Networks and Network Analysis in R

Workshop Materials prepared for NSCR-R

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Source Picture: https://www.nature.com/collections/adajhgjece/

Getting Ready: Packages in R

- **tidyverse:** Basic data management and useful pipeline for code structure
- **igraph:** Constructing network graphs
- **tidygraph**: Using the tidyverse pipeline with igraph networks
- **ggraph:** For better network visualizations
- **statnet:** For ERGM models

Background

Assistant Professor at Leiden University
(previously at Florida State University & Northeastern University)

Research Agenda: Social networks, spatial networks, victimization risk, human trafficking, dating violence, co-arrests

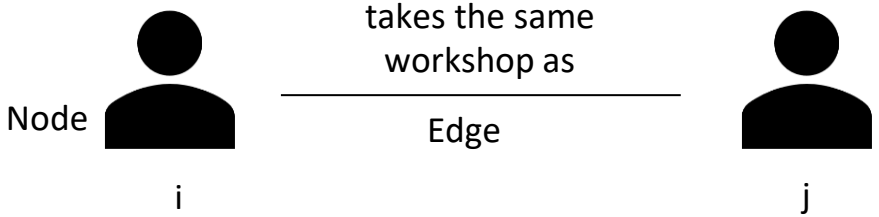
Teaching Agenda: Human trafficking; ecological context of crime; computational statistics (in R); programming in the social sciences (in Python)

What are Networks?

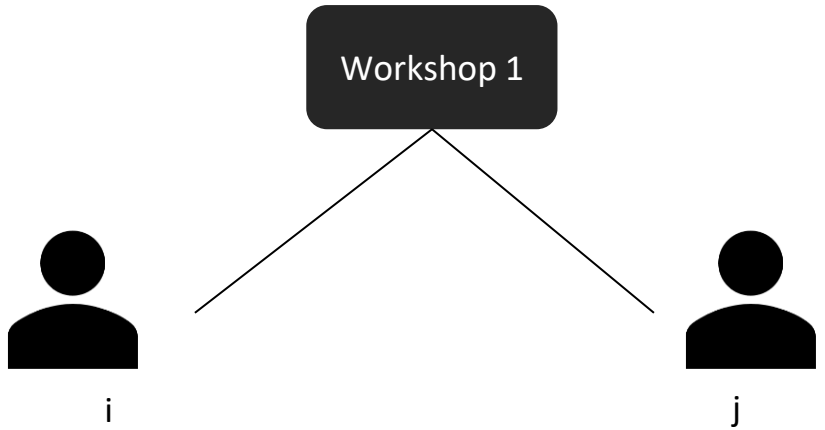
Social Networks: A “finite set or sets of actors and the relation or relations defined on them.” (Wasserman & Faust 1994, p. 20).

Networks

One-mode networks

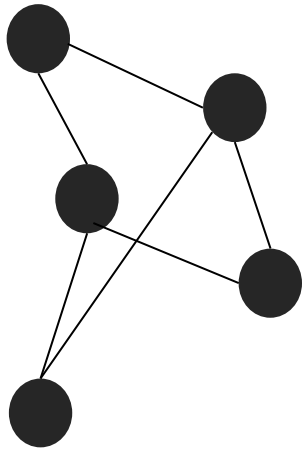


Two-mode networks



Social Network Analysis (SNA): Tools to examine social relations (their structure, their formation and/or their influence on individual, group and system behavior).

Network and/or connections as **dependent** variables:



Individual and relationship characteristics explain the formation of ties

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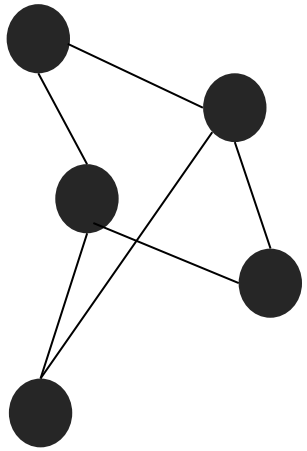


Explain or predict behaviors, opinions, experiences, attitudes

Network Analysis in R

- Reproducible, computationally efficient, more statistical analyses possible
- Origin for certain statistical packages (e.g. ERGM)

