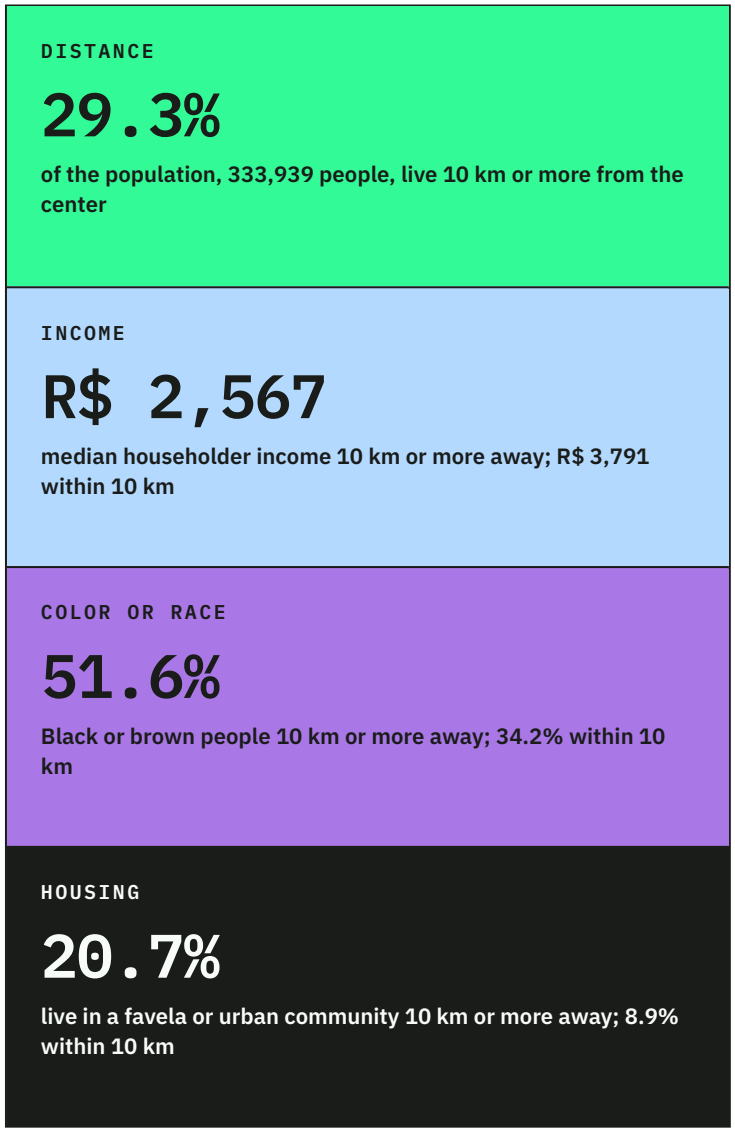
WORKING PAPER · CAMPINAS, BRAZIL · 2022 DEMOGRAPHIC CENSUS

Far from the Center: The Periphery of Campinas in the 2022 Brazilian Demographic Census

Geraldo Barros, Executive Director · Casa Hacker · São Paulo, SP, Brazil

Does distance to the city center organize inequality in Campinas? This paper reads all 2,592 census tracts of the municipality in the 2022 Census and measures, for each one, the distance between where people live and Estação Cultura, in the city center.



VERSION

English version, October 2026 · translated from the Portuguese original, *Longe do centro: a periferia de Campinas no Censo Demográfico 2022* (1st edition, September 2026)

SCOPE

Campinas (São Paulo state, Brazil) · 2,592 census tracts · 550 neighborhoods · 2022 Demographic Census

SOURCES

IBGE (tract-level aggregates, CNEFE address register, sample by weighting area) · OpenStreetMap

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Note to readers

Words with a dotted underline link to the glossary at the end of the document.

The blue **Boxes** explain, with diagrams, the concepts the method relies on. Readers familiar with them can skip them.

The interactive charts, with the value of each point, and the open data are at casahacker.org/pesquisas/campinas-censo-2022/ (in Portuguese).

Abstract

This paper examines whether distance to the city center structures intra-urban inequality in Campinas, Brazil, a municipality of 1,139,047 inhabitants. Using 2022 Demographic Census universe data for all 2,592 census tracts, we measure the straight-line distance from each tract's residential centroid, derived from the Census address register (CNEFE), to a central landmark, Estação Cultura. With the same register, a reproducible procedure assigns neighborhood names to tracts (550 neighborhoods). We describe 16 indicators ring by ring and estimate tract-level Spearman correlations with distance.

333,939 people (29.3% of the population) live 10 km or more from the center. There, the median householder income is R$ 2,567, against R$ 3,791 within 10 km; the Black or brown population is 51.6% (against 34.2%), and 20.7% live in a favela or urban community (against 8.9%). Distance to the nearest health facility is the indicator most associated with distance to the center (ρ = 0.56). Household internet access, available only from the sample, reaches 92.0% of households but ranges from 79.8% to 97.7% across the 35 weighting areas, and it follows income (ρ = 0.68) more than distance (ρ = -0.42).

The gradient is neither continuous nor symmetric: high-income districts lie as far from the center as the poorest ones, so direction matters as much as distance. Distance is a lens on inequality, not an explanation of it. We release an interactive map and open data by tract and by neighborhood.

Keywords: intra-urban inequality; urban periphery; census tracts; distance to the center; residential segregation; Brazil.
JEL codes: R23, O18, D63, J15.

1 Introduction

Campinas, in the state of São Paulo, has 1,139,047 inhabitants and concentrates universities, research centers and a technology park. The question of this paper is about territory: where, within the municipality, are the people with the least access to what the city produces?

Casa Hacker's previous study read the Campo Grande district tract by tract (Casa Hacker, 2026). Here the same method is applied to the whole city, with two changes. Distance is now measured from where people live. And the territories far from the center are read as a group of their own.

The paper makes three contributions:

1. A procedure anyone can repeat to give neighborhood names to census tracts using CNEFE, when IBGE does not publish neighborhoods for the municipality.
2. The variation from the center to the edge (center-edge gradient), ring by ring, for 16 universe indicators, with Spearman's correlation computed tract by tract.
3. A public map and open data, with the same color classes on screen and on paper.

1.1 Related literature

Reading the city by distance to the center is a legacy of urban economics, in which land use varies with the cost of reaching the center. Such models do not say, on their own, where the rich live: that depends on where amenities are, and the center can be rich, as in Paris, or poor, as in Detroit (Brueckner, Thisse and Zenou, 1999). Since Hoyt (1939), it has also been known that high-income areas tend to grow in sectors, in one direction, rather than in rings. In Latin American cities, elites concentrated in a cone linking the historic center to one part of the periphery, while the poorest settled in the most distant and worst-equipped periphery (Sabatini, Cáceres and Cerda, 2001).

In Brazil, the periphery was explained through urban spoliation: new, self-built neighborhoods without collective services (Kowarick, 1979). Villaça (1998; 2011) showed that high-income groups concentrate in one general region of the city, not in concentric circles. Studies using census tracts showed that the periphery is heterogeneous (Torres et al., 2003), with more social mixing in intermediate areas (Marques, 2014), and that physical proximity can coexist with walls and separation (Caldeira, 2000); other authors argue that the relationship of dependence between periphery and center persists (D'Andrea, 2025). In Campinas, the literature describes the pattern this paper measures: precarious settlements and low income along the southwest vector, middle and high income along the Barão Geraldo and Sousas axis (Caiado and Pires, 2006), elite self-segregation in gated communities to the north and east (Silva, 2016), and class-specific expansion vectors along the highways (Figueiredo, 2021). Recent housing policy reinforced the peripheral location of low-income residents (Rolnik et al., 2015).

Income and race overlap in Brazilian urban space. The concentration of Black and brown people in low-income classes and in distinct regions of the city sustains residential separation (Telles, 1992); income weighs more in the segregation of Black families (Sousa Filho et al., 2023), without race and class being reducible to one another (França, 2022). Nationally, the lack of sewer connection is greater among Black and brown people (IBGE, 2022). Measured by travel time, accessibility falls in the peripheries, marked by «opportunity deserts» (Pereira et al., 2020). And internet access follows income (NIC.br, 2024), although access is only the first layer of digital inequality (DiMaggio and Hargittai, 2001). This study adds to that literature a measure taken across the whole municipality, tract by tract, with the 2022 Census.

2 Data

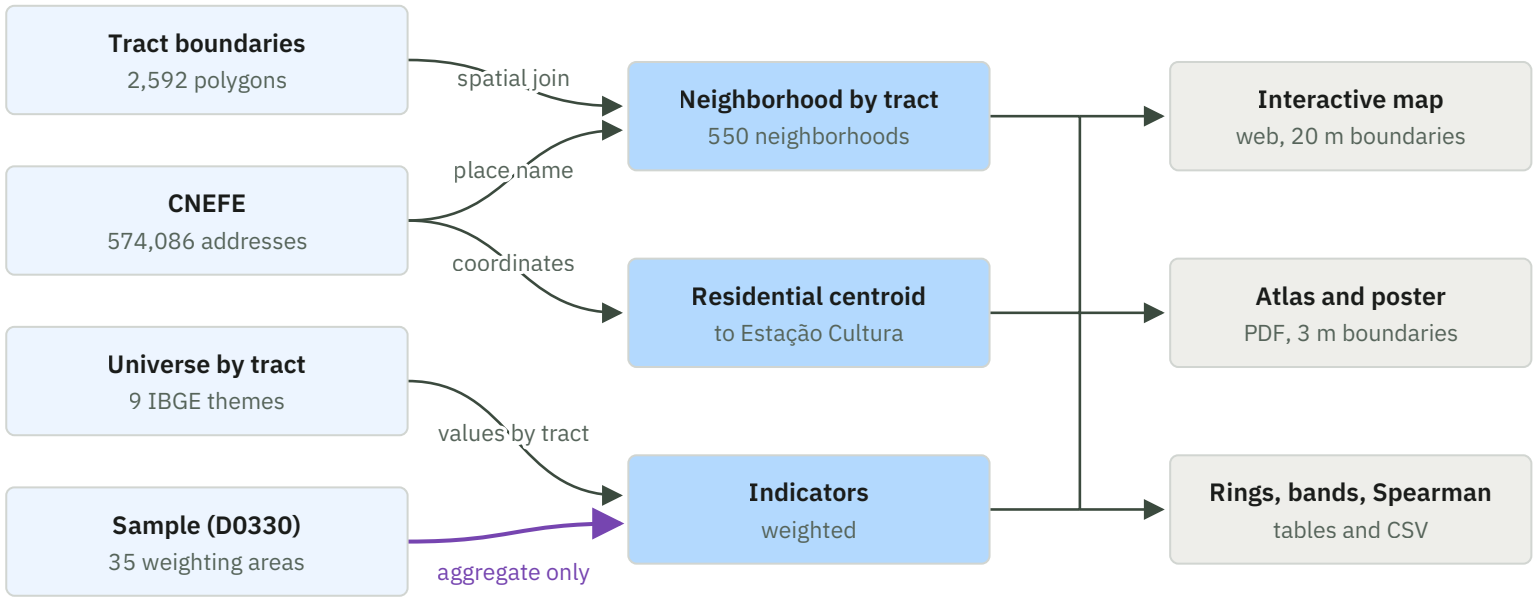


Figure 1. Sources, processing and outputs. Only the sample aggregate (internet by weighting area, in violet) comes from controlled-access microdata. Everything else is public data.

Universe by tract. We use the 2022 Census aggregates by census tract (IBGE, 2026a): demographics, color or race, literacy, household characteristics (parts 1 and 2), kinship and income of the householder. These are the 2,592 tracts of Campinas, of which 2,518 are inhabited. The sum of residents matches the municipal total, 1,139,047 people. The tract boundary file, the map with the outline of each tract, comes from the same release (IBGE, 2026b).

BOX

What a census tract is

To run the Census, IBGE divides the country into pieces small enough for one enumerator to visit every household. Each piece is a census tract. Campinas has 2,592. In the center, a tract may be a couple of blocks; in the rural area, a large area with few homes.

IBGE publishes Census results summed by tract, without identifying anyone. It is the smallest scale at which one can see, on a map, where each group of people lives. That is why the tract is the unit of this study.



Left: the 2,592 tracts of Campinas; the rectangle marks the center. Right: the center enlarged; each polygon is a tract. In violet, one tract of the Centro neighborhood. The violet dot is Estação Cultura.

CNEFE. The 2022 Census National Register of Addresses for Statistical Purposes (Cadastro Nacional de Endereços para Fins Estatísticos, CNEFE; IBGE, 2024a) is the list of addresses the Census visited. Campinas has 574,086 addresses, each with its declared locality and map coordinates (IBGE, 2024c); 573,942 fall inside some tract of the boundary file. From it come the neighborhood names, the midpoint of the homes in each tract and the location of 1,096 education and 1,737 health facilities. The register does not distinguish public from private facilities.

