Boundaries in Residential Segregation

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Plan of Presentation

1. Introduction
2. Methods
3. Results
4. Conclusion

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1. Intro
Life at the Frontier

- Terminology:
  - –Socially differentiated borders = “boundaries”
  - –Arbitrary borders = “borders”

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1. Intro
Life at the Frontier

- Minimum border length hypothesis
  - Steep boundary may imply that no-one wants to live near the frontier ⇒ underlying hostility
- Schelling
  - Segregation can occur when no-one wants it
- Segregation itself can affect behaviour
  - Allport's contact hypothesis:
  - Prejudice more likely to occur, linger and grow if a lack of interaction between groups.

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1. Intro
Impact on crime

- Not aware of empirical research that specifically looks at boundary effects
- Some studies find that:
  - "Crime, particularly violent crime, is higher in cities and metropolitan areas where Blacks and Latinos are segregated in different neighborhoods from Whites." (Krivo et al. 2015)
    - (e.g., Feldmeyer, 2010; Krivo et al., 2009; Peterson and Krivo, 2010a)

- Studies tend to ignore the spatial nature of segregation.
- Proximity to social boundaries may be particularly important
  - E.g. Belfast “peace walls”

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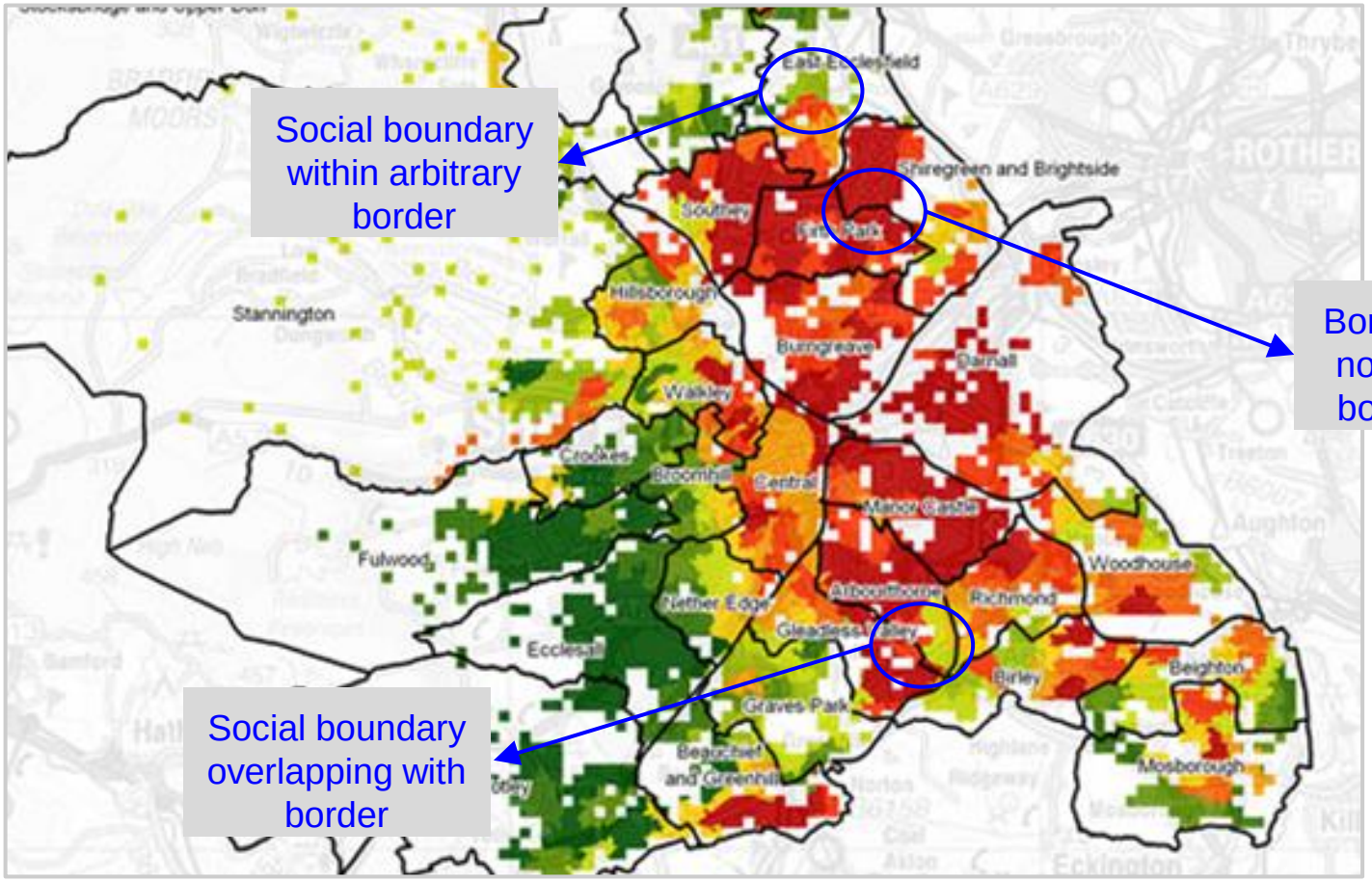

