Networks and Network Analysis in R
Workshop Materials prepared for NSCR-R
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# 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)
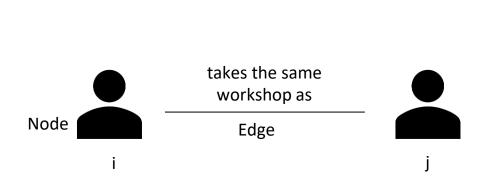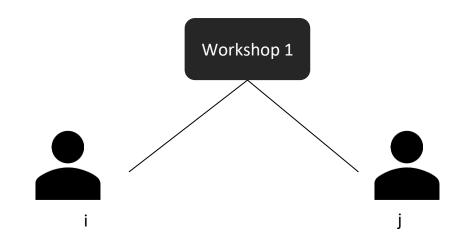
# What are Networks?

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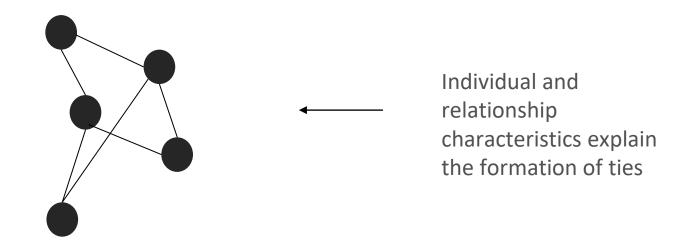
# Networks

## One-mode networks



Node

takes the same workshop as

Edge

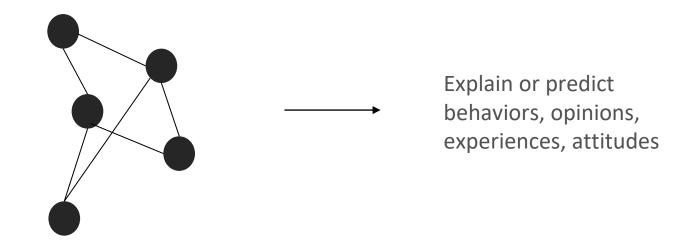i          j

## Two-mode networks



Workshop 1

i          j

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

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 **independent** variables:



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**

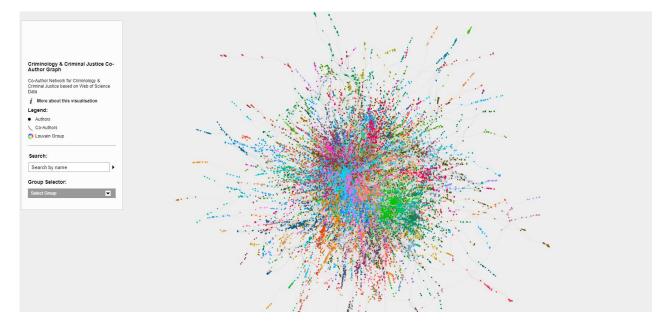Explains the odds of tie formation between any two nodes as a function of:

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/

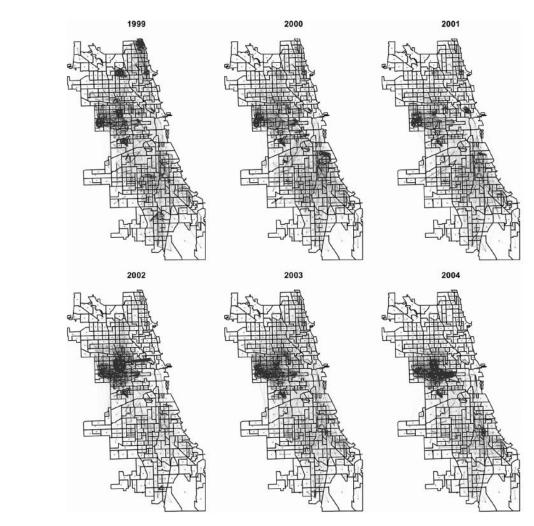# Example: Inter-neighborhood co-arrest networks (spatial networks)



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

Papachristos & Bastomski (2018)
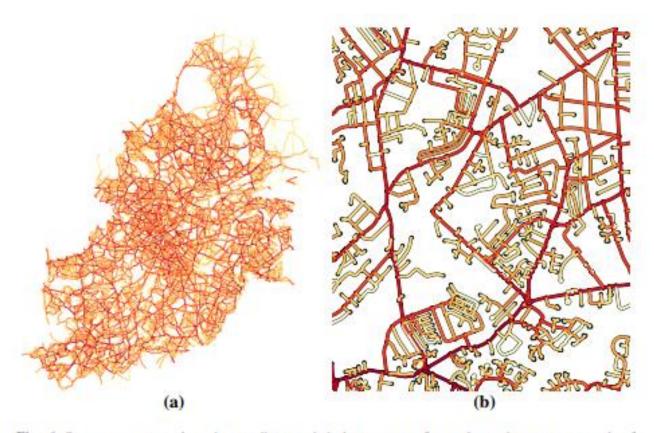
# Example: Street networks



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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