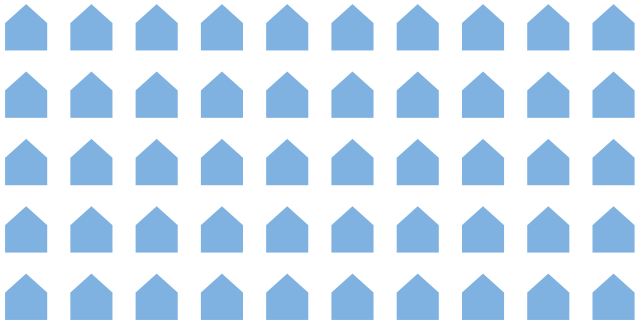
Sample. The only connectivity question in the 2022 Census is whether the household has internet access (variable D0330). It exists only in the sample questionnaire, and the smallest area for which the sample gives reliable results is the weighting area (IBGE, 2026c). The microdata, which hold each household's answers without identification, are under controlled access; they were obtained through request no. CDNH3Z to IBGE. We publish only the aggregate result for the 35 areas.

BOX

Universe, sample and weighting area

The Census has two questionnaires. The **basic** one goes to every household: this is the universe. Because it covers everyone, IBGE can publish its results by tract. The **sample questionnaire** is longer and goes only to a share of households, chosen at random. Its results apply to the whole population through statistical weights.

Basic questionnaire
goes to every household



→ results published by tract (universe)

Sample questionnaire
goes only to the drawn households



→ results only for larger areas (weighting areas)

Illustration: the share of drawn houses in the drawing is not the real one.

Within one tract, the sample has few households, and a result computed from so few people can be far off. So IBGE groups neighboring tracts into **weighting areas**, large enough for the estimate to be reliable. Campinas has 35. That is why internet access, which is only in the sample, appears in this study by weighting area, not by tract.



The same 2,592 tracts, in gray, with the outline of the 35 weighting areas on top. Each area groups dozens of tracts.

Center landmark. Estação Cultura, located through OpenStreetMap (OpenStreetMap, 2026), object way 404608979. All distances in this study are measured to it.

3 Method

3.1 Neighborhoods from the address register

IBGE does not publish neighborhoods for Campinas. To name the tracts, each CNEFE address is linked to the tract it falls in on the map, by a spatial join. We do not use the tract code because CNEFE follows the district division that predates the creation of Ouro Verde and Campo Grande. A tract's neighborhood is the locality that appears most often among its addresses.

Three rules make the result readable:

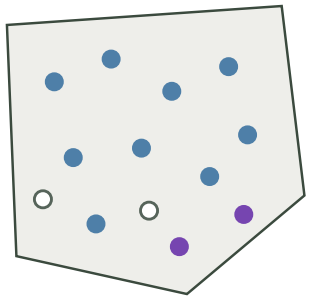
- **Generic names.** The name of the municipality and the district names do not count as neighborhoods.
- **Repeated names (homonyms).** Tracts with the same name more than 1 km apart become distinct neighborhoods, with the district in the label (and, if needed, the cardinal direction). 17 names were split this way.
- **Neighbor inheritance.** A tract without a name of its own receives the neighborhood of its neighbors in the same district when one neighborhood holds at least half of the shared boundary: 41 tracts, flagged as inferred. Where the neighbors are split, the tract is left without a neighborhood (16 tracts).

Result: 550 neighborhoods. The median dominance of the main name is 99.5% of addresses: in half of the tracts, the chosen name covers 99.5% of the addresses or more.

BOX

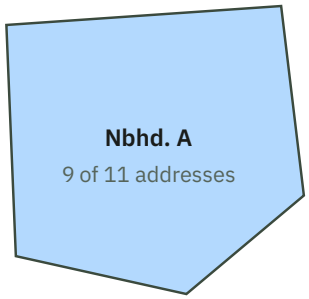
How a tract gets a neighborhood name

1. Each address falls in a tract



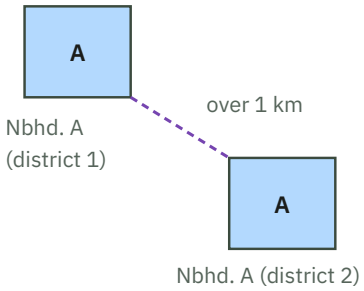
Nbhd. A · Nbhd. B
«Campinas»: generic, not counted

2. The most frequent name wins



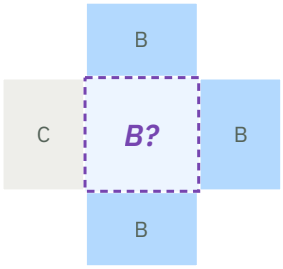
The generic name is left out; the most frequent one wins.

3. Same name, far apart: two neighborhoods



17 names were split this way.

4. No name: inherit from the neighbors



3 of the 4 sides are Nbhd. B: the tract inherits «Nbhd. B», flagged as inferred.

Diagram of the neighborhood method, with fictitious names. In Campinas, 41 tracts inherited their neighbors' name, and 16 were left without a neighborhood because the neighbors were split.

3.2 Distance from where people live

For each tract, distance runs from the midpoint of its dwelling addresses (residential centroid; CNEFE address types 1 and 2) to Estação Cultura. The computation uses the haversine formula, which measures straight-line distance over the Earth's surface.

In a large rural tract with its homes at one end, the residents are not in the middle of the polygon. So 2,533 tracts use the residential centroid. The other 59, with fewer than five addresses, use a point inside the polygon. This is straight-line distance, not travel time.

BOX

Where distance is measured from, and what it does not measure

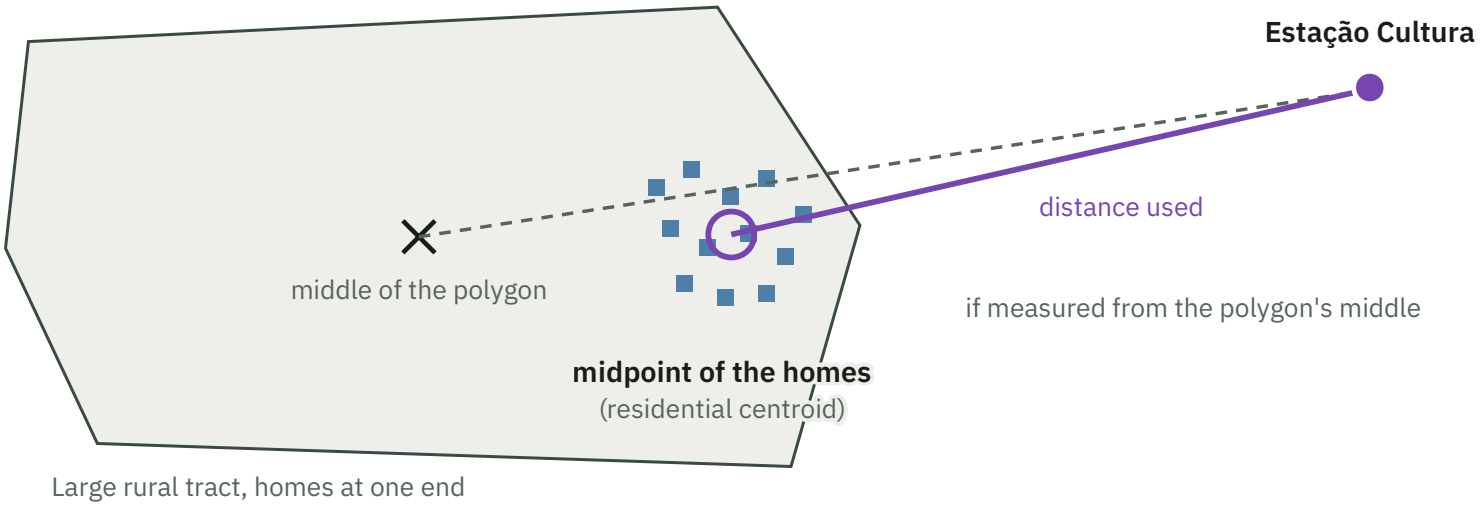


Diagram: measuring from the middle of the polygon would place people where there are no homes. The midpoint of the homes puts the measure where they live.



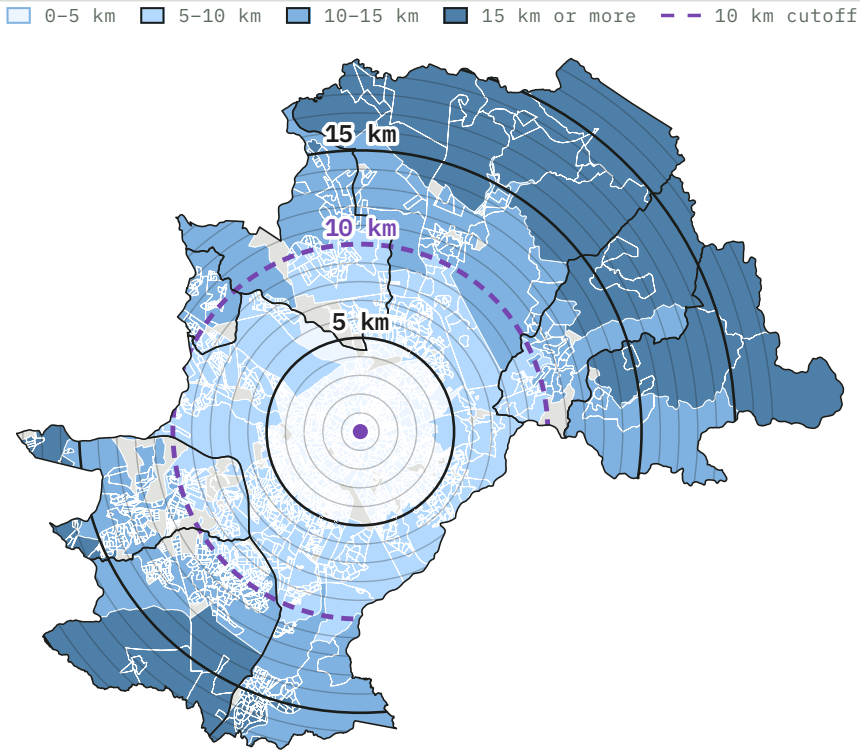
Diagram: two houses at the same straight-line distance can be very different travel times away. Transportation was not part of this study.

BOX

Rings, bands and the 10 km cutoff

To see how the indicators change from the center to the edge, tracts are grouped into 1 km rings around Estação Cultura (0 to 1 km, 1 to 2 km, and so on) and into four wider bands: 0–5 km, 5–10 km, 10–15 km and 15 km or more. Each tract goes into the ring where the midpoint of its homes lies.

The 10 km cutoff, which separates «near» from «far from the center», is a methodological choice. It serves to compare two large groups; it is not an official boundary.



The rings drawn over the tracts. Thin lines: every 1 km. Labeled: 5, 10 and 15 km. In violet, the 10 km cutoff. The circles are approximate: each tract's distance was computed from geographic coordinates, not from the drawing.

3.3 Indicators, aggregation and correlation

The indicators are proportions. When tracts are combined, each proportion is weighted differently (weighting): shares of people are weighted by the tract's population; shares of households, by occupied permanent private households; shares of householders, by the number of householders. So a populous tract counts more than an almost empty one.

The «median householder income» of a group of tracts is the population-weighted mean of the tract medians, not the median of all householders together. IBGE publishes each tract's median, not each person's income.

The «far from the center» cutoff is methodological: 10 km. The relationship between distance and each indicator is measured with Spearman's ρ (Spearman, 1904), tract by tract, with average ranks for ties.

BOX

The median, and the mean of medians

The median is the middle value: lining up all values, half fall below it and half above. For income it is better than the mean, because a few very high incomes pull the mean up and leave the median unchanged.

The median is the middle value



Combining tracts: mean of the medians, weighted by population

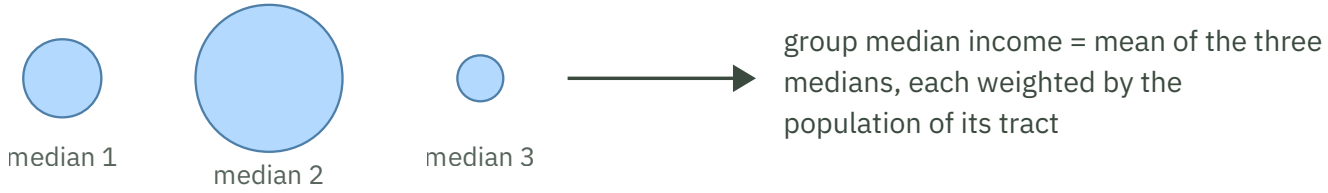


Diagram. The size of each circle represents the tract's population: tract 2, with more people, weighs more in the calculation.

BOX

Spearman's ρ (rho)

Spearman's ρ measures whether two things rise and fall together. It does not compare the values but their order: it lines up the tracts by distance, then by the indicator, and checks whether the two lines look alike. Each tract's position in line is its rank.