Explaining Networks through Exponential Random Graph Models

Exponential random graph models

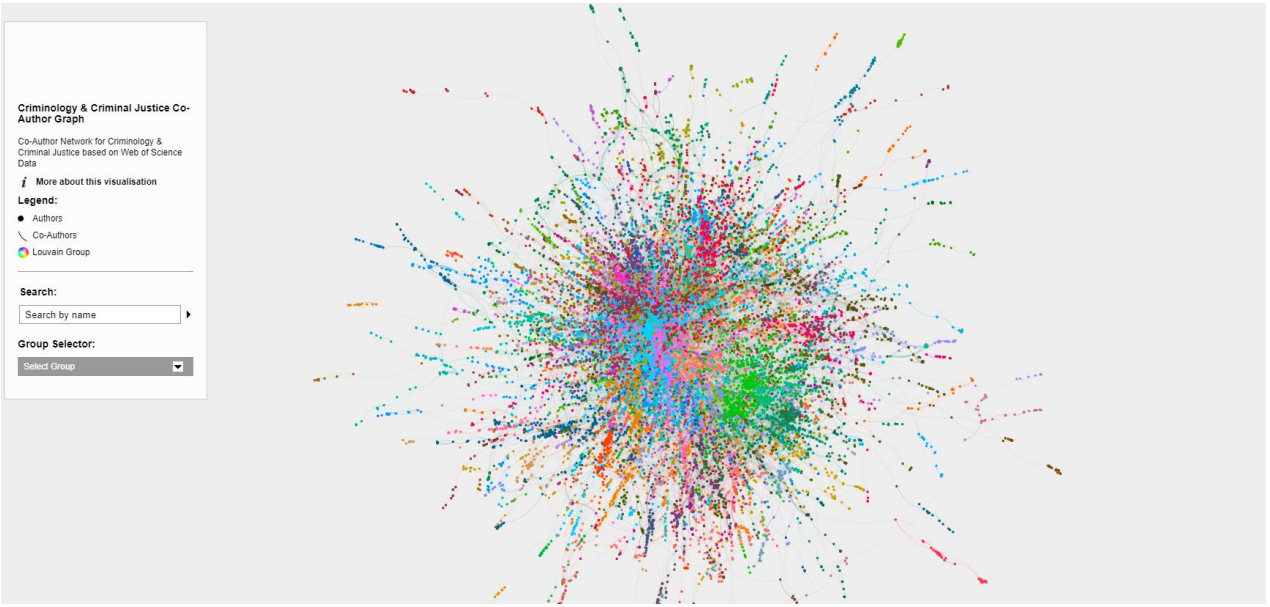
Explains the odds of tie formation between any two nodes as a function of:

1) Node attributes
2) Edge attributes
3) Network attributes

$$\Pr(Y = y) = \left(\frac{1}{C}\right) \exp\left\{\sum_{a=1}^{A} \eta_a \, g_a \, (y)\right\}$$

Not all networks are ***social*** networks

Example: Co-Author Network



https://apwheele.github.io/MathPosts/network/

Example: Inter-neighborhood co-arrest networks (spatial networks)

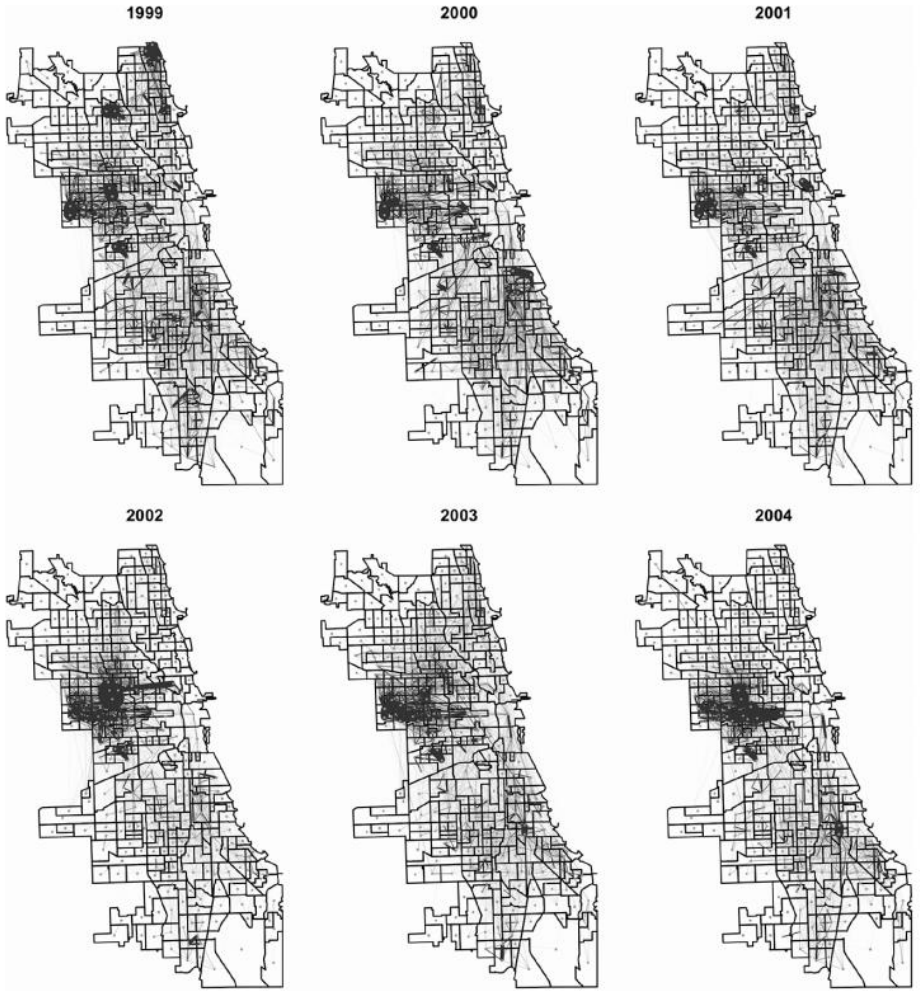


FIG. 1.—Spatial sociogram maps for six networks (1999–2004)

