85	0,87
34	Masters degree female	0,29	-0,68	0,34	0,25	0,26	0,02	0,02	0,02	0,65	0,73

		11	12	13	14	15	16	17	18	19	20
1	Population	0,84	-0,07	0,95	0,43	0,57	-0,54	-0,10	0,97	0,44	0,64
2	Gender ratio	-0,30	0,32	0,06	0,30	-0,55	-0,31	0,04	-0,23	0,33	-0,31
3	Female population	0,86	-0,08	0,94	0,40	0,60	-0,51	-0,10	0,98	0,41	0,65
4	Male population	0,82	-0,06	0,96	0,45	0,53	-0,56	-0,10	0,96	0,47	0,62
5	Married population	0,77	0,01	0,88	0,41	0,52	-0,47	-0,01	0,89	0,41	0,53
6	Total number of births	0,63	0,10	0,99	0,64	0,29	-0,66	0,08	0,85	0,62	0,51
7	Number of female births	0,63	0,10	0,99	0,64	0,28	-0,66	0,08	0,85	0,61	0,51
8	Number of male births	0,63	0,11	1,00	0,65	0,29	-0,66	0,08	0,85	0,62	0,50
9	Total number of deaths	0,99	-0,40	0,59	-0,06	0,91	-0,11	-0,28	0,88	0,03	0,72
10	Number of female deaths	0,97	-0,41	0,50	-0,13	0,95	-0,02	-0,26	0,84	-0,05	0,71
11	Number of male deaths	1,00	-0,38	0,65	0,00	0,87	-0,19	-0,30	0,91	0,10	0,71
12	Population growth rate	-0,38	1,00	0,09	0,43	-0,35	-0,14	0,53	-0,14	0,25	-0,53
13	Child population	0,65	0,09	1,00	0,64	0,31	-0,66	0,07	0,86	0,62	0,51
14	Child dependency ratio	0,00	0,43	0,64	1,00	-0,30	-0,83	0,44	0,25	0,92	-0,08

		11	12	13	14	15	16	17	18	19	20
15	Elderly population	0,87	-0,35	0,31	-0,30	1,00	0,19	-0,23	0,72	-0,25	0,64
16	Elderly dependency ratio	-0,19	-0,14	-0,66	-0,83	0,19	1,00	0,13	-0,39	-0,86	-0,07
17	Total dependency ratio	-0,30	0,53	0,07	0,44	-0,23	0,13	1,00	-0,18	0,26	-0,26
18	Total number of households	0,91	-0,14	0,86	0,25	0,72	-0,39	-0,18	1,00	0,25	0,73
19	Average household size	0,10	0,25	0,62	0,92	-0,25	-0,86	0,26	0,25	1,00	-0,12
20	More than one person without nuclear family household	0,71	-0,53	0,51	-0,08	0,64	-0,07	-0,26	0,73	-0,12	1,00
21	At least one nuclear family and other persons household	0,85	-0,13	0,94	0,40	0,57	-0,52	-0,12	0,95	0,45	0,63
22	Nuclear family with kids household	0,77	0,05	0,96	0,50	0,49	-0,59	-0,07	0,94	0,50	0,52
23	Nuclear family without kids	0,88	-0,05	0,61	0,00	0,89	-0,11	-0,18	0,90	-0,01	0,59
24	Single nuclear family household	0,85	-0,01	0,91	0,37	0,63	-0,49	-0,12	0,98	0,37	0,58
25	Single parent with children household	0,95	-0,22	0,71	0,06	0,86	-0,23	-0,26	0,97	0,07	0,72
26	Single person household	0,84	-0,40	0,45	-0,22	0,88	0,06	-0,30	0,81	-0,26	0,88
27	People aged 15+ and literate	0,88	-0,09	0,91	0,35	0,65	-0,48	-0,15	0,98	0,38	0,62
28	Literacy ratio	-0,09	0,12	-0,35	-0,51	0,28	0,54	-0,03	-0,09	-0,63	0,03
29	Primary education female	0,62	0,06	0,97	0,61	0,22	-0,68	0,00	0,80	0,63	0,43
30	Primary school female	0,79	-0,11	0,93	0,49	0,42	-0,62	-0,13	0,87	0,57	0,47
31	Secondary school female	0,72	0,01	0,99	0,58	0,36	-0,64	-0,01	0,88	0,60	0,51
32	High school female	0,91	-0,14	0,79	0,18	0,77	-0,34	-0,23	0,98	0,20	0,67
33	College female	0,82	-0,13	0,47	-0,13	0,91	0,00	-0,23	0,82	-0,15	0,61
34	Masters degree female	0,57	-0,19	0,05	-0,42	0,88	0,37	-0,14	0,49	-0,45	0,48