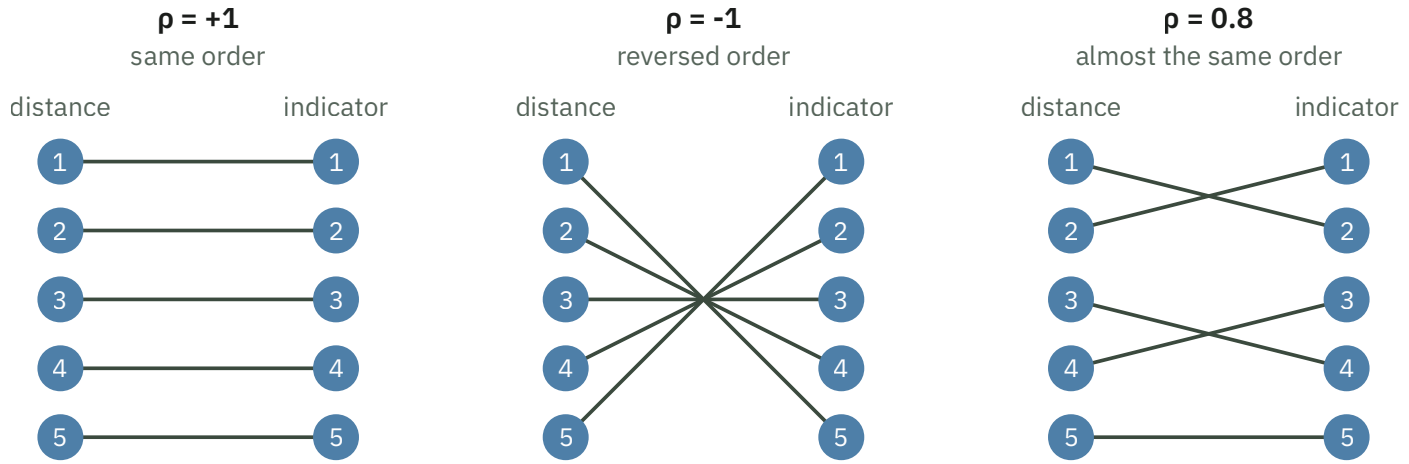


Diagram with five imaginary tracts. Parallel lines: same order (+1). All crossing in the middle: reversed order (-1). In the third example, two swaps between neighbors give ρ = 0.8.

Each line links a tract's rank in distance to the same tract's rank in the indicator. Rank 1 = lowest value.

ρ ranges from -1 to +1. Near +1, the farther the tract, the higher the indicator. Near -1, the farther, the lower. Near 0, the order of one says nothing about the order of the other. When two tracts have the same value (a tie), each receives the average of the ranks they would take: for example, 2.5 and 2.5 instead of 2 and 3.

Because it works with order, ρ is not swayed by a few extreme values, and it captures relationships that rise without being a straight line.

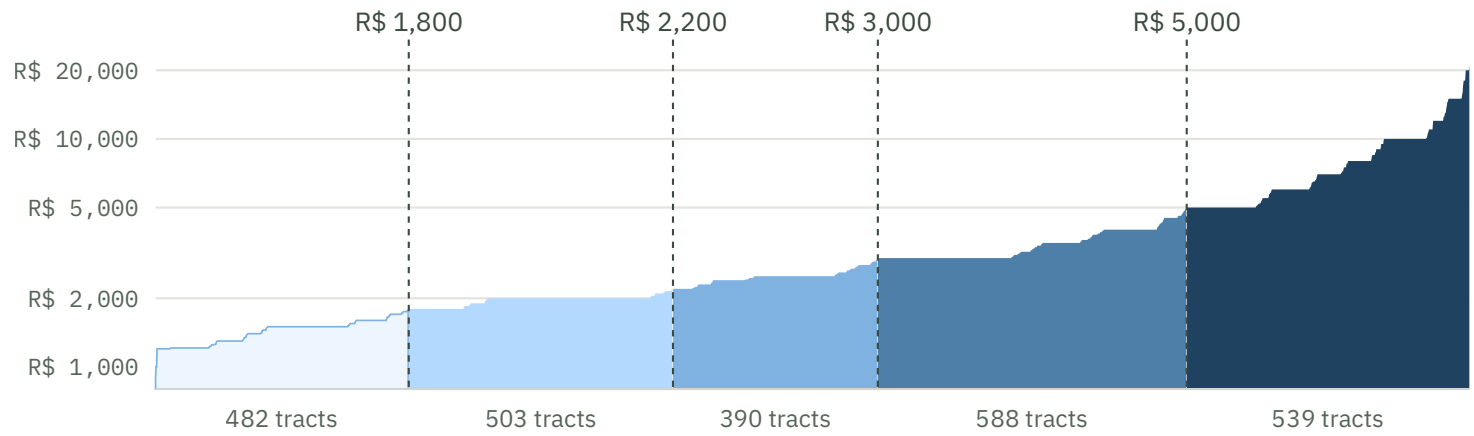
3.4 Publication

For the screen, the boundaries are simplified jointly at 20 m (boundary simplification, with the Visvalingam–Whyatt algorithm; Visvalingam and Whyatt, 1993): outlines lose details smaller than 20 m, and the border between two neighboring tracts remains a single line. Neighborhood names appear according to the zoom level, without overlapping. For print, the tolerance is 3 m. The color classes are quintiles of the inhabited tracts (Brewer and Pickle, 2002), and they are the same in both media.

BOX

Quintiles: why each color holds roughly the same number of tracts

The maps in this study use five colors. To decide where one color ends and the next begins, the tracts are lined up from lowest to highest value, and the line is cut into five parts with the same number of tracts. Each part is a quintile. So each color covers about one fifth of the inhabited tracts, and the map is not almost entirely one color.



2,502 tracts with published income, from lowest to highest median householder income

Real data: the median householder income of the tracts, in line. The breaks are those of the published map. Because many tracts share the same round value (for example, R$ 3,000), the parts are not exactly equal: each color holds 390 to 588 tracts.

A quintile is not a grade. The darkest color means «among the 20% of tracts with the highest values», not «high» in absolute terms. And when many tracts have exactly the same value, like the 1,478 tracts with 100% sewer connection, two breaks can coincide, and one color is left almost empty.

BOX

Simplifying the boundaries: 20 m on screen, 3 m on paper

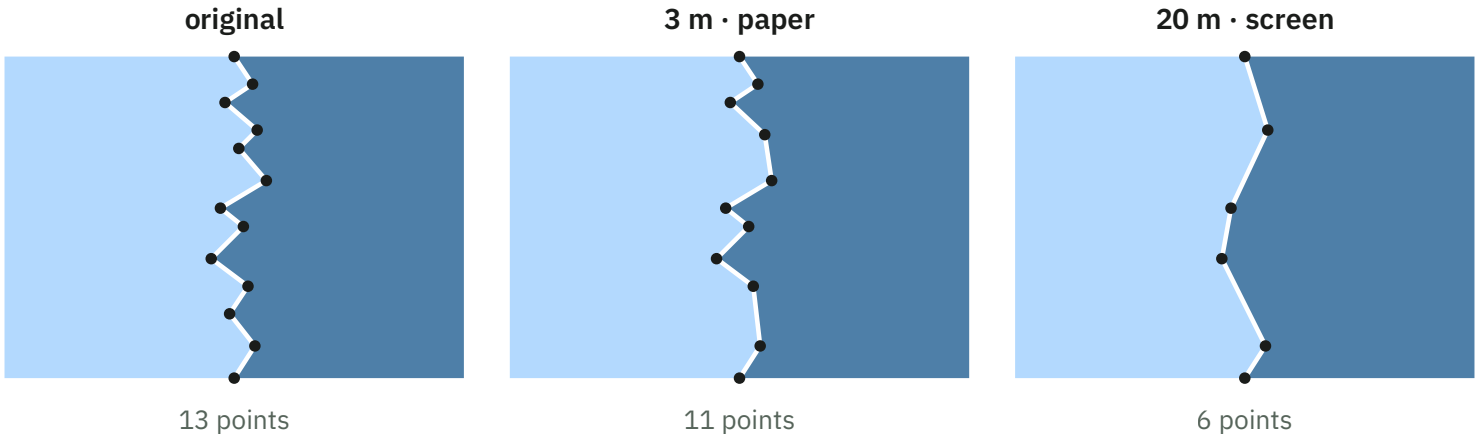


Diagram. Simplifying removes points from the outline: less detail, lighter file. Because the simplification is joint, the two neighbors still share the same line, with no gap or overlap between them.

4 Results

1,139,047 PEOPLE IN THE MUNICIPALITY	**2,592** CENSUS TRACTS	**550** NEIGHBORHOODS NAMED FROM CNEFE	**29.3%** OF THE POPULATION 10 KM OR MORE FROM THE CENTER
92.0% OF HOUSEHOLDS WITH INTERNET	**93.9%** OF HOUSEHOLDS CONNECTED TO THE SEWER NETWORK	**12.4%** LIVE IN A FAVELA OR URBAN COMMUNITY	**0.37** GINI OF INCOME BETWEEN TRACTS

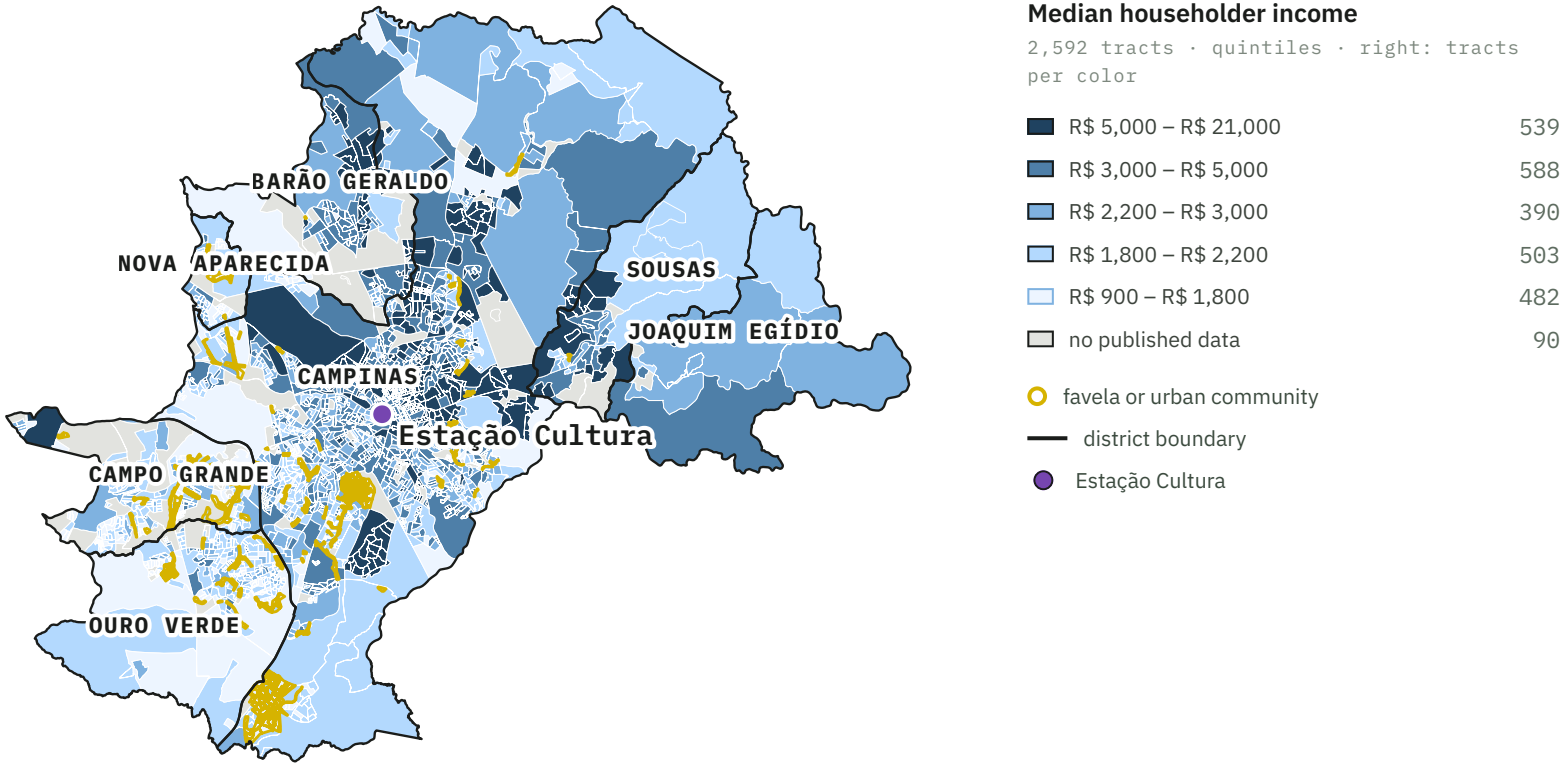


Figure 2. Median householder income by census tract, in quintiles. Yellow outline: favela or urban community; black line: districts; violet dot: Estação Cultura. To the right of the legend, the number of tracts in each class. Each tract's values are in the open data; the summaries by distance and by district are in Tables 1, 2 and 4.

Table 1. Within 10 km and 10 km or more from Estação Cultura.