Papachristos & Bastomski (2018)

Example: Street networks

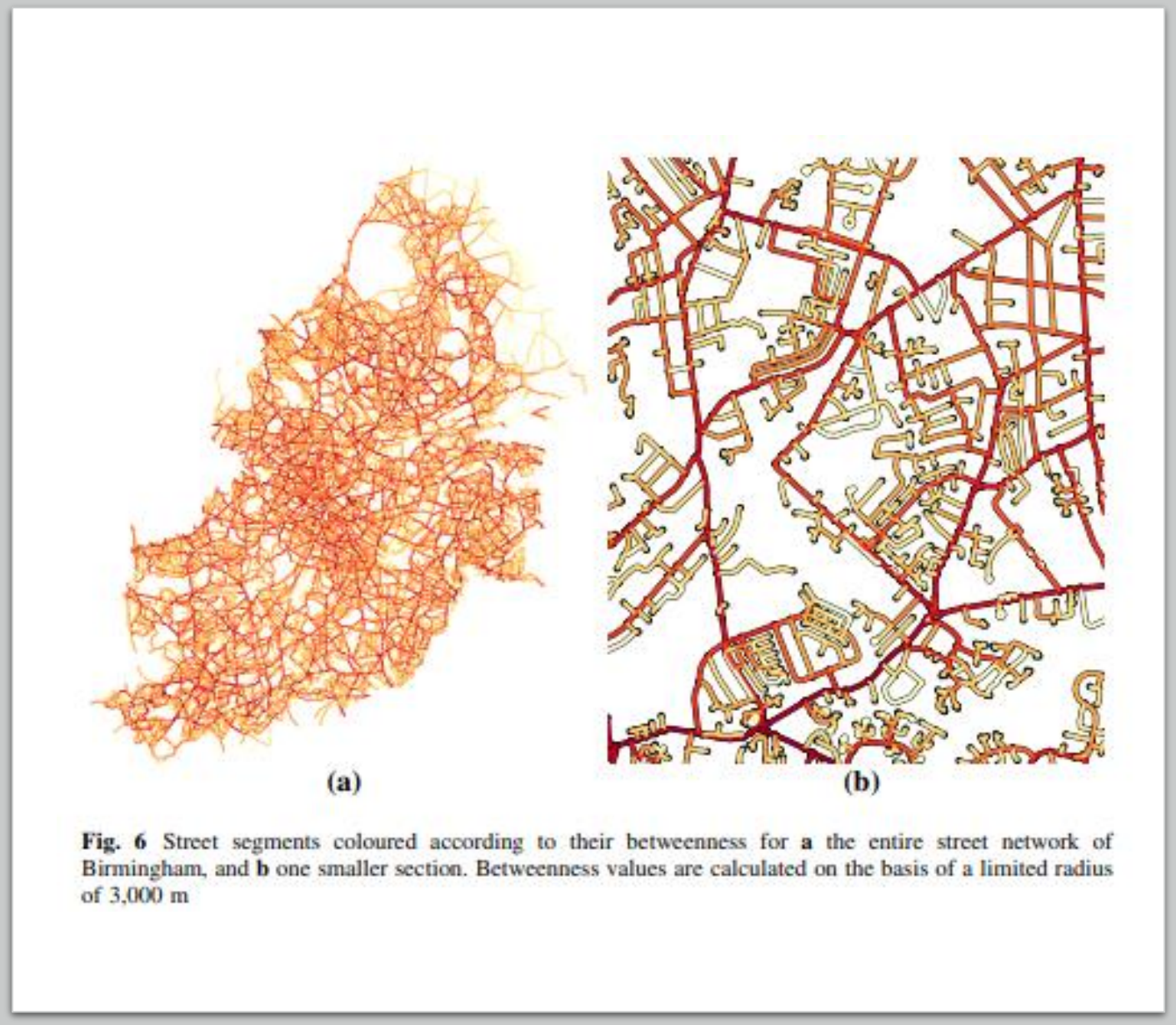


Fig. 6 Street segments coloured according to their betweenness for **a** the entire street network of Birmingham, and **b** one smaller section. Betweenness values are calculated on the basis of a limited radius of 3,000 m

Davies & Johnson (2015)

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