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2. Methods

Identifying Boundaries

- Two Step approach to identifying boundaries:
  - Step 1: Identify significant step changes in the spatial distribution of ethnicity (e.g. non-white population).
    - using a locally adaptive spatial conditional autoregressive model (Lee and Mitchell 2013), indicating significant differences in minority proportions on the two sides of a boundary.
  - Step 2: Set a threshold to ensure that the boundary is not just statistically significant from zero, but also substantively different from zero

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A Binomial Locally Adaptive Spatial Conditional Autoregressive Model

- The study region (each city) is partitioned into *n* non-overlapping areal units (e.g. LSOAs or DZs), denoted as $A = \{A_1, \ldots, A_n\}$
- Y_k denote the number of people who are in the ethnicity minority (e.g. non-white) in area A_k
- N_k denote the total number of people in A_k
- Constructed a Bayesian locally adaptive spatial conditional autoregressive model
  - for a binomial dependent variable.
  - Lee and Mitchel (2013)

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The basic model specification

$$Y_k \sim \text{Binomial}(N_k, p_k), \quad k = 1, \ldots, n$$

$$\ln(p_k/(1-p_k)) = \beta_0 + u_k$$

$$u_k \mid \mathbf{u_{-k}}, W, \lambda, \tau^2 \sim N\left(\frac{\lambda \sum_{l=1}^{n} w_{kl} u_l}{1 - \lambda + \lambda \sum_{l=1}^{n} w_{kl}}, \frac{1}{\tau^2(1 - \lambda + \lambda \sum_{l=1}^{n} w_{kl})}\right)$$

$$\beta_0 \sim N(0, b); \quad \tau^2 \sim \text{Gamma}(e, f); \quad \text{logit}(\lambda) \sim N(0, 100).$$

- ***u*** is a vector of random effects conceptualised as a conditional autoregressive model (CAR), capturing the spatial correlations in the distribution of p_k and the potential over-dispersion effect
- *W* is a binary neighbourhood structure of spatial weights matrix with $w_{jk} = 1$ if units A_j and A_k share a common geographical boundary and $w_{jk} = 0$ otherwise.