		21	22	23	24	25	26	27
1	Population	0,99	0,99	0,80	0,98	0,89	0,66	0,99
2	Gender ratio	-0,11	-0,05	-0,37	-0,15	-0,36	-0,45	-0,15
3	Female population	0,99	0,98	0,82	0,99	0,91	0,69	0,99
4	Male population	0,99	0,99	0,77	0,98	0,87	0,64	0,98
5	Married population	0,90	0,92	0,75	0,91	0,81	0,59	0,92
6	Total number of births	0,92	0,95	0,59	0,89	0,69	0,45	0,90
7	Number of female births	0,92	0,95	0,59	0,89	0,69	0,45	0,89
8	Number of male births	0,92	0,95	0,59	0,90	0,69	0,45	0,90
9	Total number of deaths	0,81	0,72	0,89	0,81	0,94	0,87	0,84
10	Number of female deaths	0,73	0,65	0,89	0,75	0,92	0,89	0,78
11	Number of male deaths	0,85	0,77	0,88	0,85	0,95	0,84	0,88
12	Population growth rate	-0,13	0,05	-0,05	-0,01	-0,22	-0,40	-0,09
13	Child population	0,94	0,96	0,61	0,91	0,71	0,45	0,91
14	Child dependency ratio	0,40	0,50	0,00	0,37	0,06	-0,22	0,35
15	Elderly population	0,57	0,49	0,89	0,63	0,86	0,88	0,65
16	Elderly dependency ratio	-0,52	-0,59	-0,11	-0,49	-0,23	0,06	-0,48
17	Total dependency ratio	-0,12	-0,07	-0,18	-0,12	-0,26	-0,30	-0,15
18	Total number of households	0,95	0,94	0,90	0,98	0,97	0,81	0,98
19	Average household size	0,45	0,50	-0,01	0,37	0,07	-0,26	0,38
20	More than one person without nuclear family household	0,63	0,52	0,59	0,58	0,72	0,88	0,62
21	At least one nuclear family and other persons household	1,00	0,96	0,76	0,96	0,88	0,65	0,98
22	Nuclear family with kids household	0,96	1,00	0,77	0,98	0,85	0,57	0,98
23	Nuclear family without kids	0,76	0,77	1,00	0,87	0,96	0,85	0,86
24	Single nuclear family household	0,96	0,98	0,87	1,00	0,93	0,68	0,99
25	Single parent with children household	0,88	0,85	0,96	0,93	1,00	0,87	0,93
26	Single person household	0,65	0,57	0,85	0,68	0,87	1,00	0,71
27	People aged 15+ and literate	0,98	0,98	0,86	0,99	0,93	0,71	1,00
28	Literacy ratio	-0,28	-0,24	0,18	-0,14	0,04	0,17	-0,18
29	Primary education female	0,91	0,92	0,53	0,86	0,64	0,38	0,87
30	Primary school female	0,96	0,94	0,64	0,91	0,76	0,48	0,93
31	Secondary school female	0,96	0,97	0,63	0,92	0,75	0,48	0,93
32	High school female	0,92	0,91	0,93	0,96	0,98	0,79	0,96
33	College female	0,66	0,65	0,96	0,77	0,92	0,86	0,76
34	Masters degree female	0,26	0,24	0,75	0,39	0,65	0,76	0,38

		28	29	30	31	32	33	34
1	Population	-0,23	0,91	0,94	0,96	0,93	0,69	0,29
2	Gender ratio	-0,44	0,17	0,07	0,06	-0,31	-0,55	-0,68
3	Female population	-0,20	0,89	0,93	0,95	0,95	0,72	0,34
4	Male population	-0,26	0,93	0,95	0,97	0,91	0,65	0,25
5	Married population	-0,20	0,86	0,89	0,90	0,84	0,63	0,26
6	Total number of births	-0,38	0,97	0,92	0,98	0,77	0,44	0,02
7	Number of female births	-0,38	0,97	0,92	0,98	0,77	0,44	0,02
8	Number of male births	-0,38	0,97	0,92	0,98	0,77	0,44	0,02
9	Total number of deaths	-0,03	0,54	0,72	0,66	0,89	0,85	0,65
10	Number of female deaths	0,04	0,44	0,63	0,57	0,85	0,87	0,73
11	Number of male deaths	-0,09	0,62	0,79	0,72	0,91	0,82	0,57
12	Population growth rate	0,12	0,06	-0,11	0,01	-0,14	-0,13	-0,19
13	Child population	-0,35	0,97	0,93	0,99	0,79	0,47	0,05
14	Child dependency ratio	-0,51	0,61	0,49	0,58	0,18	-0,13	-0,42
15	Elderly population	0,28	0,22	0,42	0,36	0,77	0,91	0,88
16	Elderly dependency ratio	0,54	-0,68	-0,62	-0,64	-0,34	0,00	0,37
17	Total dependency ratio	-0,03	0,00	-0,13	-0,01	-0,23	-0,23	-0,14
18	Total number of households	-0,09	0,80	0,87	0,88	0,98	0,82	0,49
19	Average household size	-0,63	0,63	0,57	0,60	0,20	-0,15	-0,45
20	More than one person without nuclear family household	0,03	0,43	0,47	0,51	0,67	0,61	0,48
21	At least one nuclear family and other persons household	-0,28	0,91	0,96	0,96	0,92	0,66	0,26
22	Nuclear family with kids household	-0,24	0,92	0,94	0,97	0,91	0,65	0,24
23	Nuclear family without kids	0,18	0,53	0,64	0,63	0,93	0,96	0,75
24	Single nuclear family household	-0,14	0,86	0,91	0,92	0,96	0,77	0,39
25	Single parent with children household	0,04	0,64	0,76	0,75	0,98	0,92	0,65
26	Single person household	0,17	0,38	0,48	0,48	0,79	0,86	0,76
27	People aged 15+ and literate	-0,18	0,87	0,93	0,93	0,96	0,76	0,38
28	Literacy ratio	1,00	-0,45	-0,45	-0,39	0,01	0,33	0,52
29	Primary education female	-0,45	1,00	0,95	0,98	0,72	0,35	-0,09
30	Primary school female	-0,45	0,95	1,00	0,97	0,81	0,48	0,06
31	Secondary school female	-0,39	0,98	0,97	1,00	0,81	0,48	0,06
32	High school female	0,01	0,72	0,81	0,81	1,00	0,88	0,56
33	College female	0,33	0,35	0,48	0,48	0,88	1,00	0,87
34	Masters degree female	0,52	-0,09	0,06	0,06	0,56	0,87	1,00