INDICATOR	WITHIN 10 KM	10 KM OR MORE	CITY
Median householder income	R$ 3,791	R$ 2,567	R$ 3,432
Black or brown	34.2%	51.6%	39.3%
Aged 0 to 14	15.3%	20.1%	16.7%
Children aged 0 to 4	4.7%	6.3%	5.2%
Literacy, aged 15 or over	97.9%	96.3%	97.5%
Sewage to the general or storm-drain network	96.4%	87.0%	93.9%
Sewage to a rudimentary pit, ditch or stream, or no bathroom	1.8%	5.0%	2.6%
Water from the general network	99.7%	97.1%	99.0%
Lives in a favela or urban community	8.9%	20.7%	12.4%
Female householder, no spouse, with children	12.4%	14.7%	13.0%
Distance to the nearest health facility	0.42 km	0.71 km	0.50 km

The gradient exists, but it is not a ramp. Median householder income is R$ 3,842 in the first kilometer, reaches R$ 5,484 in the second, drops to R$ 2,848 between 4 and 5 km (where 20.6% of people live in favelas), rises again to R$ 4,676 between 6 and 7 km and falls to R$ 1,631 between 15 and 16 km (Figure 3). The center is not the richest ring, and there are pockets of poverty near it. From 10 km on, however, the direction settles: the Black or brown population rises from 48.2% to 63.8% between the tenth and the sixteenth kilometer, and the population in favelas between 15 and 16 km reaches 51.6%.

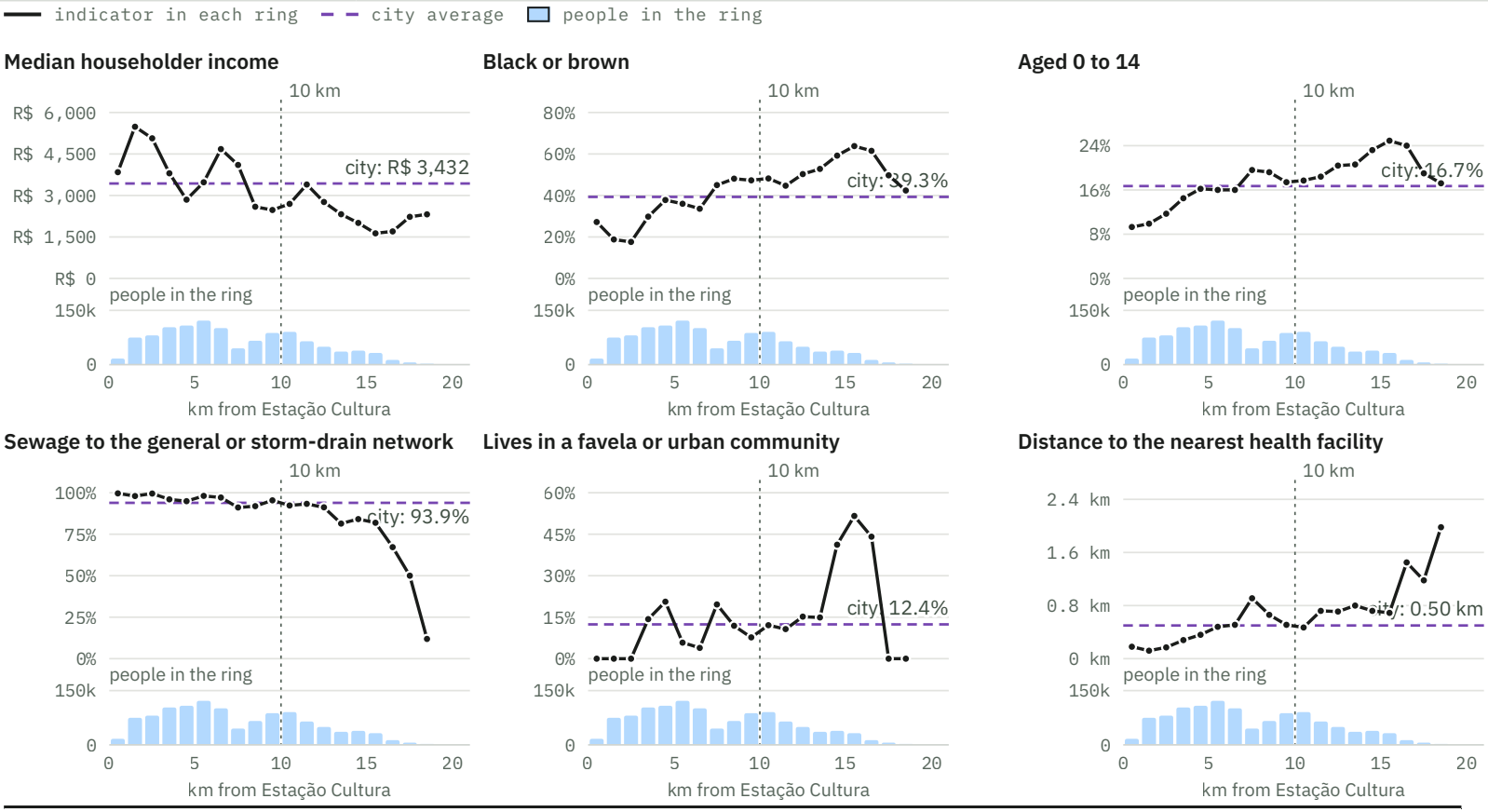


Figure 3. From the center to the edge, 1 km ring by 1 km ring, for six indicators. In each panel, the line shows the indicator (rings with fewer than 1,000 people are left out) and the dashed violet line is the city average; the bars below show how many people live in each ring, each with its own axis.

Table 2. Distance bands from Estação Cultura.

BAND	TRACTS	PEOPLE	MEDIAN INCOME	BLACK OR BROWN	SEWER NETWORK	IN FAVELAS
0–5 km	922	383,819	R$ 4,128	27.3%	97.1%	9.7%
5–10 km	909	421,274	R$ 3,485	40.6%	95.7%	8.2%
10–15 km	570	279,417	R$ 2,726	49.9%	89.9%	16.7%
15+ km	117	54,522	R$ 1,752	60.5%	71.3%	41.1%

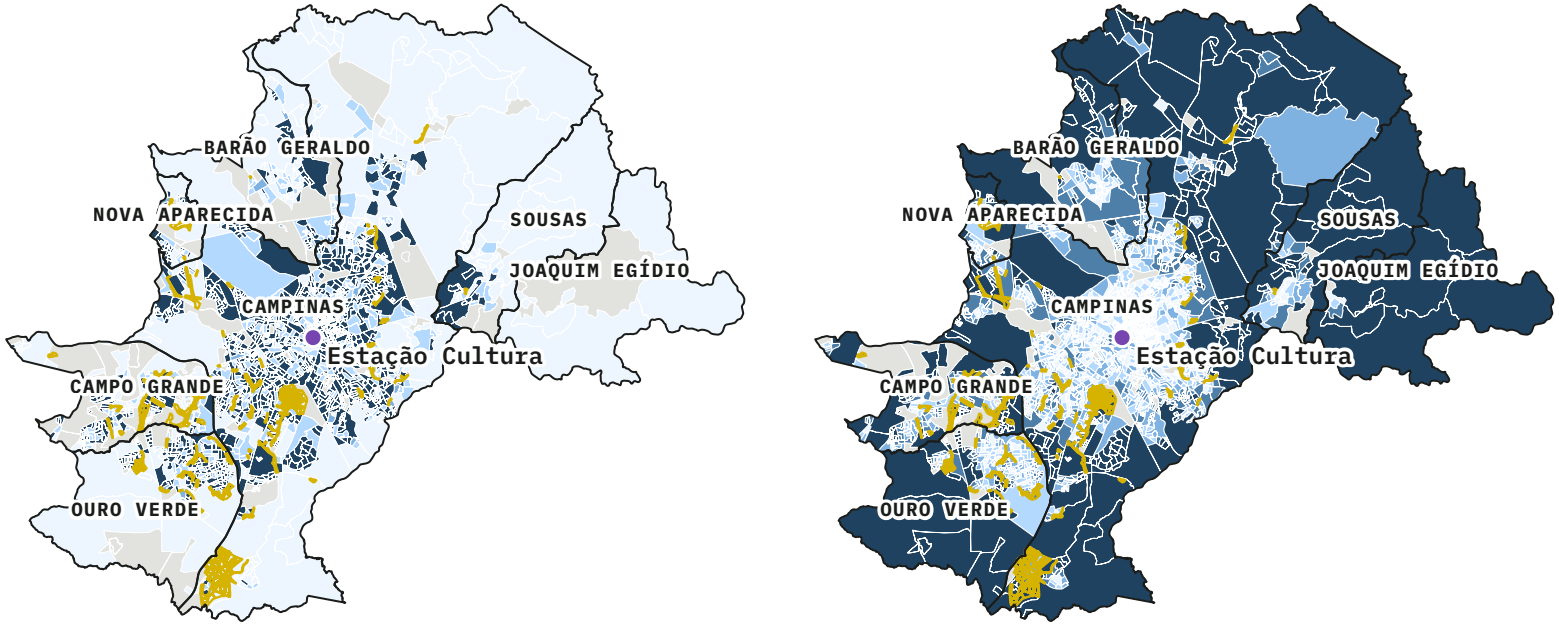


Figure 4. Sewage to the general or storm-drain network (left) and distance to the nearest health facility (right), by tract, in quintiles. For sewers, 1,478 tracts have 100% connection and the breaks coincide: two classes barely appear.

Sewage to the general or storm-drain network

2,592 tracts · quintiles · right: tracts per color

100.0%	1,478
100.0%	0
99.7% – 100.0%	19
97.4% – 99.7%	488
0.0% – 97.4%	494
no published data	113

Many tracts have exactly the same value, and the breaks coincide: one color is almost empty. See the count on the right.

favela or urban community
district boundary
Estação Cultura

Distance to the nearest health facility

2,592 tracts · quintiles · right: tracts per color

0.72 km – 5.35 km	508
0.44 km – 0.72 km	505
0.29 km – 0.44 km	503
0.14 km – 0.29 km	528
0.00 km – 0.14 km	474
no published data	74

favela or urban community
district boundary
Estação Cultura

Infrastructure: garbage collection arrived, sewers did not. Garbage collection is practically universal (99.8% of households) and does not vary with distance (ρ = -0.13). Sewer connection falls from 97.1% within 5 km to 71.3% at 15 km or more, where 18.1% of households use a rudimentary pit, a ditch or a stream, or have no bathroom (Figure 4).

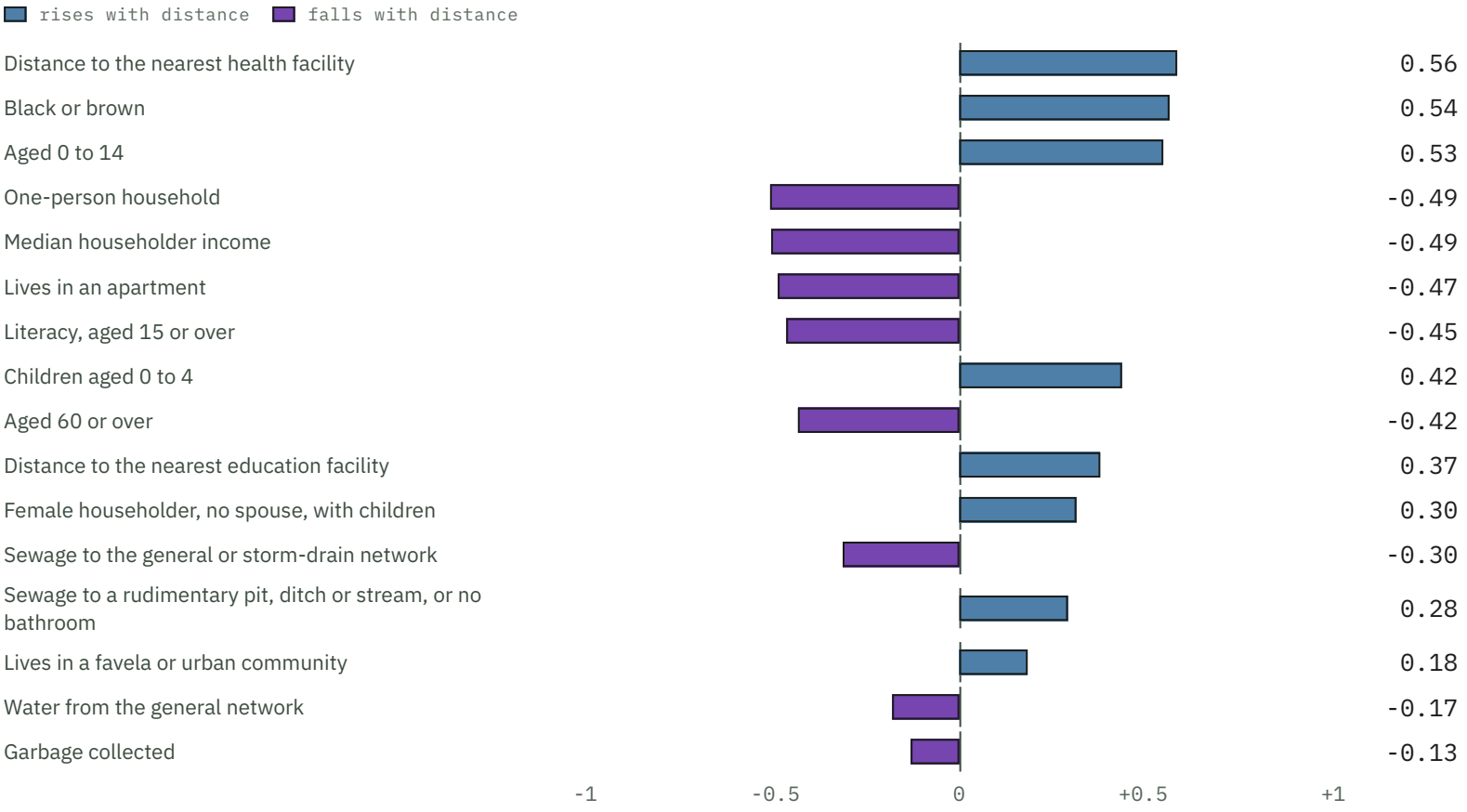


Table 3, as a chart. Spearman's correlation between distance and each indicator, tract by tract, from strongest to weakest. Bar to the right: the farther from the center, the higher the indicator. To the left: the farther, the lower.