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Model estimation

- Model parameters to estimate
  - Random effects ***u***, other hyper-parameters and β_0
  - The spatial weights matrix W, a new feature of this model
- An iterative estimation procedure
  - The estimation of (Θ | W) treating W as given where Θ denotes all other unknown quantities
  - The estimation of (W | Θ) using a deterministic procedure.
    - Set w_{kj} = 0 if the marginal 95% posterior credible intervals of u_k and u_j do not overlap
    - Set w_{kj} = 1 if the marginal 95% posterior credible intervals of u_k and u_j do overlap
  - Iterate the two steps until a termination condition for the hyper-parameter matrix W was met
    - The sequence of estimated W is such that $W^{(t+1)} = W^{(t)}$
- Models implemented using R-INLA, details see Lee and Mitchel (2013)

- Step 2: Set a threshold to ensure that the boundary is not just statistically significant from zero, but also substantively different from zero

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2. Methods
Impact on Crime

- **Are these boundaries linked to crime rates?**

- Street-level crime data (https://data.police.uk/) in the South Yorkshire Police force from December 2010 to December 2012
  - aggregated to the LSOA (lower super output areas) units in Sheffield LA.
  - LSOA, a spatial unit with an average population of about 1500

- We look at two groups:
  - Frontier/Social boundary-paired LSOAs
  - border-paired LSOAs

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2. Methods

Impact on Crime

- Difference of crime rates between the two groups was compared and tested by using a permutation procedure.

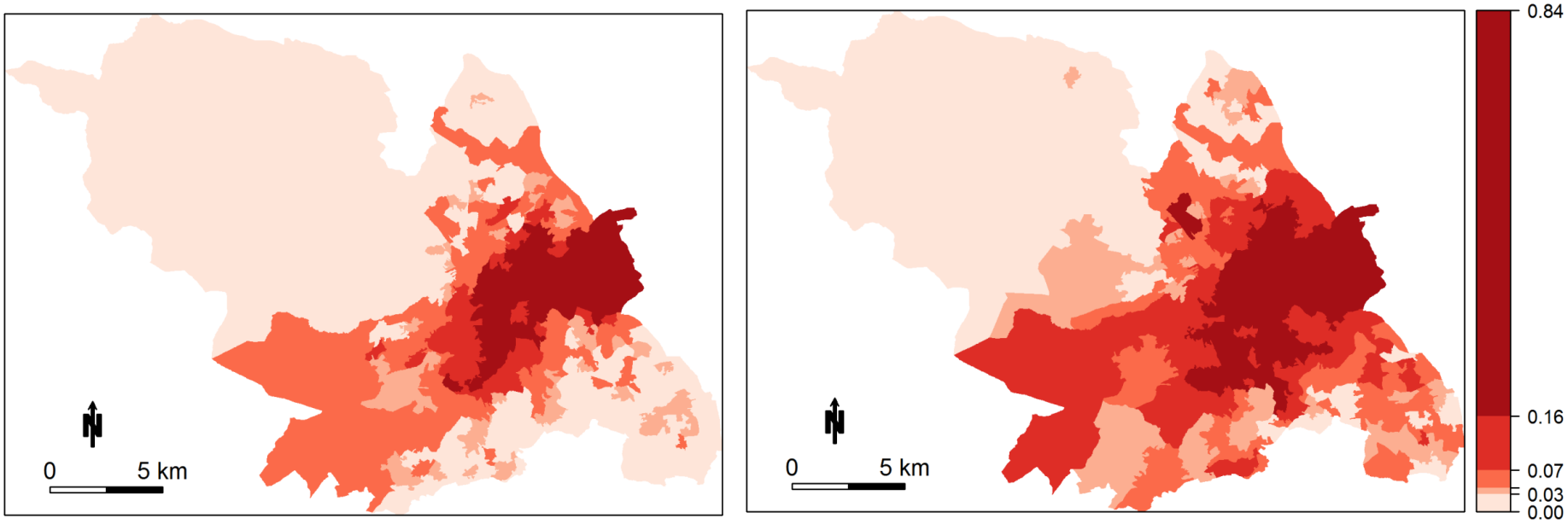
$$\frac{C_F}{N_F * P_F} - \frac{C_B}{N_B * P_B}$$