		1	2	3	4	5	6	7	8	9	10
35	Doctorate female	0,12	-0,70	0,17	0,07	0,09	-0,13	-0,13	-0,13	0,51	0,62
36	Higher education female	0,62	-0,59	0,66	0,58	0,56	0,36	0,36	0,36	0,82	0,86
37	Primary education male	0,88	0,24	0,85	0,90	0,84	0,96	0,96	0,96	0,51	0,41
38	Primary school male	0,90	0,15	0,88	0,91	0,85	0,89	0,89	0,90	0,67	0,58
39	Secondary school male	0,93	0,16	0,91	0,95	0,88	0,98	0,98	0,98	0,60	0,51
40	High school male	0,97	-0,10	0,97	0,97	0,89	0,88	0,87	0,88	0,80	0,73
41	College male	0,74	-0,47	0,77	0,71	0,68	0,51	0,51	0,51	0,85	0,86
42	Masters degree male	0,38	-0,64	0,43	0,34	0,34	0,12	0,11	0,12	0,68	0,75
43	Doctorate male	0,17	-0,69	0,21	0,12	0,13	-0,09	-0,09	-0,09	0,54	0,64
44	Higher education male	0,68	-0,52	0,71	0,64	0,62	0,43	0,43	0,44	0,84	0,86
45	Higher education total	0,65	-0,56	0,69	0,61	0,59	0,40	0,40	0,40	0,83	0,86
46	Annual average income	-0,16	-0,71	-0,12	-0,20	-0,20	-0,37	-0,37	-0,37	0,21	0,30
47	Health facility area per capita	-0,19	-0,36	-0,17	-0,21	-0,13	-0,25	-0,25	-0,25	-0,04	0,00
48	Number of clinics	-0,03	-0,52	0,01	-0,06	-0,01	-0,19	-0,19	-0,19	0,32	0,41
49	Number of medical centers	0,40	-0,60	0,43	0,37	0,34	0,24	0,24	0,24	0,56	0,59
50	Population per family physician	0,17	-0,03	0,17	0,17	0,05	0,26	0,26	0,26	-0,12	-0,13
		1	2	3	4	5	6	7	8	9	10
51	Emergency medical services stations	0,85	-0,17	0,86	0,84	0,80	0,69	0,69	0,69	0,89	0,86
52	Housing sales	0,68	-0,09	0,68	0,68	0,59	0,73	0,73	0,72	0,39	0,35
53	Homeowners to tenants ratio	-0,34	0,16	-0,34	-0,34	-0,22	-0,36	-0,36	-0,35	-0,23	-0,22
54	Average duration of residence in the current residence	-0,57	0,10	-0,57	-0,56	-0,58	-0,58	-0,57	-0,58	-0,38	-0,36
55	Average house net size m2	0,01	-0,01	0,02	0,01	0,00	-0,02	-0,02	-0,01	-0,05	-0,03
56	Water consumption m3	0,95	-0,19	0,95	0,94	0,84	0,87	0,87	0,87	0,78	0,73
57	Social assistance recipients	0,88	0,15	0,86	0,89	0,81	0,96	0,96	0,95	0,53	0,44
58	Car ownership rate	-0,40	-0,22	-0,39	-0,41	-0,32	-0,42	-0,42	-0,42	-0,31	-0,27

59	Technological device ownership rate	-0,03	-0,27	0,00	-0,05	0,03	-0,11	-0,11	-0,11	0,14	0,21
60	Population registered other cities	0,99	-0,04	0,99	0,99	0,93	0,96	0,96	0,96	0,75	0,68
61	Population registered istanbul	0,98	-0,14	0,98	0,98	0,91	0,90	0,89	0,90	0,82	0,75
62	Population registered abroad	0,62	-0,15	0,62	0,62	0,48	0,57	0,57	0,57	0,53	0,49
63	Foreign population	0,64	0,10	0,63	0,66	0,55	0,71	0,71	0,71	0,43	0,37
64	Distribution of foreign population to municipality	0,64	0,10	0,63	0,66	0,55	0,71	0,71	0,71	0,43	0,37
65	Foreign to native population ratio	0,31	0,08	0,29	0,32	0,23	0,35	0,35	0,35	0,25	0,22
66	Area	-0,38	0,21	-0,39	-0,37	-0,31	-0,25	-0,25	-0,25	-0,45	-0,44
67	Population density	0,39	-0,02	0,39	0,39	0,37	0,35	0,35	0,35	0,46	0,43
68	Birth to death ratio	0,49	0,26	0,46	0,51	0,48	0,70	0,70	0,70	-0,03	-0,09

		11	12	13	14	15	16	17	18	19	20
35	Doctorate female	0,42	-0,22	-0,11	-0,49	0,79	0,49	-0,08	0,31	-0,51	0,40
36	Higher education female	0,78	-0,15	0,39	-0,20	0,93	0,08	-0,22	0,77	-0,22	0,60
37	Primary education male	0,58	0,06	0,95	0,64	0,18	-0,69	0,02	0,76	0,66	0,40
38	Primary school male	0,74	-0,15	0,90	0,49	0,35	-0,64	-0,15	0,81	0,60	0,46
39	Secondary school male	0,67	0,01	0,97	0,60	0,29	-0,67	-0,02	0,83	0,64	0,47
40	High school male	0,85	-0,08	0,89	0,34	0,60	-0,51	-0,23	0,96	0,36	0,60
41	College male	0,84	-0,09	0,54	-0,06	0,89	-0,07	-0,23	0,86	-0,08	0,61
42	Masters degree male	0,61	-0,13	0,14	-0,34	0,89	0,29	-0,14	0,56	-0,38	0,49
43	Doctorate male	0,45	-0,21	-0,06	-0,46	0,81	0,45	-0,09	0,36	-0,48	0,42
44	Higher education male	0,81	-0,11	0,46	-0,12	0,91	0,01	-0,21	0,81	-0,15	0,60
45	Higher education total	0,80	-0,13	0,43	-0,16	0,92	0,04	-0,22	0,79	-0,18	0,60
46	Annual average income	0,13	-0,38	-0,35	-0,70	0,47	0,61	-0,26	0,01	-0,70	0,31
47	Health facility area per capita	-0,07	-0,08	-0,24	-0,25	0,12	0,36	0,14	-0,14	-0,26	-0,02
48	Number of clinics	0,24	-	-	-	0,49	0,40	-	0,13	-	0,39