Age and family. Distant territories are younger: 20.1% of people are aged 0 to 14, against 15.3% (ρ = 0.53); early childhood (0 to 4 years) follows (ρ = 0.42). The share of households headed by a woman without a spouse, with children, also grows with distance (ρ = 0.30).

Districts. Campo Grande and Ouro Verde, 11.9 km and 11.0 km away on average, add up to 249,630 people, with median householder incomes of R$ 1,833 and R$ 1,987. Barão Geraldo and Sousas, at similar distances, have R$ 5,116 and R$ 5,035. Distance alone does not explain inequality: direction matters.

Table 4. The seven districts, by the average distance of their residents.

DISTRICT	DISTANCE	PEOPLE	MEDIAN INCOME	BLACK OR BROWN	SEWER NETWORK	IN FAVELAS
Campinas	5.8 km	774,301	R$ 3,831	34.8%	94.3%	12.6%
Barão Geraldo	9.1 km	58,820	R$ 5,116	24.9%	94.9%	0.3%
Sousas	10.4 km	17,565	R$ 5,035	24.7%	82.6%	1.6%
Nova Aparecida	10.5 km	37,384	R$ 1,965	53.2%	94.7%	7.9%
Ouro Verde	11.0 km	124,593	R$ 1,987	53.9%	96.8%	15.4%
Campo Grande	11.9 km	125,037	R$ 1,833	57.8%	89.4%	16.3%
Joaquim Egídio	15.8 km	1,332	R$ 2,673	34.4%	48.0%	0.0%

Internet. Across the 35 weighting areas, household internet access ranges from 79.8% (the area of Jardim Campo Belo and Jardim São Domingos, 13.9 km from the center) to 97.7%. The three areas with the least access are 13.9 km, 15.7 km and 10.1 km from Estação Cultura. The variable records whether there is access; it does not measure quality, devices or use (DiMaggio and Hargittai, 2001).

5 Further analyses

5.1 Small-multiple atlas

Six indicators side by side, with the same color classes as the public map (Figure 5). High income is concentrated to the north and east, in Barão Geraldo (R$ 5,116) and Sousas (R$ 5,035), and the map of the Black or brown population is almost its negative (ρ = -0.90 between the two, tract by tract). Sewer connection is lowest in the districts with rural areas, Joaquim Egídio (48.0%) and Sousas (82.6%), and in Campo Grande (89.4%).

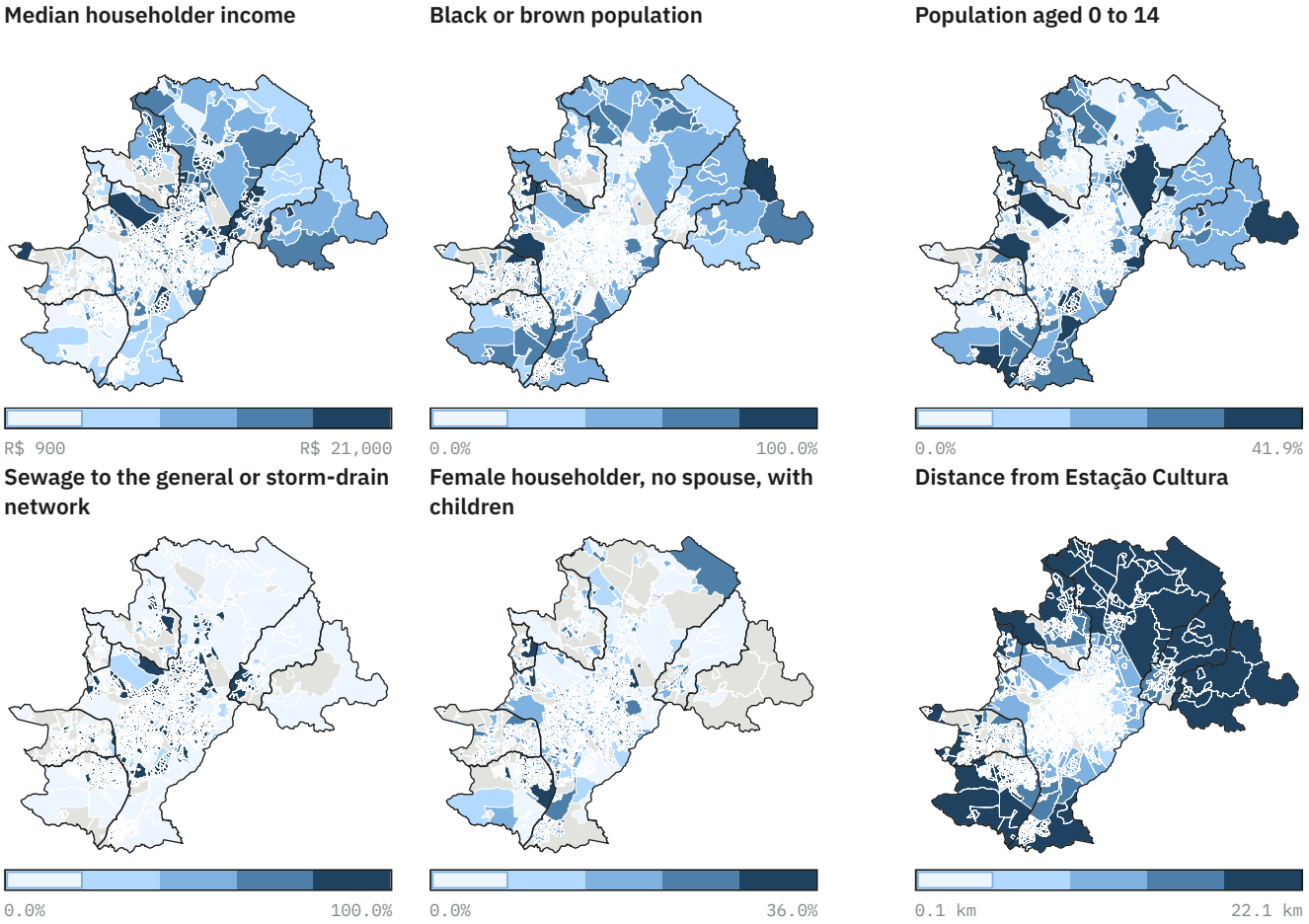


Figure 5. Small-multiple atlas: six indicators by tract, in quintiles. In each map, the lightest color holds the fifth of tracts with the lowest values, and the darkest, the fifth with the highest. Black lines: districts. Values by tract are in the open data.

5.2 Age profile

Children aged 0 to 4 are 4.7% of the population within 10 km and 6.3% at 10 km or more; people aged 70 or over are 9.6% and 5.4%. The edge is where the city is being born, and it is there that the demand for daycare, schools and training is shifting (Figure 6).

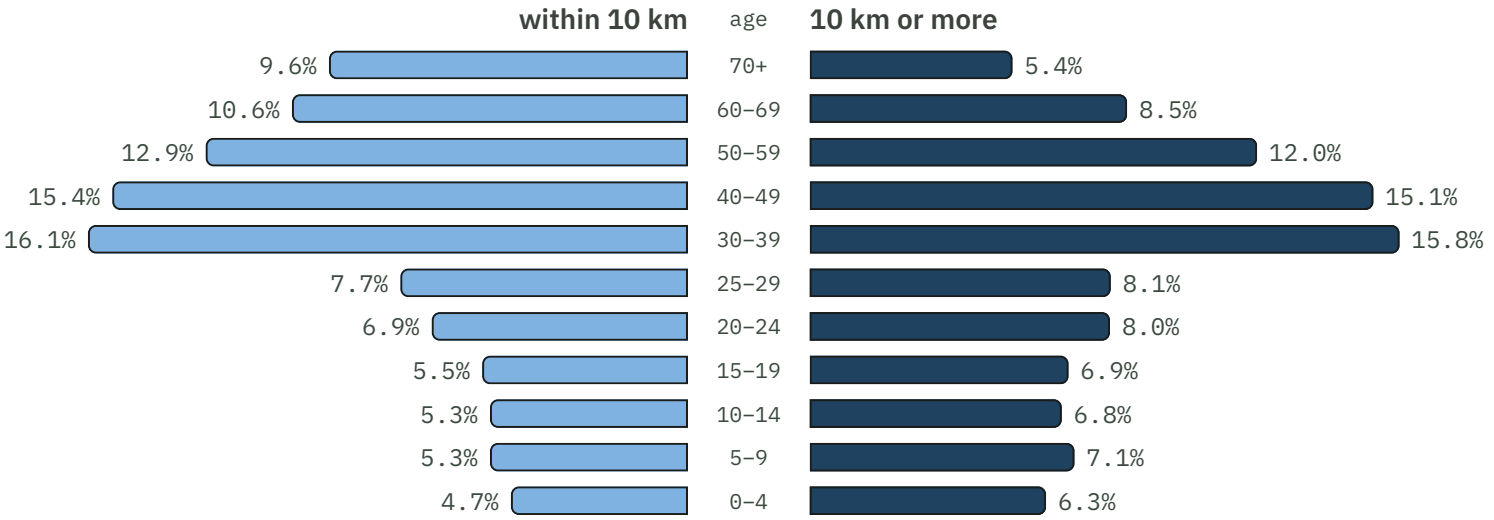


Figure 6. Age distribution (% of the population of each group), within 10 km and 10 km or more from Estação Cultura.

5.3 Composition by color or race

The share of white people falls from 79.1% in the second kilometer to 36.0% between 15 and 16 km, while the share of brown people rises from 13.9% to 52.1% and that of Black people from 4.9% to 11.7% (Figure 7).

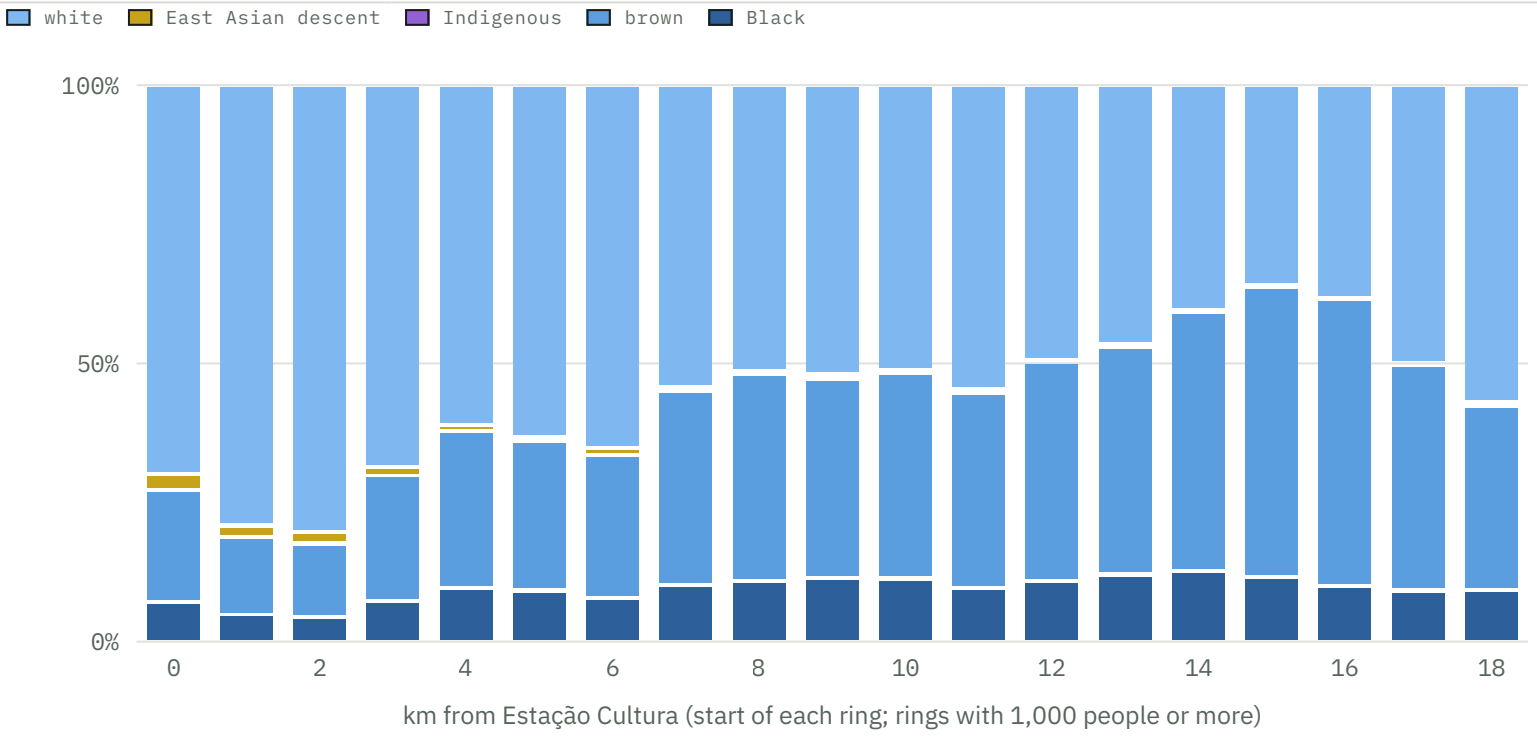


Figure 7. Composition by color or race in each 1 km ring (100% = people living in the ring). Rings with 1,000 people or more. The colors were chosen to remain distinguishable for people with color vision deficiency.

