

# Spatial sensitivity analysis

Course and practical application

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- 1 Introduction
- 2 Spatial synthetic data
- 3 Perturbation of data
- 4 Spatial indicators for model outputs
- 5 Application: sensitivity to spatial configuration

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\*Classical problems in geography / spatial sciences : MAUP, scale dependency, spatial non-stationarity\*

=> spatial configuration are parameters too

- Space matters - Synthetic generators - Sensitivity to data noise

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*At the microscopic scale (district): building layouts*  
[Raimbault and Perret, 2019]







\*At the mesoscopic scale: population grid\*

[Raimbault, 2018]

- Reaction-diffusion model - Urban form measures





\*At the macroscopic scale: systems of cities\*

- Evolutive urban theory: systems of cities follow general stylized facts - rank-size law - central place theory



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\*How does noise in real data impacts the result ?\*

- WIP

\*How does perturbation of real data allows to explore scenario\* -

Forcity example

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\*In the spatial approach, spatial model indicators are also important: what kind of spatial structure does the model produce ?\*

- previous form indicators at different scales - spatial statistics

\*spatial correlations ?\*

(examples)

\*Spatial autocorrelation at a given range\*

Given spatial weights  $w_{ij}$

$$I = \frac{N}{\sum_{i,j} w_{ij}} \cdot \frac{\sum_{i,j} w_{ij} \cdot (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2}$$





\*Quantifying level of clustering regarding a null model\*



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Relative distance of phase diagrams

$$d_r(\mu_{\vec{\alpha}_1}, \mu_{\vec{\alpha}_2}) = 2 \cdot \frac{d(\mu_{\vec{\alpha}_1}, \mu_{\vec{\alpha}_2})^2}{\text{Var}[\mu_{\vec{\alpha}_1}] + \text{Var}[\mu_{\vec{\alpha}_2}]}$$

\*Why could the Schelling model be sensitive to space ?\*

[Banos, 2012]



\*A model of resource collection\*





Banos, A. (2012).

Network effects in schelling's model of segregation: new evidence from agent-based simulation.

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39(2):393–405.



Raimbault, J. (2018).

Calibration of a density-based model of urban morphogenesis.

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Generating urban morphologies at large scales.

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