		11	12	13	14	15	16	17	18	19	20
			0,33	0,19	0,46			0,17		0,49	
49	Number of medical centers	0,52	-0,43	0,26	-0,23	0,60	0,15	-0,18	0,50	-0,24	0,59
50	Population per family physician	-0,10	0,33	0,26	0,43	-0,12	-0,29	0,29	0,15	0,19	0,11
51	Emergency medical services stations	0,91	-0,25	0,71	0,06	0,75	-0,21	-0,22	0,90	0,09	0,69
52	Housing sales	0,42	0,19	0,71	0,39	0,28	-0,33	0,16	0,68	0,19	0,63
53	Homeowners to tenants ratio	-0,25	0,17	-0,35	-0,21	-0,11	0,28	0,07	-0,32	-0,25	-0,34
54	Average duration of residence in the current residence	-0,39	-0,17	-0,58	-0,45	-0,29	0,40	-0,16	-0,56	-0,31	-0,40
55	Average house net size m2	-0,06	0,40	0,01	0,13	0,09	-0,02	0,20	0,02	0,03	-0,11
56	Water consumption m3	0,82	-0,15	0,88	0,30	0,61	-0,41	-0,13	0,96	0,26	0,78
57	Social assistance recipients	0,60	-0,03	0,94	0,58	0,21	-0,63	0,00	0,78	0,58	0,55
58	Car ownership rate	-0,34	0,14	-0,41	-0,17	-0,12	0,26	0,11	-0,36	-0,24	-0,38
59	Technological device ownership rate	0,07	0,22	-0,11	-0,08	0,34	0,22	0,22	0,07	-0,20	0,07
60	Population registered other cities	0,79	-0,01	0,96	0,46	0,52	-0,54	-0,06	0,95	0,45	0,61
61	Population registered istanbul	0,86	-0,06	0,92	0,40	0,60	-0,53	-0,14	0,96	0,44	0,56
62	Population registered abroad	0,55	-0,40	0,58	0,16	0,39	-0,22	-0,07	0,63	0,11	0,88
63	Foreign population	0,47	-0,34	0,70	0,38	0,17	-0,39	0,05	0,58	0,36	0,75
64	Distribution of foreign population to municipality	0,47	-0,34	0,70	0,38	0,17	-0,39	0,05	0,58	0,36	0,75
65	Foreign to native population ratio	0,27	-0,57	0,35	0,26	0,03	-0,30	-0,03	0,25	0,31	0,61
66	Area	-0,45	0,28	-0,27	0,15	-0,40	0,15	0,51	-0,42	0,01	-0,42
67	Population density	0,48	-0,44	0,35	0,06	0,26	-0,23	-0,26	0,35	0,28	0,30
68	Birth to death ratio	0,02	0,45	0,69	0,95	-0,25	-0,82	0,37	0,34	0,83	0,04

		21	22	23	24	25	26	27	28	29	30
35	Doctorate female	0,10	0,05	0,59	0,20	0,47	0,67	0,20	0,54	-0,23	-0,10
36	Higher education female	0,59	0,58	0,93	0,71	0,88	0,86	0,69	0,38	0,27	0,41
37	Primary education male	0,88	0,89	0,47	0,81	0,59	0,34	0,83	-0,51	0,99	0,94
38	Primary school male	0,92	0,89	0,56	0,84	0,69	0,43	0,88	-0,52	0,93	0,99
39	Secondary school male	0,93	0,93	0,56	0,88	0,68	0,42	0,90	-0,46	0,99	0,97
40	High school male	0,96	0,97	0,83	0,98	0,91	0,66	0,98	-0,17	0,86	0,92
41	College male	0,71	0,72	0,97	0,82	0,94	0,84	0,81	0,27	0,43	0,55
42	Masters degree male	0,34	0,33	0,81	0,48	0,71	0,78	0,46	0,50	0,00	0,14
43	Doctorate male	0,14	0,10	0,63	0,25	0,51	0,68	0,25	0,55	-0,20	-0,06
44	Higher education male	0,64	0,65	0,96	0,77	0,91	0,85	0,75	0,33	0,34	0,47
45	Higher education total	0,62	0,61	0,95	0,74	0,90	0,85	0,72	0,36	0,31	0,44
46	Annual average income	-0,15	-0,24	0,19	-0,12	0,17	0,43	-0,10	0,59	-0,44	-0,35
47	Health facility area per capita	-0,17	-0,22	-0,05	-0,18	-0,06	0,01	-0,18	0,40	-0,31	-0,28
48	Number of clinics	-0,02	-0,11	0,27	0,00	0,23	0,52	0,02	0,34	-0,24	-0,17
49	Number of medical centers	0,43	0,31	0,48	0,39	0,54	0,68	0,43	0,24	0,19	0,26
50	Population per family physician	0,11	0,21	0,10	0,18	0,07	0,04	0,12	0,07	0,15	0,02
51	Emergency medical services stations	0,84	0,80	0,84	0,86	0,90	0,80	0,88	-0,08	0,67	0,78

		21	22	23	24	25	26	27	28	29	30
52	Housing sales	0,61	0,67	0,54	0,66	0,58	0,55	0,63	0,03	0,62	0,49
53	Homeowners to tenants ratio	-0,35	-0,32	-0,16	-0,30	-0,27	-0,25	-0,32	0,40	-0,31	-0,29
54	Average duration of residence in the current residence	-0,52	-0,57	-0,48	-0,57	-0,50	-0,38	-0,55	0,02	-0,50	-0,43
55	Average house net size m2	-0,01	0,03	0,14	0,05	0,04	-0,02	0,02	0,49	-0,06	-0,11
56	Water consumption m3	0,92	0,91	0,80	0,93	0,89	0,78	0,94	-0,08	0,81	0,83
57	Social assistance recipients	0,88	0,86	0,48	0,80	0,62	0,43	0,82	-0,48	0,95	0,90
58	Car ownership rate	-0,42	-0,37	-0,18	-0,34	-0,28	-0,25	-0,38	0,51	-0,44	-0,43
59	Technological device ownership rate	-0,08	-0,04	0,29	0,04	0,15	0,23	0,00	0,38	-0,18	-0,18