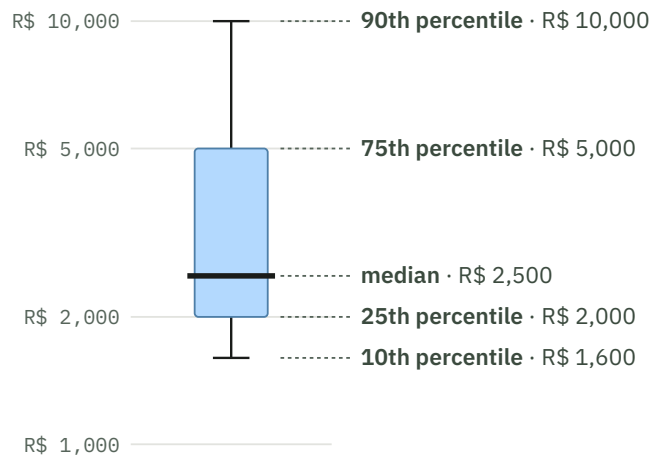
5.4 Income distribution within each band

Averages hide dispersion. The weighted median of the tracts' median householder income falls from R$ 5,000 within 2 km to R$ 1,500 between 14 and 16 km. The most unequal band is not the center: it is 6 to 8 km, where the 10th percentile is R$ 1,600 and the 90th, R$ 10,000. High-income tracts and low-income communities sit side by side there. At the edge, between 14 and 16 km, the same measure ranges from R$ 1,212 to R$ 2,000 (Figure 8).

BOX

How to read the box plot and the logarithmic scale

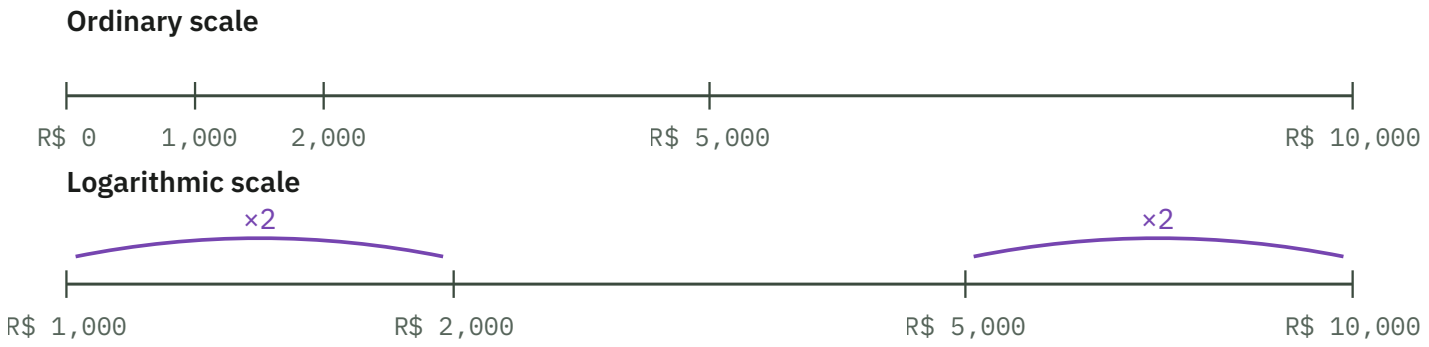
Each box summarizes the tracts of one distance band, weighted by population. The box runs from the 25th to the 75th percentile: it is the middle half. The thick line is the median. The whiskers run from the 10th to the 90th percentile.



Reading a percentile: «25th percentile = R$ 2,000» means that a quarter of the people in the band live in tracts with a median income of up to R$ 2,000.

A long box means tracts that are very different from one another; a short box, similar tracts.

The 6 to 8 km band, the most unequal in Figure 8.



On the logarithmic scale, the same distance on the axis means the same multiplication. It is used in Figures 8, 10 and 12 to show very different incomes together without squeezing the lowest ones.

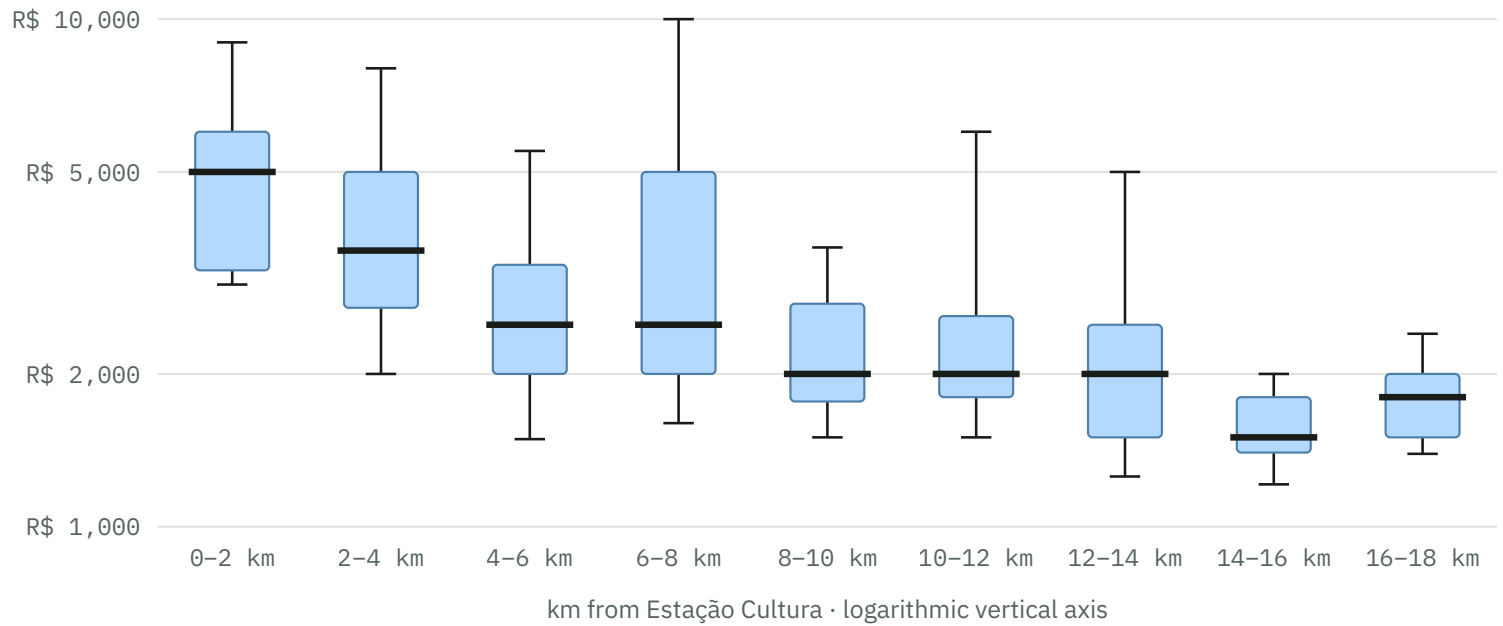


Figure 8. Median householder income of the tracts in each 2 km band, weighted by population: box between the 25th and 75th percentiles, line at the median, whiskers from the 10th to the 90th percentile. Vertical axis on a logarithmic scale.

5.5 Concentration between tracts

Ordering the tracts from lowest to highest mean householder income, weighted by the number of householders, the between-tract Gini index is 0.37 (Gini, 1912; Lorenz, 1905; Figure 9). It measures inequality between places: inequality between people, within each tract, can only be measured with the sample, and is not included here.

BOX

The Gini index, and why income here is the mean, not the median

The concentration curve lines up the tracts from poorest to richest and keeps adding: on the horizontal axis, the cumulative share of householders; on the vertical axis, the share of income. If all tracts had the same mean income, the curve would be the diagonal. The farther it bends from the diagonal, the more concentrated the income. The Gini index sums up that gap in a number from 0 (all equal) to 1 (all income in a single tract).

To add up income, one needs each tract's total income, which is the mean income times the number of householders. The median cannot be added this way. That is why this section uses **mean income** of the householder, while the rest of the study uses **median income**, which is not pulled by a few very high incomes.

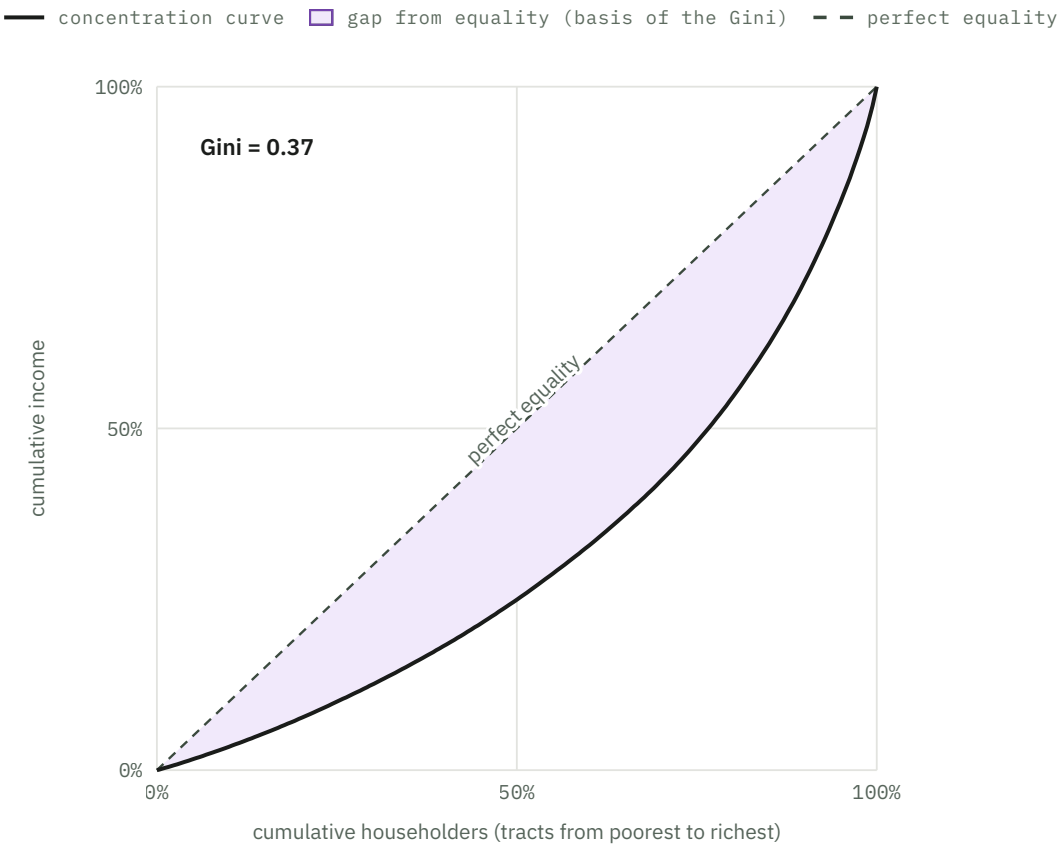


Figure 9. Concentration curve of mean householder income between tracts; the diagonal is perfect equality between tracts. Gini = 0.37.

5.6 Tract by tract

The cloud of 2,502 tracts shows why the gradient is «a lens, not an explanation»: at any distance there are high- and low-income tracts. The moving median (violet line) goes down with distance, and the band between the 25th and 75th percentiles (interquartile range) narrows at the edge. Far from the center, tracts are more alike (Figure 10).