  - C_F and P_F represent the counts of crimes and the total population of paired LSOAs on the opposite sides of social frontiers identified above.
  - N_F and N_B represent the number of the frontiers and borders
  - So the simple text accounts for population distribution and the scale of social frontiers and borders

  - 1000 permutations to give an inference on the difference statistic

3. Results

Social boundaries



- Fig.1 The distribution of the proportion (%) of non-white population in Sheffield in 2001 (left) and 2011 (right)

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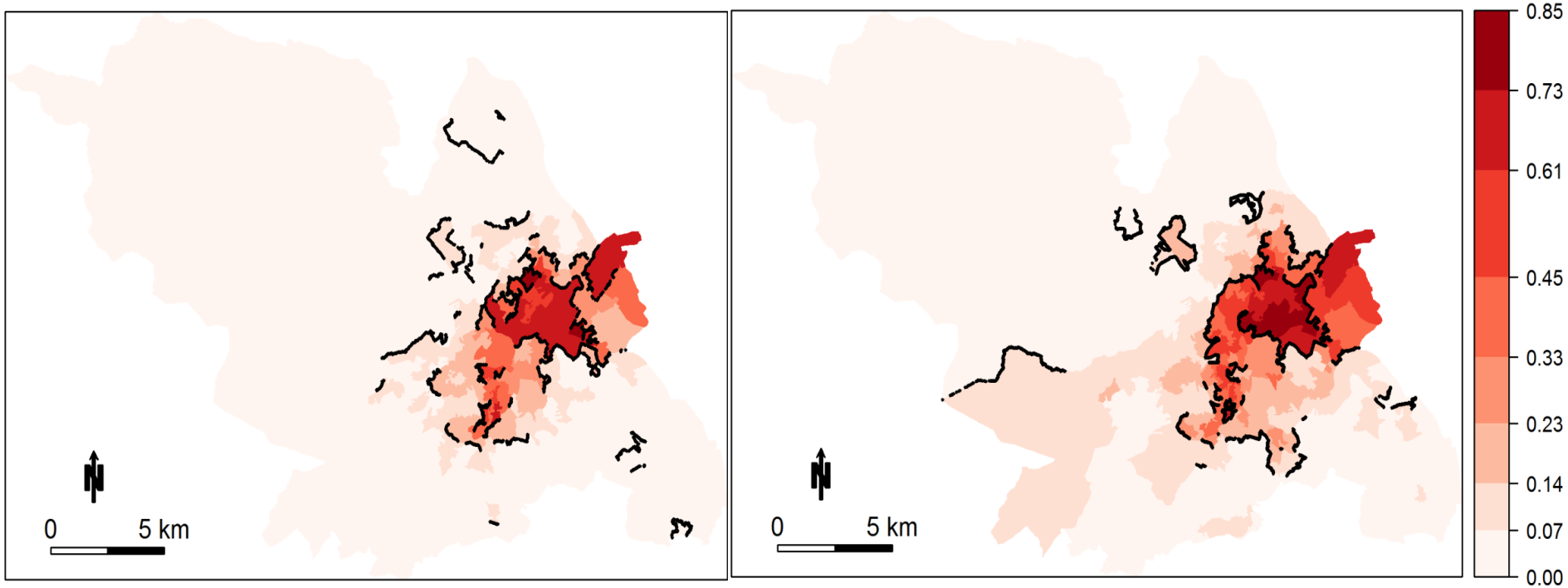
3. Results

Social boundaries



- Fig.1 The social boundary/frontiers of ethnicity distribution in Sheffield in 2001 (left) and 2011 (right)