		21	22	23	24	25	26	27	28	29	30
60	Population registered other cities	0,97	0,98	0,77	0,97	0,85	0,63	0,98	-0,26	0,93	0,93
61	Population registered Istanbul	0,97	0,98	0,82	0,98	0,90	0,64	0,99	-0,22	0,87	0,94
62	Population registered abroad	0,61	0,53	0,41	0,54	0,56	0,62	0,56	0,01	0,49	0,49
63	Foreign population	0,65	0,56	0,24	0,52	0,43	0,44	0,56	-0,36	0,67	0,63
64	Distribution of foreign population to municipality	0,65	0,56	0,24	0,52	0,43	0,44	0,56	-0,36	0,67	0,63
65	Foreign to native population ratio	0,33	0,21	-0,06	0,17	0,15	0,24	0,23	-0,43	0,33	0,34
66	Area	-0,38	-0,34	-0,37	-0,38	-0,45	-0,40	-0,40	-0,13	-0,22	-0,31
67	Population density	0,45	0,34	0,19	0,33	0,32	0,22	0,39	-0,33	0,39	0,51
68	Birth to death ratio	0,44	0,56	0,09	0,44	0,13	-0,10	0,41	-0,43	0,65	0,49

		31	32	33	34	35	36	37	38	39	40
35	Doctorate female	-0,10	0,36	0,72	0,96	1,00	0,79	-0,26	-0,17	-0,17	0,12
36	Higher education female	0,40	0,83	0,99	0,92	0,79	1,00	0,20	0,31	0,31	0,66
37	Primary education male	0,97	0,66	0,28	-0,14	-0,26	0,20	1,00	0,94	0,99	0,81
38	Primary school male	0,95	0,74	0,39	-0,02	-0,17	0,31	0,94	1,00	0,96	0,86
39	Secondary school male	0,99	0,75	0,39	-0,03	-0,17	0,31	0,99	0,96	1,00	0,88
40	High school male	0,91	0,96	0,74	0,32	0,12	0,66	0,81	0,86	0,88	1,00
41	College male	0,55	0,92	0,99	0,81	0,64	0,98	0,35	0,45	0,47	0,80
42	Masters degree male	0,15	0,63	0,91	0,99	0,92	0,95	-0,06	0,05	0,05	0,41
43	Doctorate male	-0,06	0,42	0,76	0,97	0,99	0,82	-0,24	-0,13	-0,14	0,17
44	Higher education male	0,47	0,88	1,00	0,87	0,72	0,99	0,27	0,37	0,38	0,73
45	Higher education total	0,44	0,86	1,00	0,89	0,75	1,00	0,23	0,34	0,35	0,70
46	Annual average income	-0,34	0,08	0,42	0,70	0,77	0,49	-0,48	-0,38	-0,40	-0,13
47	Health facility area per capita	-0,25	-0,08	0,08	0,23	0,29	0,11	-0,32	-0,30	-0,29	-0,19
48	Number of clinics	-0,16	0,13	0,39	0,61	0,67	0,45	-0,25	-0,19	-0,21	-0,05
49	Number of medical centers	0,29	0,49	0,57	0,59	0,60	0,59	0,17	0,24	0,24	0,36
50	Population per family physician	0,15	0,14	0,11	0,01	-0,05	0,09	0,12	-0,01	0,13	0,15

		31	32	33	34	35	36	37	38	39	40
51	Emergency medical services stations	0,75	0,89	0,77	0,49	0,33	0,73	0,63	0,72	0,70	0,87
52	Housing sales	0,64	0,62	0,47	0,20	0,08	0,42	0,58	0,43	0,60	0,63
53	Homeowners to tenants ratio	-0,34	-0,30	-0,20	-0,07	-0,03	-0,18	-0,30	-0,28	-0,33	-0,31
54	Average duration of residence in the current residence	-0,54	-0,55	-0,44	-0,21	-0,07	-0,40	-0,47	-0,39	-0,50	-0,53
55	Average house net size m2	-0,03	0,08	0,17	0,18	0,15	0,17	-0,08	-0,15	-0,05	0,03
56	Water consumption m3	0,88	0,91	0,73	0,40	0,26	0,68	0,78	0,78	0,84	0,92
57	Social assistance recipients	0,94	0,67	0,31	-0,09	-0,20	0,23	0,96	0,90	0,96	0,80
58	Car ownership rate	-0,43	-0,30	-0,11	0,08	0,15	-0,07	-0,44	-0,45	-0,45	-0,36
59	Technological device ownership rate	-0,13	0,10	0,31	0,47	0,48	0,35	-0,20	-0,23	-0,18	-0,05
60	Population registered other cities	0,97	0,90	0,65	0,25	0,08	0,58	0,90	0,89	0,95	0,96
61	Population registered Istanbul	0,94	0,94	0,72	0,33	0,15	0,65	0,84	0,90	0,90	0,97
62	Population registered abroad	0,55	0,58	0,40	0,20	0,12	0,37	0,47	0,48	0,53	0,56
63	Foreign population	0,69	0,45	0,15	-0,10	-0,15	0,10	0,70	0,66	0,70	0,53
64	Distribution of foreign population to municipality	0,69	0,45	0,15	-0,10	-0,15	0,10	0,70	0,66	0,70	0,53
65	Foreign to native population ratio	0,35	0,15	-0,09	-0,20	-0,21	-0,12	0,37	0,41	0,37	0,20
66	Area	-0,30	-0,45	-0,42	-0,31	-0,24	-0,41	-0,21	-0,31	-0,28	-0,40
67	Population density	0,43	0,31	0,13	-0,01	-0,04	0,10	0,43	0,57	0,45	0,34
68	Birth to death ratio	0,61	0,25	-0,02	-0,30	-0,38	-0,08	0,66	0,48	0,63	0,39