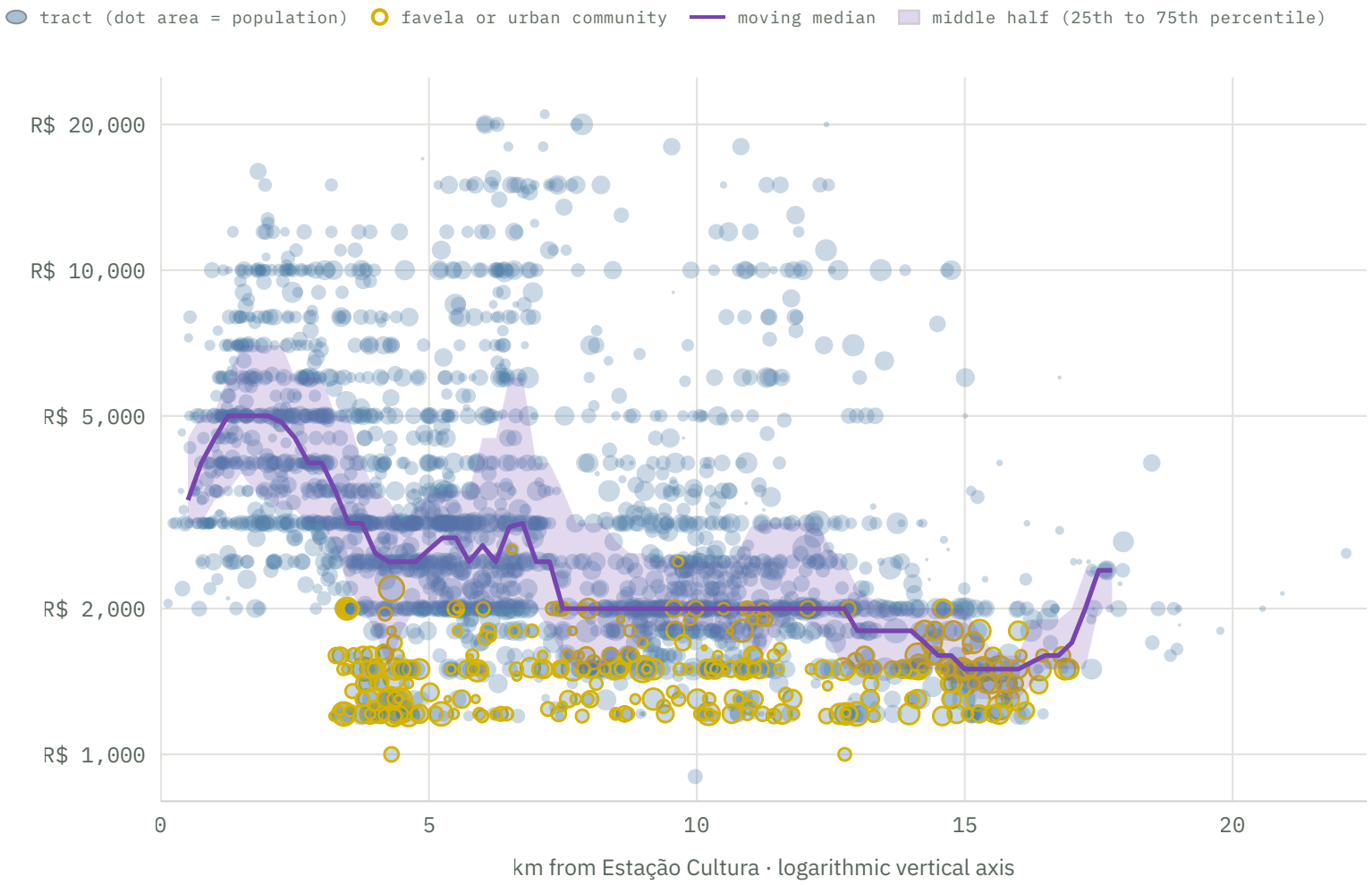


Figure 10. Median householder income of each tract against distance; dot area proportional to population, yellow outline in favelas. Violet line and band: median and interquartile range in moving 1 km windows, weighted by population. Vertical axis on a logarithmic scale.

5.7 How the indicators move together

The Spearman matrix (Figure 11) shows two blocks. On one side, income, literacy, older people, apartments and one-person households; on the other, the Black or brown population, children and female householders without a spouse with children.

The correlation between income and the Black or brown population is -0.90, stronger than that of either with distance (-0.49 and 0.54): the territory separates by income and by race, and distance is one of the forms of that separation.

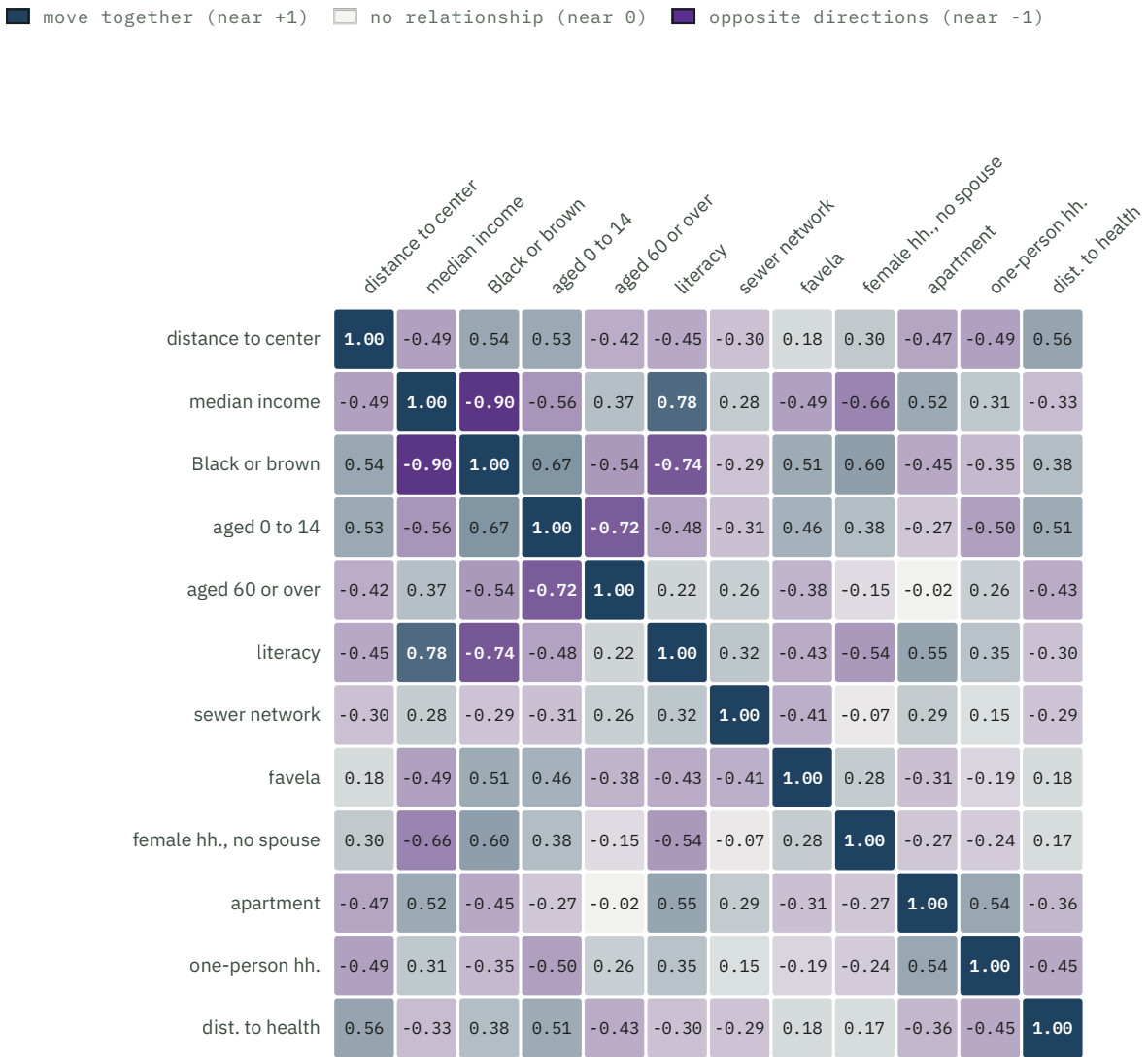


Figure 11. Spearman's correlation between indicators, tract by tract. Blue: move together; violet: opposite directions. The stronger the color, the stronger the relationship.

BOX

Correlation is not causation

Two things may move together on the map because one causes the other, because a third thing causes both, or by coincidence. ρ does not tell these cases apart. It says that income and the Black or brown population are distributed together across the territory of Campinas; it does not say why. Explaining why requires other data and another study. The correlation is between tracts, not a segregation index: it supports no conclusion about individuals (Robinson, 1950), and dissimilarity indices show moderate to low racial segregation in Brazilian metropolitan areas by U.S. standards (Valente and Berry, 2020).

5.8 Internet, income and distance

Across the 35 weighting areas, internet access follows income (ρ = 0.68) more than distance (ρ = -0.42). The areas with the least access are both low-income and distant (Figure 12): the digital exclusion that remains in Campinas is a feature of poverty, not of geography alone. Nationally, too, household internet access follows income (NIC.br, 2024).

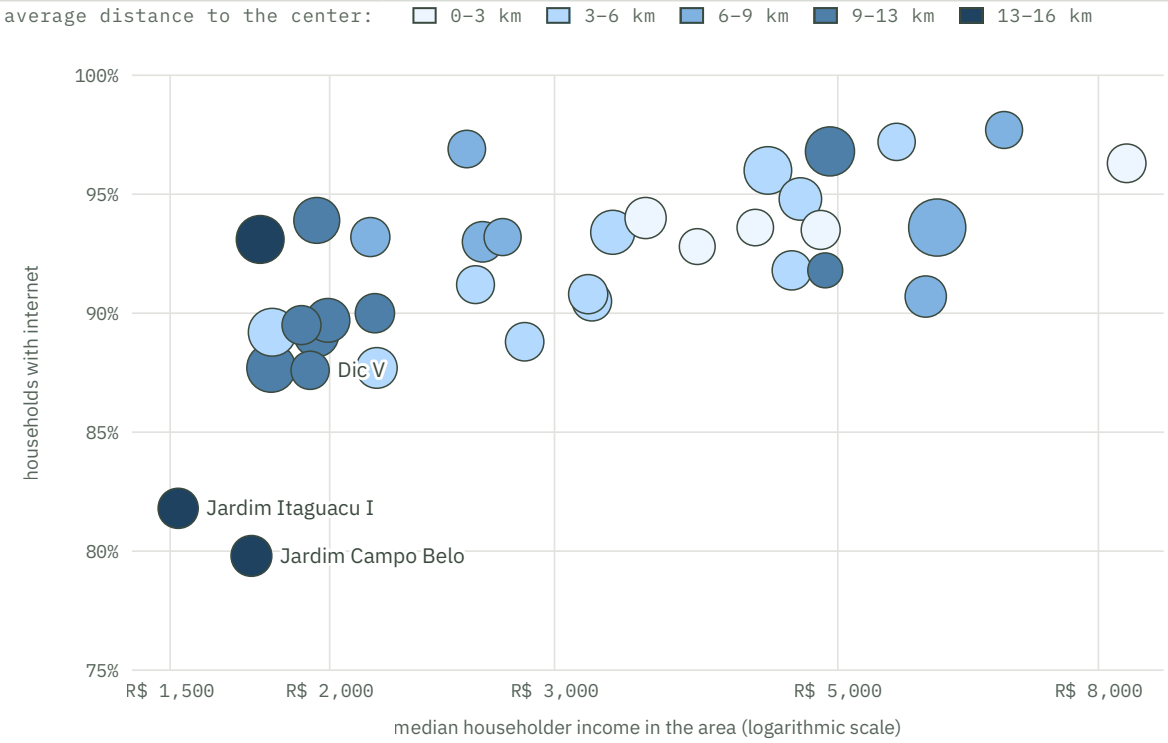


Figure 12. Household internet access (sample) against median householder income (universe) in the weighting areas; bubble area proportional to population, color by average distance to the center. Horizontal axis on a logarithmic scale.

5.9 The distant neighborhoods

56 neighborhoods are 10 km or more from Estação Cultura and have 2,000 residents or more. The fifteen most populous add up to 112,095 people (Figure 13).

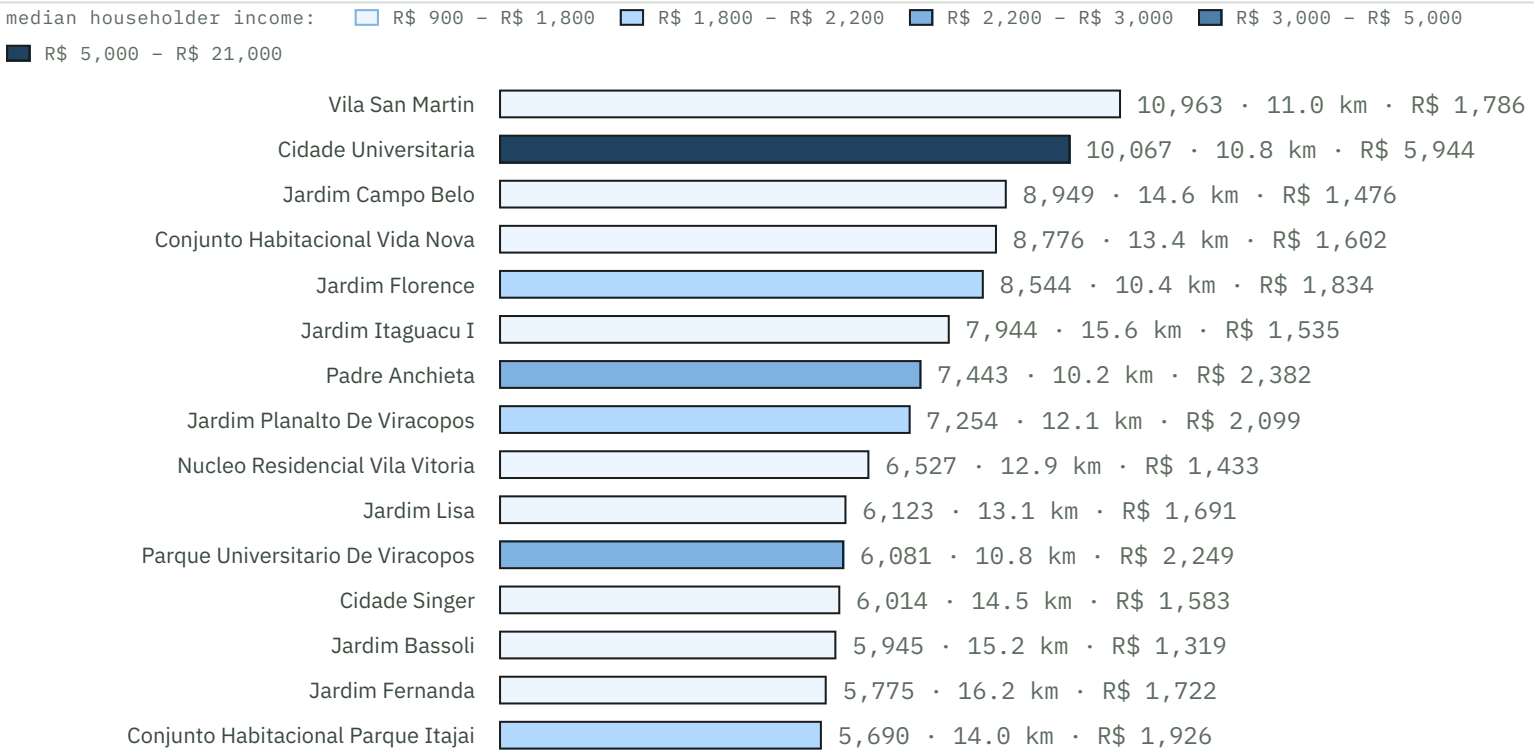


Figure 13. The 15 most populous distant neighborhoods: population, average distance and median householder income; color by the map's income class (quintiles). Names as they appear in CNEFE.

