Overview of the Quantitative Histories Workshop

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4 Research Problem

Increasingly complex problems require complex tools.

Sub-disciplinary tools require interdisciplinary thinking.

How can information theory inform interdisciplinary curriculum and software development?

5 Information theory

Information theory is a branch of applied mathematics and computer science that deals with the quantification, storage, transmission, and manipulation of information. We take an abstract approach to our study of information.

- Information theory seeks to measure the amount of information contained in a *message* or signal and how efficiently it can be transmitted or stored.
- In this way, our projects define *information* using a curricular perspective.

6 Quantitative history

7 Mathematical sociology

8 Curriculum and software development

Design, development, implementation, and evaluation of computational curricular materials

8.1 Research projects

- ECHO: Education, Community, and Health Observations
  - Information and spatial segregation
- Teaching statistical learning and mathematical modeling
- Theory and quantification

Figure 1: *Historie Quantitative* by Pierre Chaunu

Figure 2: *Journal of Mathematical Sociology*

8.2 Project group 1: Spatial information and racial isolation

How do patterns of racial segregation inform education, community, and health outcomes?

- Historical legacies of injustice
- Traditional modeling approaches
- Modern computational tools

9 Dividing walls

10 Geometric approach

We adopt a **topological** model for spatial segregation on a geographical area, G to develop a theory of dividing walls.

Builds on the topological and topographical work of Short (2011).

Theorem 1. Given any configuration of blue and green towns, there is a dividing wall that separates blue towns from green towns.

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10.1 Is there a dividing wall for an island with coastal towns?

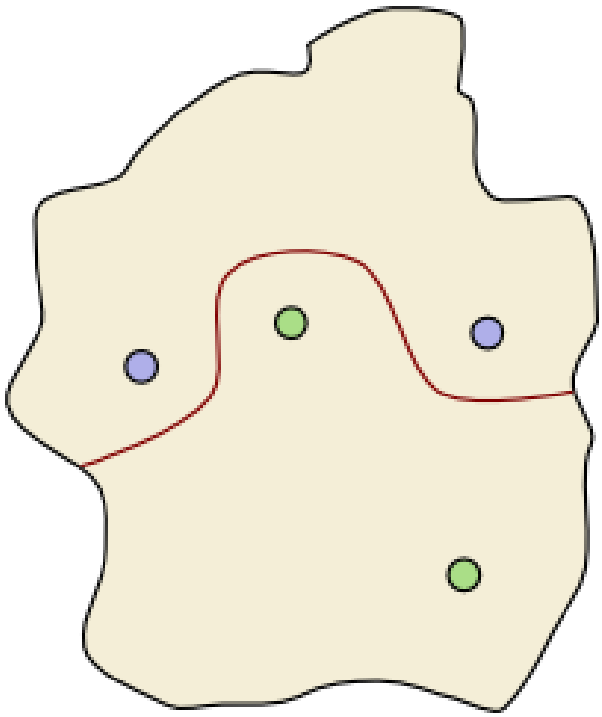

Figure 3: Geographic area with neighborhood units

10.2 Is there a dividing wall for an island with coastal towns?

Theorem 2. Alternating configurations of towns do not have a dividing wall, whereas non-alternating configurations of towns do have a dividing wall.

10.2.1 Algebraic approach

We then develop a algebraic modeling approach using methods from **mathematical sociology**.

Segregation indices

- *Dissimilarity index*: Measures the proportion of one group's population that would need to move to achieve an even distribution across all areas. It ranges from 0 to 1, with higher values indicating greater segregation.

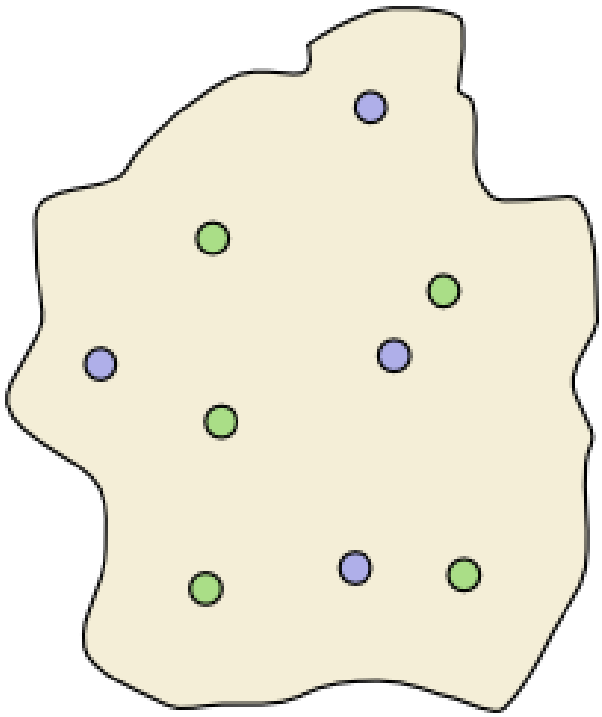

Figure 4: Geographic area with neighborhood units

- *Isolation index*: Measures the extent to which members of a particular group are surrounded by others from the same group. It represents the percentage of people from a specific group who would need to change neighborhoods to achieve an even distribution. Higher values indicate higher isolation and segregation.

10.2.2 Algebraic approach

We then develop a algebraic modeling approach using methods from **mathematical sociology**.

Segregation indices

- *Exposure index*: Measures the extent to which members of one group are exposed to members of another group. It quantifies the likelihood that a randomly selected individual from one group will encounter individuals from another group. Higher values indicate higher exposure and lower segregation.