		41	42	43	44	45	46	47	48	49	50
35	Doctorate female	0,64	0,92	0,99	0,72	0,75	0,77	0,29	0,67	0,60	-0,05
36	Higher education female	0,98	0,95	0,82	0,99	1,00	0,49	0,11	0,45	0,59	0,09
37	Primary education male	0,35	-0,06	-0,24	0,27	0,23	-0,48	-0,32	-0,25	0,17	0,12
38	Primary school male	0,45	0,05	-0,13	0,37	0,34	-0,38	-0,30	-0,19	0,24	-0,01
39	Secondary school male	0,47	0,05	-0,14	0,38	0,35	-0,40	-0,29	-0,21	0,24	0,13
40	High school male	0,80	0,41	0,17	0,73	0,70	-0,13	-0,19	-0,05	0,36	0,15
41	College male	1,00	0,87	0,69	0,99	0,99	0,33	0,04	0,32	0,53	0,13

		41	42	43	44	45	46	47	48	49	50
42	Masters degree male	0,87	1,00	0,95	0,92	0,94	0,63	0,20	0,56	0,57	0,07
43	Doctorate male	0,69	0,95	1,00	0,77	0,80	0,76	0,29	0,62	0,59	-0,02
44	Higher education male	0,99	0,92	0,77	1,00	1,00	0,41	0,07	0,38	0,55	0,12
45	Higher education total	0,99	0,94	0,80	1,00	1,00	0,45	0,09	0,42	0,57	0,10
46	Annual average income	0,33	0,63	0,76	0,41	0,45	1,00	0,46	0,64	0,64	-0,16
47	Health facility area per capita	0,04	0,20	0,29	0,07	0,09	0,46	1,00	0,35	0,37	0,08
48	Number of clinics	0,32	0,56	0,62	0,38	0,42	0,64	0,35	1,00	0,69	0,01
49	Number of medical centers	0,53	0,57	0,59	0,55	0,57	0,64	0,37	0,69	1,00	0,06
50	Population per family physician	0,13	0,07	-0,02	0,12	0,10	-0,16	0,08	0,01	0,06	1,00
51	Emergency medical services stations	0,81	0,55	0,38	0,78	0,75	0,10	-0,06	0,22	0,53	-0,01
52	Housing sales	0,51	0,28	0,11	0,47	0,45	-0,11	-0,09	0,05	0,29	0,55
53	Homeowners to tenants ratio	-0,22	-0,10	-0,04	-0,20	-0,19	-0,12	0,08	-0,13	-0,25	-0,17
54	Average duration of residence in the current residence	-0,47	-0,28	-0,09	-0,44	-0,42	0,17	0,14	-0,10	-0,15	-0,43
55	Average house net size m2	0,17	0,20	0,18	0,18	0,18	0,04	0,21	0,06	0,08	0,18
56	Water consumption m3	0,77	0,48	0,30	0,73	0,70	0,02	-0,11	0,10	0,52	0,26
57	Social assistance recipients	0,37	-0,02	-0,18	0,29	0,26	-0,39	-0,28	-0,19	0,23	0,16
		41	42	43	44	45	46	47	48	49	50
58	Car ownership rate	-0,15	0,05	0,15	-0,11	-0,09	0,19	0,61	0,07	0,07	0,18
59	Technological device ownership rate	0,28	0,46	0,47	0,32	0,34	0,16	-0,03	0,26	0,06	0,09
60	Population registered other cities	0,71	0,34	0,13	0,64	0,61	-0,20	-0,21	-0,05	0,36	0,18
61	Population registered Istanbul	0,77	0,42	0,20	0,71	0,68	-0,14	-0,18	-0,02	0,40	0,13
62	Population registered abroad	0,42	0,24	0,15	0,39	0,38	0,07	-0,04	0,12	0,41	0,22
63	Foreign population	0,18	-0,06	-0,14	0,13	0,12	-0,20	-0,17	-0,06	0,26	0,12
64	Distribution of foreign population to municipality	0,18	-0,06	-0,14	0,13	0,12	-0,20	-0,17	-0,06	0,26	0,12
65	Foreign to native population ratio	-0,08	-0,20	-0,21	-0,11	-0,11	-0,14	-0,13	0,00	0,14	-0,03
66	Area	-0,41	-0,32	-0,26	-0,40	-0,41	-0,36	-0,04	-0,20	-0,36	0,18
67	Population density	0,13	-	-	0,10	0,10	-	-	-	0,16	-

		41	42	43	44	45	46	47	48	49	50
			0,02	0,05			0,11	0,15	0,01		0,35
68	Birth to death ratio	0,04	-0,22	-0,35	-0,02	-0,05	-0,58	-0,26	-0,37	-0,15	0,48

		51	52	53	54	55	56	57	58	59	60
35	Doctorate female	0,33	0,08	-0,03	-0,07	0,15	0,26	-0,20	0,15	0,48	0,08
36	Higher education female	0,73	0,42	-0,18	-0,40	0,17	0,68	0,23	-0,07	0,35	0,58
37	Primary education male	0,63	0,58	-0,30	-0,47	-0,08	0,78	0,96	-0,44	-0,20	0,90
38	Primary school male	0,72	0,43	-0,28	-0,39	-0,15	0,78	0,90	-0,45	-0,23	0,89
39	Secondary school male	0,70	0,60	-0,33	-0,50	-0,05	0,84	0,96	-0,45	-0,18	0,95
40	High school male	0,87	0,63	-0,31	-0,53	0,03	0,92	0,80	-0,36	-0,05	0,96
41	College male	0,81	0,51	-0,22	-0,47	0,17	0,77	0,37	-0,15	0,28	0,71
42	Masters degree male	0,55	0,28	-0,10	-0,28	0,20	0,48	-0,02	0,05	0,46	0,34
43	Doctorate male	0,38	0,11	-0,04	-0,09	0,18	0,30	-0,18	0,15	0,47	0,13
44	Higher education male	0,78	0,47	-0,20	-0,44	0,18	0,73	0,29	-0,11	0,32	0,64

