

When the city ranking reverses

Activity 1 / 10 minutes / Counts, percentages and case mix

All counts below are invented. They are not findings about real cities, service quality or policy effects. Compare the proportion of requests completed on time.

City / request type	On time	Requests	On-time share
A / routine	90	100	90%
A / complex	30	100	30%
B / routine	720	900	80%
B / complex	20	100	20%

Calculate and explain

1. Combine the counts for each city. Which city has the higher overall share?
2. Which city has the higher share within each request type?
3. Recalculate each city with a common 50% routine / 50% complex mix.
4. Does the reversal establish which city's policy caused better outcomes?

A overall: _____ B overall: _____

A with common mix: _____ B with common mix: _____

Answer key

1. A: $(90 + 30) / (100 + 100) = 60\%$. B: $(720 + 20) / (900 + 100) = 74\%$. B leads overall.
2. A leads for routine requests (90% vs 80%) and complex requests (30% vs 20%).
3. A: $0.5 \times 90\% + 0.5 \times 30\% = 60\%$. B: $0.5 \times 80\% + 0.5 \times 20\% = 50\%$. A leads under this common mix.
4. No. B has a larger share of routine requests. These descriptive calculations do not establish a causal effect or identify an automatically correct comparison.

Choose the question before the weights

The overall share describes each city's actual fictional case mix. The standardized share compares both under an assumed common mix. Explain why a reference mix fits the question. Do not choose it because it produces a preferred ranking.

Further reading

WorldLensia: city ranking reversal and its limits

Background: Kievit and colleagues (2013), Simpson's paradox in psychological science: a practical guide, *Frontiers in Psychology*. Read the paper.

AI assisted preparation. The numerical example is original WorldLensia teaching material; arithmetic checked separately.

Which density answers the question?

Activity 2 / 10 minutes / Boundaries, area and population weights

These are fictional places and zones. Use people per square kilometer (km²). No values below describe an actual neighborhood or measure household crowding.

Place	Residents	Land area (km ²)	Density
A	100,000	50	_____
B	100,000	200	_____

1. Calculate each density. Why do equal populations produce different results?
2. If A's boundary expands to include 150 km² of uninhabited land, what is its new average density? Did that arithmetic establish that residents moved?

Now inspect two zones within a different place

Zone	Residents	Land area (km ²)	Density
Dense zone	9,000	1	9,000/km ²
Sparse zone	1,000	9	111.11/km ²

3. Calculate total population / total land area.
4. Calculate population-weighted zone density: each zone's density multiplied by its share of residents, then sum. Use the unrounded sparse-zone density (1,000 / 9).
5. Do these two answers contradict each other?

Answer key

1. $A = 100,000 / 50 = 2,000/\text{km}^2$. $B = 100,000 / 200 = 500/\text{km}^2$. The area denominator differs.
2. The new average is $100,000 / 200 = 500/\text{km}^2$. In this scenario nobody moved; only the boundary changed.
3. $10,000 \text{ residents} / 10 \text{ km}^2 = 1,000/\text{km}^2$.
4. $(9,000 / 10,000) \times 9,000 + (1,000 / 10,000) \times (1,000 / 9) = \text{about } 8,111.11/\text{km}^2$.
5. No. One is the whole-place ratio; the other averages zone densities using resident shares. The weighted value depends on the zone definitions. Neither alone measures people per room or proves a causal effect.

Keep the definition beside the number

Record the population date, boundary date, land or total area, units and weighting method. Compare matching geographies and periods; do not silently change the denominator.

WorldLensia: boundaries and weighting in population density

Primary definition reference: Census Geography Program Glossary. All numerical inputs here are invented, not Census estimates. AI assisted preparation; arithmetic checked separately.