6 Discussion and limitations

The results support that the edge of Campinas concentrates lower income, a larger Black or brown population, more children, less sanitation and greater distance from services. But the gradient is neither continuous nor symmetrical. There are pockets near the center and high-income neighborhoods far from it. Measured by walking and cycling travel time, accessibility in Campinas shows an exception that reinforces this point: the richest take longer to reach the nearest school, which the authors attribute to self-segregation in distant gated communities (Pereira et al., 2020). Distance, therefore, is a lens, not an explanation.

What the study does not measure:

- **A straight line is not travel time.** Real access depends on transportation, which was not measured.
- **A CNEFE neighborhood is not an official boundary.** The city government's division was not checked.
- **Health and education facilities are not split into public and private, nor by level of care.** In Brazilian cities, low-income residents have better access to primary care, and high-income residents to high-complexity care (Tomasiello et al., 2023); this study's indicator combines both.

- **Aggregated income is a mean of medians; the sampling error of internet access was not computed.** Every sample estimate has a margin of uncertainty, and it was not computed for the 35 areas.
- **Correlation is not causation.** ρ says that two things move together in the territory, not why. It is measured between tracts and does not apply to individuals (Robinson, 1950); another spatial partition could give another value (Openshaw, 1983).

7 Open source technologies

All the work was done with free software and open data, except for IBGE's sample microdata, which are under controlled access. The table lists what was used, its version and the role of each piece.

Table 5. Software and open data used in the study, the website and the documents.

TOOL	VERSION	LICENSE	ROLE
Python	3.12.14	PSF	all data processing
Shapely / GEOS	2.1.2 / 3.13.1	BSD-3 / LGPL-2.1	spatial join, dissolve, coverage simplification
GDAL (ogr2ogr)	3.10.3	MIT	clipping the tract boundary file
openpyxl	3.1.5	MIT	reading the data dictionaries and the weighting-area composition
WeasyPrint	70.0	BSD-3	atlas, poster and this paper in PDF
fontTools	4.63.0	MIT	merging the IBM Plex subsets
Pillow / Poppler / librsvg	12.2.0 / 24.02.0 / 2.57.1	MIT-CMU / GPL / LGPL-2.1	visual proofs of figures and pages
Astro	7.2	MIT	the casahacker.org website, statically generated
TypeScript / Node.js	5.9 / 22 (CI)	Apache-2.0 / MIT	interactive components of the map and the analysis
Tailwind CSS	4.1	MIT	the website's style system
Pagefind	1.4	MIT	website search (including the neighborhood table)
IBM Plex Sans and Mono	@fontsource 5.2	SIL OFL 1.1	typography of the website and the PDFs
Git / GitLab CI	2.52	GPL-2.0 / MIT	version control and validation of every change
OpenStreetMap	—	ODbL 1.0	coordinates of the landmark (Estação Cultura)

The map uses no map server or third-party library: tracts are drawn in SVG straight from IBGE's own boundary file, which keeps it light, readable without JavaScript and independent of external services.

8 Data, code and declarations

Data and code. Interactive map and analysis at casahacker.org/pesquisas/campinas-censo-2022/ (in Portuguese); open data by tract and by neighborhood (CSV, column names in Portuguese) on the same page; code in a Casa Hacker repository, currently private. The sample microdata (IBGE request no. CDNH3Z) are not redistributed, under the commitment agreement signed with IBGE.

License. This text and the figures are under the CC BY 4.0 license (creativecommons.org/licenses/by/4.0/deed.en); the open data on the web page follow the website license, CC BY-SA 4.0.

Translation. This is the English version of *Longe do centro: a periferia de Campinas no Censo Demográfico 2022*, published by Casa Hacker in September 2026. Text, figures and tables were generated from the same data files as the original; only the language and the number format changed.

Funding and conflicts of interest. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. The author declares no conflicts of interest.

Use of artificial intelligence. This English version was translated with the assistance of a large language model (Claude, by Anthropic). The author reviewed the translation and is responsible for the content.

G Glossary

The technical terms of the study, in plain language. IBGE category names (such as «color or race» and «favela or urban community») are kept as IBGE uses them, with the Portuguese term where useful, because changing them would change their meaning.

10 km cutoff
A methodological choice that splits the tracts into two groups, within 10 km of Estação Cultura and 10 km or more away. It serves to compare; it is not an official boundary.

Aggregates by census tract
IBGE tables with Census results summed for each tract: how many people, of what color or race, with what income, in what kind of dwelling. They identify no one. They are the basis of this study. See Data.

Black or brown (preta ou parda)
The sum of people who self-identify as preta (Black) and as parda (brown), two IBGE categories. Together they form what Brazil's Statute of Racial Equality (Law No. 12.288/2010) calls the Black population.

Box plot
A chart that summarizes a distribution: the box runs from the 25th to the 75th percentile, the line marks the median and the whiskers run from the 10th to the 90th percentile. See How to read the box plot.

Census tract (setor censitário)
The smallest area into which IBGE divides the territory to run the Census, sized to the work of one enumerator. Campinas has 2,592. See What a census tract is.

Center-edge gradient
How an indicator changes from the center to the edge of the city, ring by ring. See Figure 3.

CNEFE
Cadastro Nacional de Endereços para Fins Estatísticos (National Register of Addresses for Statistical Purposes): the list of addresses the 2022 Census visited, with declared locality and map coordinates. In Campinas, 574,086 addresses.

Color or race (cor ou raça)
A self-reported Census question with five categories: branca (white), preta (Black), parda (brown), amarela (East Asian descent) and indígena (Indigenous). The study uses IBGE's categories unchanged.

Concentration curve
A chart that accumulates the income of the tracts, from poorest to richest. The farther the curve bends from the diagonal, the more concentrated the income between tracts. It is the basis of the Gini index. See Figure 9.

Controlled-access microdata
Each household's answers, without identification, which IBGE releases only upon request and a signed commitment agreement. The study used the sample microdata for internet access and publishes only the aggregate result.

Correlation
A measure of how much two things vary together. Correlation is not causation: it shows that they move together, not why. See Correlation is not causation.

Distance band
A group of rings: 0–5 km, 5–10 km, 10–15 km and 15 km or more. In Figure 8, the bands are 2 km wide.

Distance ring
A 1 km wide band around Estação Cultura: 0 to 1 km, 1 to 2 km, and so on. Each tract goes into the ring where the midpoint of its homes lies. See Rings, bands and the 10 km cutoff.

District
An official subdivision of the municipality. Campinas has seven: Campinas (the seat), Barão Geraldo, Joaquim Egídio, Nova Aparecida, Sousas, Ouro Verde and Campo Grande.

Dominance
In each tract, the share of addresses that carry the chosen neighborhood name. The median dominance is 99.5%: in half of the tracts, the main name covers 99.5% of the addresses or more.

Estação Cultura
A former railway station in the center of Campinas, now a cultural venue. It is the center landmark: all distances are measured to it.

Favela or urban community (favela ou comunidade urbana)
The name IBGE adopted in 2024 for what it previously called «subnormal agglomerate» (aglomerado subnormal). It is an official Census category (IBGE, 2024b); the study does not redefine it.

Gini index between tracts
A number from 0 to 1 that sums up income concentration: 0 would mean all tracts with the same mean income; the closer to 1, the more concentrated. In Campinas, 0.37. It measures inequality between places, not between people. See The Gini index.

Homonyms
Tracts with the same neighborhood name but more than 1 km apart. They become distinct neighborhoods, with the district in the label. 17 names were split.

Householder (responsável pelo domicílio)
The person whom the other residents of the dwelling recognize as responsible for it. An IBGE category.

Inhabited tract
A tract with population. In this study, 2,518 of the 2,592.

Interquartile range
The middle half: the band between the 25th and the 75th percentile. In Figure 10 it is the violet band; in Figure 8, the box.

Literacy (aged 15 or over)
The share of people aged 15 or over who can read and write, according to the Census.

Logarithmic scale
An axis on which the same distance means the same multiplication: R$ 1,000 to R$ 2,000 takes the same space as R$ 5,000 to R$ 10,000. It serves to show very different incomes together. See How to read the box plot.

Mean householder income
The sum of householders' incomes divided by their number. Used only for the Gini index (section 5.5).

Neighbor inheritance
A rule for tracts without a name of their own: they receive the neighborhood of their neighbors in the same district when one neighborhood holds at least half of the shared boundary. 41 tracts, flagged as inferred.

Percentile
The value below which a given share of cases falls. The 10th percentile leaves 10% below; the 90th, 90%. The median is the 50th percentile.

Median
The middle value: half of the values fall below it, half above. It is not pulled by a few very high values, which is why it is used for income.

Median householder income
In each tract, the middle monthly income among the householders, in Brazilian reais (R$). For groups of tracts, the study uses the mean of the medians, weighted by population.

Moving median
A median computed over a window that slides along the axis (here, 1 km distance windows). It shows the trend without hiding the cloud of points.

Neighborhood (from CNEFE)
The place name the study gave each tract, from the localities declared in CNEFE addresses. It is not the city government's official division. See 3.1.

Occupied permanent private household
In IBGE terms: a dwelling built to be lived in (permanent), of one person or a group bound by kinship or cohabitation (private), with people living in it on the Census date (occupied). It is the basis of the sanitation indicators.

OpenStreetMap
A collaborative, open map of the world. The coordinates of Estação Cultura come from it.

Quintile
Each of the five parts into which an ordered line is cut, with the same number of cases in each. On the map, each color holds about one fifth of the inhabited tracts. See Quintiles.

Rank
The position of a value in the line from lowest to highest (1st, 2nd, 3rd...). Spearman's ρ compares ranks, not values. In a tie, each value gets the average of the ranks. See Spearman's ρ.

Residential centroid
The midpoint of the homes in a tract: the mean of the coordinates of CNEFE dwelling addresses. Distance to the center is measured from it. See Where distance is measured from.

Rudimentary pit (fossa rudimentar)
An unlined hole in the ground that receives sewage from the bathroom. The study's indicator combines rudimentary pits, ditches, streams and households without a bathroom: the most precarious forms of sewage disposal.

Sample (sample questionnaire)
A longer questionnaire, applied only to a share of households drawn at random. Its results apply to the whole population through statistical weights. The internet question comes from it. See Universe, sample and weighting area.

Spearman's ρ
A measure of association from -1 to +1 that compares the order of the tracts on two variables. +1: same order; -1: reversed order; 0: the order of one says nothing about the other. See Spearman's ρ.

Straight-line distance (haversine)
The «as the crow flies» distance between two points, computed with the haversine formula, which accounts for the Earth's curvature. It is not the route along streets or the travel time.

Universe
Results of the basic Census questionnaire, which goes to every household. Because they cover everyone, they can be published by tract.

Weighted mean
A mean in which each value weighs according to its size: a tract with more people counts more. See The median, and the mean of medians.

Sewage to the general or storm-drain network
Households whose bathroom discharges sewage into the collection network (for sewage or for rainwater). An IBGE category.

Spatial join
Matching two datasets by position on the map: each address is assigned to the tract it falls in.

Tract boundary file
IBGE's official map with the outline of each census tract.

Tract boundary simplification
Removing from the outlines details smaller than a tolerance (20 m on screen, 3 m on paper), so the map stays light. Done jointly, it keeps the border between neighbors as a single line. See Simplifying the boundaries.

Weighting
Giving each value a weight when combining tracts: population, households or householders, depending on the indicator.

Weighting area (área de ponderação)
A group of neighboring tracts, defined by IBGE, large enough for the sample results to be reliable. Campinas has 35. It is the smallest area with internet data.

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