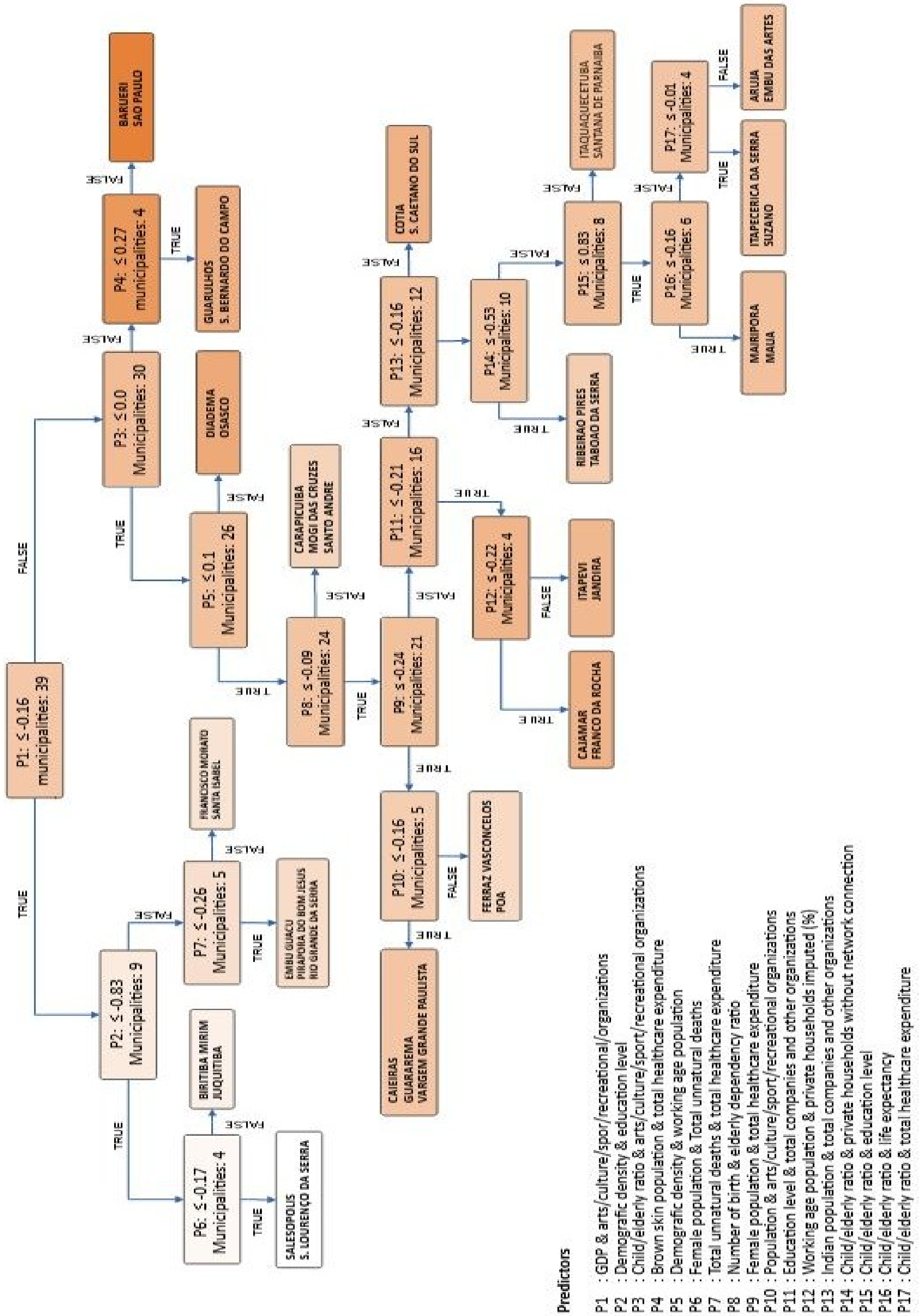
		51	52	53	54	55	56	57	58	59	60
45	Higher education total	0,75	0,45	-0,19	-0,42	0,18	0,70	0,26	-0,09	0,34	0,61
46	Annual average income	0,10	-0,11	-0,12	0,17	0,04	0,02	-0,39	0,19	0,16	-0,20
47	Health facility area per capita	-0,06	-0,09	0,08	0,14	0,21	-0,11	-0,28	0,61	-0,03	-0,21
48	Number of clinics	0,22	0,05	-0,13	-0,10	0,06	0,10	-0,19	0,07	0,26	-0,05
49	Number of medical centers	0,53	0,29	-0,25	-0,15	0,08	0,52	0,23	0,07	0,06	0,36
50	Population per family physician	-0,01	0,55	-0,17	-0,43	0,18	0,26	0,16	0,18	0,09	0,18
51	Emergency medical services stations	1,00	0,50	-0,35	-0,45	-0,07	0,85	0,62	-0,39	0,01	0,83
52	Housing sales	0,50	1,00	-0,29	-0,64	0,11	0,77	0,70	-0,19	0,15	0,71
53	Homeowners to tenants ratio	-0,35	-0,29	1,00	0,41	0,47	-0,36	-0,35	0,61	0,24	-0,36
54	Average duration of residence in the current residence	-0,45	-0,64	0,41	1,00	-0,05	-0,54	-0,49	0,31	-0,35	-0,59

