

# PAF 593 Final Project Report - Co-Offending Networks in Phoenix (2018-2023)

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# Overview of Presentation

- Introduction and Problem
  - Crime is mainly a group phenomenon: co-offending networks
  - Structural properties of co-offending networks
- Project Goal
  - Develop and pursue an open-science approach to analyzing co-offending networks in Phoenix
- Project Methodology
- Results
- Discussion and Policy Recommendations

# Introduction and Problem

- Crime is mainly a group phenomenon
  - Research and policy has focused on co-offending networks
- Important structural properties of co-offending networks
  - Reachability
  - Clustering

# Project Goal

- Examine reachability and clustering in co-offending networks
- Develop and pursue an open-science approach to analyzing co-offending networks in Phoenix

# Project Methodology

- Data Acquisition and Workflow
  - Data were downloaded from the City of Phoenix Open Data Portal
  - Co-offending defined as arrests between two or more individuals
- All project documents were stored on a GitHub repository
  - <https://github.com/jacobtnyoung/PAF-593-project>

# Project Methodology

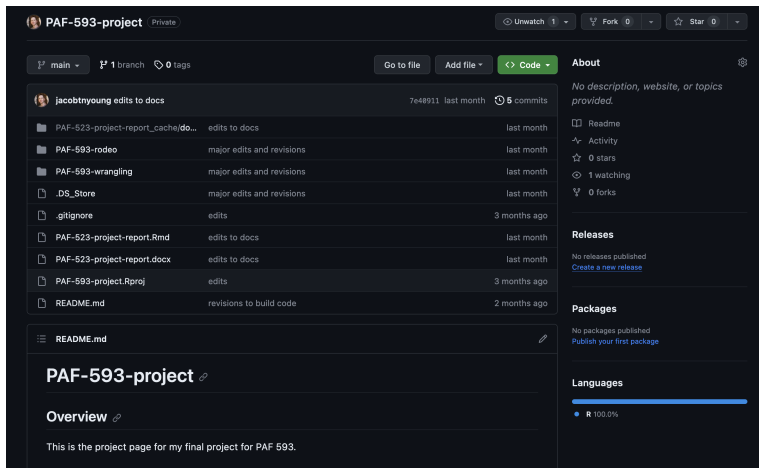


Figure 1: Screen shot of the repository

- Network Construction
  - A two-mode network: incidents (i.e. arrests) and individuals (i.e. people arrested together)
  - Defined as:  $G = (N, M, L)$ , where  $G$  is the graph and is defined by two node sets  $N = \{n_1, n_2, \dots, n_g\}$  and  $M = \{m_1, m_2, \dots, m_g\}$  and an edge set:  $L = \{l_1, l_2, \dots, l_L\}$
- There are  $N$  nodes in the first set,  $M$  nodes in the second set, and  $L$  lines/edges in the network.

- Network Measures
  - Reachability
    - ▶ Inverse of the distance between the two nodes
- Clustering
  - Clustering coefficient defined as:  $\frac{4 \times C_4}{L_3}$ , where  $C_4$  is defined as a cycle and  $L_3$  defines a 3-path structure
  - Higher values of the clustering coefficient indicate greater overlap in shared co-offenders



# Analytic Approach

- Descriptive analysis of the reachability scores and clustering coefficient for the co-offending networks by year.

# Results

Year	Events	Individuals	Edges
2018	7353	13044	15979
2019	7992	12962	16043
2020	6580	10118	12594
2021	5405	8201	10246
2022	4330	6422	7648
2023	3582	6048	7359

Figure 2: Descriptive Information for Co-Offending Networks

- Average number of incidents per year was 5,874
- Average number of individuals involved in those events was 9,466
- General decline in co-offending from 2018 to 2023

# Results: Description of Reachability for Co-Offending Networks

Year	Mean	Minimum	Maximum
2018	5.941779	0.2542611	16.27271
2019	7.052026	0.2039933	21.41930
2020	6.983182	0.2571481	21.60044
2021	6.778950	0.2085411	21.37547
2022	6.222526	0.1499775	17.32240
2023	5.748357	0.2657048	17.35938

Figure 3: Description of Reachability for Co-Offending Networks

- Average reachability is 6.45
  - Interpretation: The average individual can reach 6.45 other individuals through their co-arrest history
- The trend over time has been for reachability to remain roughly similar from 2018-2023

# Results: Description of Clustering for Co-Offending Networks

Year	Clustering
2018	0.0067226
2019	0.0079311
2020	0.0139256
2021	0.0186057
2022	0.0295114
2023	0.0252911

Figure 4: Description of Clustering for Co-Offending Networks

- Average clustering is 0.02
- Clustering is very low, suggesting that there is very little overlap in co-offenders

# Results: Description of Clustering for Co-Offending Networks (cont.)

- But, an increase in clustering from 2018 (i.e. 0.007) to 2023 (i.e. 0.025)
  - May be indicative of an increase in the tendency for co-offenders to trust other co-offenders

# Discussion and Policy Recommendations

- Results show an increase in clustering from 2018 to 2023
  - Clustering and trust are important in co-offending networks as these structures may facilitate group solidarity and greater criminal organization
  - Networks where there is high clustering tend to create modularity or sets of individuals that are only connected to members of that set.
- The **policy recommendation** is that agencies focus greater attention on the mechanisms that may lead to the observed increase in clustering.

# Discussion and Policy Recommendations

- Developed an open-science approach to examining adult arrest data from the City of Phoenix Open Data Portal
- Shows importance of reproducible results
- Provides a framework that can be updated as more data are generated