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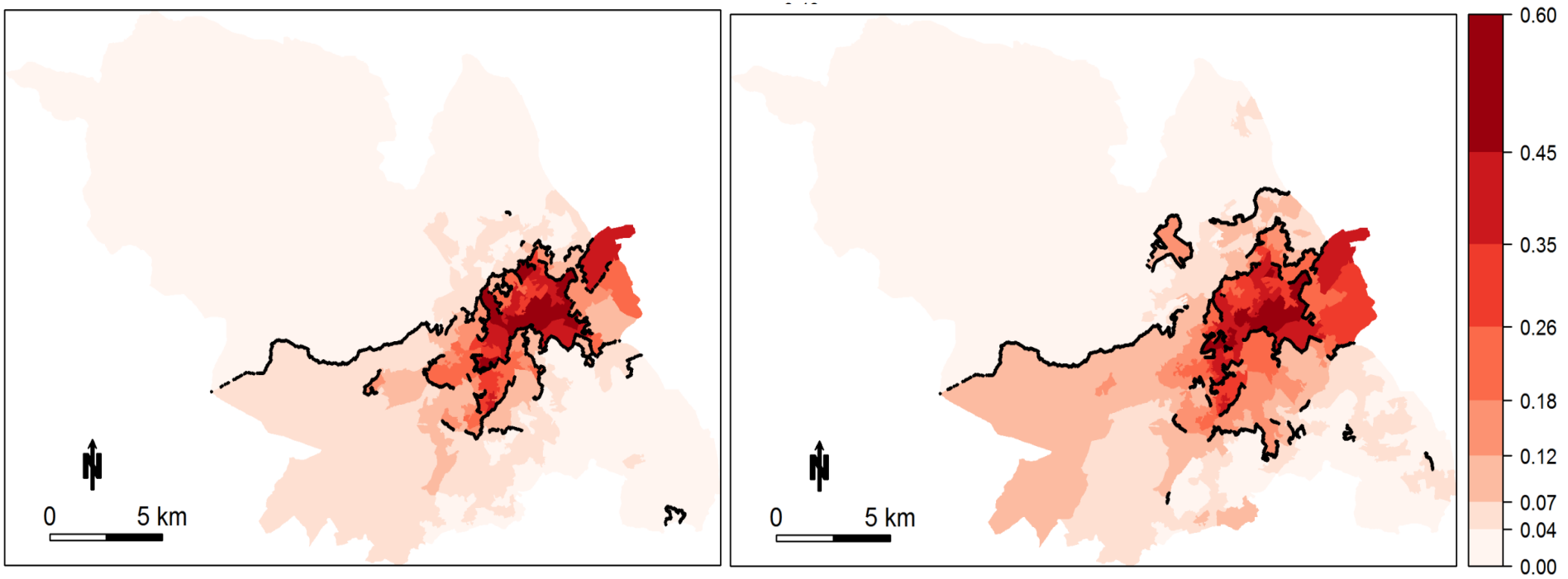
3. Results

Social boundaries



- Fig.2 The social boundary/frontiers of COB in Sheffield in 2001 (left) and 2011 (right)

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3. Results
– Permutation Sig. Test

	Ethnicity frontiers		Country of birth frontiers	
Units: Counts / per 1000 persons	Differences as in Equation (2)	p-values	Differences as in Equation (2)	p-values
All crimes	1.428	0.002	1.358	0.001
Burglary crimes	0.096	0.002	0.090	0.001
Violent crimes	0.083	0.011	0.084	0.001
Vehicle crimes	0.096	0.001	0.089	0.001
Shoplifting crimes	0.054	0.046	0.054	0.024

Table 1. Comparing differences in crime rates between the two groups and the permutation test results.