55	Average house net size m2	-0,07	0,11	0,47	-0,05	1,00	0,03	-0,13	0,39	0,32	0,02
56	Water consumption m3	0,85	0,77	-0,36	-0,54	0,03	1,00	0,82	-0,34	0,01	0,94
57	Social assistance recipients	0,62	0,70	-0,35	-0,49	-0,13	0,82	1,00	-0,44	-0,18	0,90
58	Car ownership rate	-0,39	-0,19	0,61	0,31	0,39	-0,34	-0,44	1,00	0,18	-0,42
59	Technological device ownership rate	0,01	0,15	0,24	-0,35	0,32	0,01	-0,18	0,18	1,00	-0,03
60	Population registered other cities	0,83	0,71	-0,36	-0,59	0,02	0,94	0,90	-0,42	-0,03	1,00
61	Population registered Istanbul	0,85	0,58	-0,31	-0,51	0,00	0,91	0,81	-0,35	-0,03	0,96
62	Population registered abroad	0,54	0,65	-0,26	-0,42	-0,02	0,73	0,60	-0,37	-0,01	0,58
63	Foreign population	0,48	0,60	-0,32	-0,38	-0,18	0,69	0,79	-0,48	-0,15	0,64
64	Distribution of foreign population to municipality	0,48	0,60	-0,32	-0,38	-0,18	0,69	0,79	-0,48	-0,15	0,64
65	Foreign to native population ratio	0,25	0,23	-0,36	-0,22	-0,36	0,34	0,47	-0,46	-0,22	0,28
66	Area	-0,43	-0,17	0,44	0,31	0,14	-0,40	-0,26	0,32	-0,02	-0,35
67	Population density	0,28	0,02	-0,16	-0,16	-0,37	0,30	0,46	-0,28	-0,17	0,36
68	Birth to death ratio	0,13	0,52	-0,31	-0,53	0,09	0,40	0,62	-0,22	-0,02	0,53

		61	62	63	64	65	66	67	68
35	Doctorate female	0,15	0,12	-0,15	-0,15	-0,21	-0,24	-0,04	-0,38
36	Higher education female	0,65	0,37	0,10	0,10	-0,12	-0,41	0,10	-0,08
37	Primary education male	0,84	0,47	0,70	0,70	0,37	-0,21	0,43	0,66
38	Primary school male	0,90	0,48	0,66	0,66	0,41	-0,31	0,57	0,48
39	Secondary school male	0,90	0,53	0,70	0,70	0,37	-0,28	0,45	0,63
40	High school male	0,97	0,56	0,53	0,53	0,20	-0,40	0,34	0,39
41	College male	0,77	0,42	0,18	0,18	-0,08	-0,41	0,13	0,04
42	Masters degree male	0,42	0,24	-0,06	-0,06	-0,20	-0,32	-0,02	-0,22
43	Doctorate male	0,20	0,15	-0,14	-0,14	-0,21	-0,26	-0,05	-0,35
44	Higher education male	0,71	0,39	0,13	0,13	-0,11	-0,40	0,10	-0,02
45	Higher education total	0,68	0,38	0,12	0,12	-0,11	-0,41	0,10	-0,05
46	Annual average income	-0,14	0,07	-0,20	-0,20	-0,14	-0,36	-0,11	-0,58
47	Health facility area per capita	-0,18	-0,04	-0,17	-0,17	-0,13	-0,04	-0,15	-0,26
48	Number of clinics	-0,02	0,12	-0,06	-0,06	0,00	-0,20	-0,01	-0,37
49	Number of medical centers	0,40	0,41	0,26	0,26	0,14	-0,36	0,16	-0,15

		61	62	63	64	65	66	67	68
50	Population per family physician	0,13	0,22	0,12	0,12	-0,03	0,18	-0,35	0,48
51	Emergency medical services stations	0,85	0,54	0,48	0,48	0,25	-0,43	0,28	0,13
52	Housing sales	0,58	0,65	0,60	0,60	0,23	-0,17	0,02	0,52
53	Homeowners to tenants ratio	-0,31	-0,26	-0,32	-0,32	-0,36	0,44	-0,16	-0,31
54	Average duration of residence in the current residence	-0,51	-0,42	-0,38	-0,38	-0,22	0,31	-0,16	-0,53
55	Average house net size m2	0,00	-0,02	-0,18	-0,18	-0,36	0,14	-0,37	0,09
56	Water consumption m3	0,91	0,73	0,69	0,69	0,34	-0,40	0,30	0,40
57	Social assistance recipients	0,81	0,60	0,79	0,79	0,47	-0,26	0,46	0,62
58	Car ownership rate	-0,35	-0,37	-0,48	-0,48	-0,46	0,32	-0,28	-0,22
59	Technological device ownership rate	-0,03	-0,01	-0,15	-0,15	-0,22	-0,02	-0,17	-0,02
60	Population registered other cities	0,96	0,58	0,64	0,64	0,28	-0,35	0,36	0,53
61	Population registered Istanbul	1,00	0,53	0,54	0,54	0,22	-0,38	0,40	0,44
62	Population registered abroad	0,53	1,00	0,87	0,87	0,74	-0,36	0,28	0,21
63	Foreign population	0,54	0,87	1,00	1,00	0,84	-0,25	0,43	0,42
64	Distribution of foreign population to municipality	0,54	0,87	1,00	1,00	0,84	-0,25	0,43	0,42
65	Foreign to native population ratio	0,22	0,74	0,84	0,84	1,00	-0,24	0,45	0,24
66	Area	-0,38	-0,36	-0,25	-0,25	-0,24	1,00	-0,48	0,04
67	Population density	0,40	0,28	0,43	0,43	0,45	-0,48	1,00	0,02
68	Birth to death ratio	0,44	0,21	0,42	0,42	0,24	0,04	0,02	1,00

APPENDIX I – DECISION TREE FOR METROPOLITAN SÃO PAULO



APPENDIX J – DECISION TREE FOR METROPOLITAN ISTANBUL