Urban Deprivation in Tanzania: The Bayesian Spatial Bradley—Terry Model

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Deprivation in Dar es Salaam, Tanzania

We are interested in the deprivation in different parts of Dar es Salaam, Tanzania. The city of Dar es Salaam is the largest in Tanzania, with over 6 million inhabitants. It is growing at a rapid pace, and is expected to double in size in the next 10 years. Many citizens live in low quality housing, with over 70% living in informal residences.

Figure 1: A map of Dar es Salaam, Tanzania

However, in Tanzania and other less developed countries

- official statistics are unavailable or unreliable, and
- the population is changing so quickly that available statistics are out of date.

To get up-to-date and reliable information about the city we decided to ask people living there.

Citizen judgements

There are several ways we can ask citizens about deprivation.

Absolute Judgement

On a scale of 1 to 10, area A is a 6.

Rank Judgement

1. Area D
2. Area C
3. Area A
4. Area B

Comparative Judgement

Area A is more affluent than area C.

Absolute judgements involve defining levels of deprivation, which can be difficult and arbitrary. Rank judgements can overwhelm judges and give noisy results when judges are ambivalent to areas. Comparative judgement avoid these difficulties by asking judges to compare only two areas.

Collecting data in Tanzania

In August 2018, we spent 2 weeks in Dar es Salaam collecting data. We collected over 75,000 comparisons of the 452 areas from over 200 judges. The judges were all citizens of Dar es Salaam, and we found judges via universities in the city and a taxi driver association.

Figure 2: Judges making comparisons

Mathematical Modelling

We let the level of deprivation in area A be λ_A, and we estimate the level of deprivation in each area of the city based on the comparisons we collected. Of the comparisons between A and B, we expect A and B both to be judged as more affluent in half of the comparisons if the two areas have similar levels of deprivation ($\lambda_A \approx \lambda_B$). We expect to see area A being judged as more affluent in most of the comparisons if λ_A is much bigger than λ_B. We also assume that the levels of deprivation in 'nearby' areas are correlated, but levels of deprivation in different parts of the city are not.

Estimated Deprivation

We fit the model and estimate the level of deprivation in each area of the city. The results are shown below. There is a both a north-south and coastal-interior trend to the level of deprivation. We are also able to estimate the level of deprivation in several slums in the centre of the city.

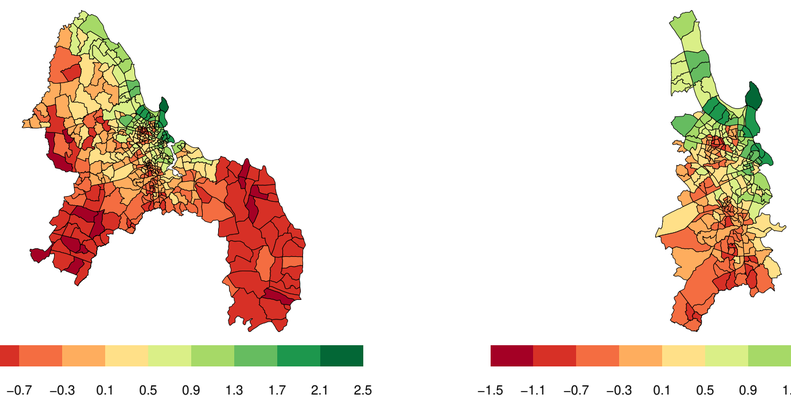

Figure 3: The level of deprivation in each area of Dar es Salaam. The figure on the right shows the centre of the city.

We also analyse how men and women view the city differently. We find that there are parts of the centre of the city that women think are more deprived than the men do.

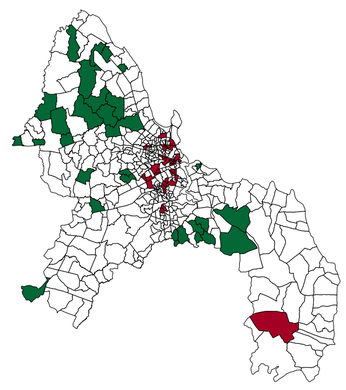

Figure 4: The areas which men and women view differently. The green subwards are viewed as more affluent by women, the red as more deprived.

More Information

We have a pre-print available with more details on the modelling

`arXiv:2010.14128`

We have an R package with the data and functions for the analysis

`github.com/rowlandseymour/BSBT`

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