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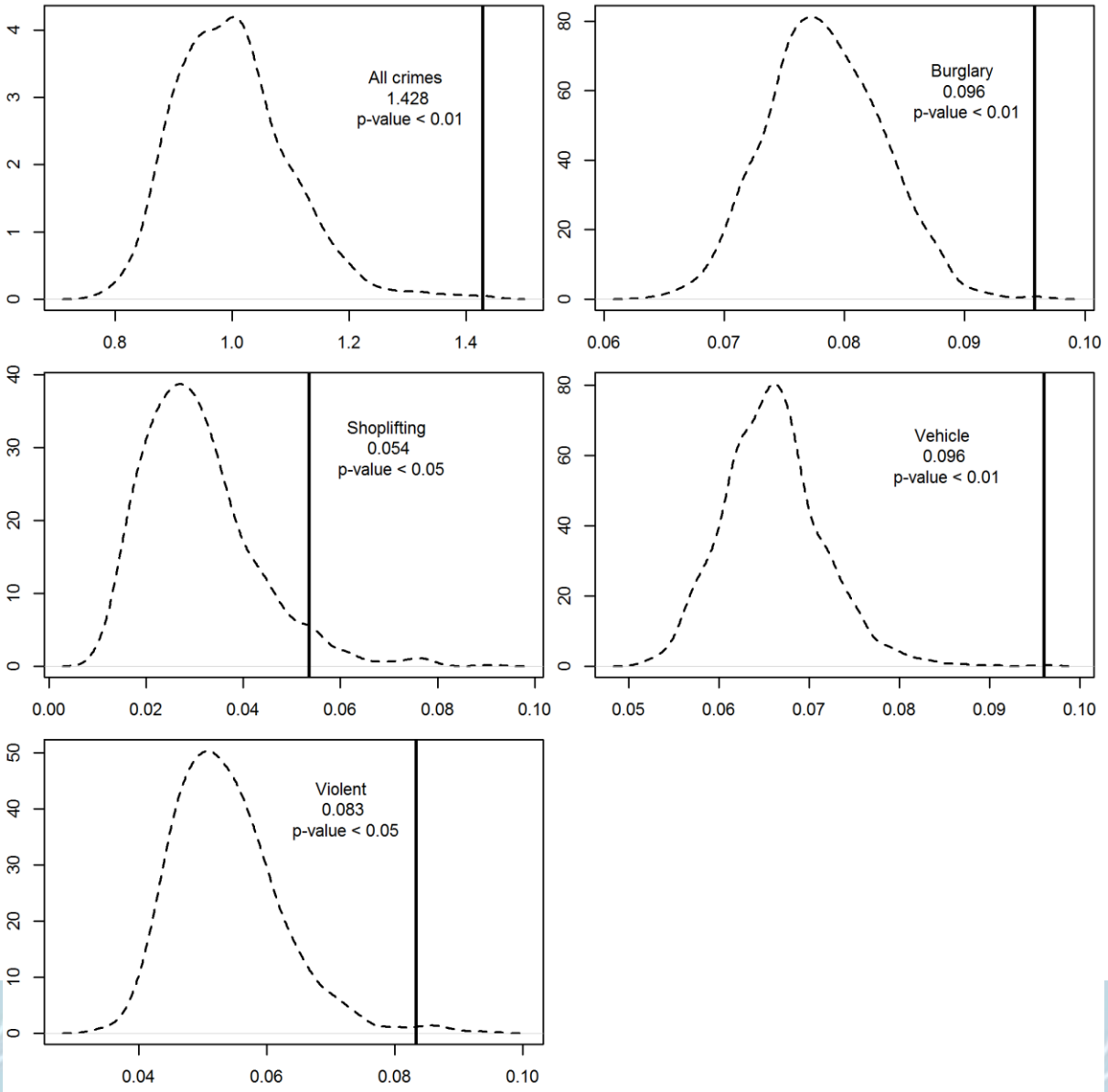
3. Results

Social boundaries



4. Findings and future work

- Localised spatial modelling provides an methodological framework for identifying boundaries/frontiers in segregation and inequality studies

- These social frontiers seem to make a difference in the distribution of crimes with crimes happening more often near frontiers

- Future work
  - Apply to different cities especially including those with known racial tensions
  - Apply to other aspects of ethnicity & social difference including a multi-variate approach to boundaries such as Religion, Social Class, Deprivation

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- Many thanks
- Any comments?