Student Collaboration Models Using Random Graphs

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Context

Student collaboration networks

- Introductory Physics (Calc based)
- Self-reported networks
- During group exams (with open collaboration) [1]

Goal: Model collaboration to describe student behavior.

Methods

(Social) Network Analysis (SNA) tools to describe collaboration networks: [2]

Nodes Students
Edges (Directional) collaborations between students

SNA parameters for describing these networks:

Plot Degree Number of collaborators
Betweenness number of connections
Plot Transitivity Number of mutual collaborators in a triad
Plot Reciprocity Probability for verticies to be linked in a directed network

`StuNet` model parameters

pGroup probability of nodes connecting within a group
pOther probability of nodes connecting outside a group
clump average group size

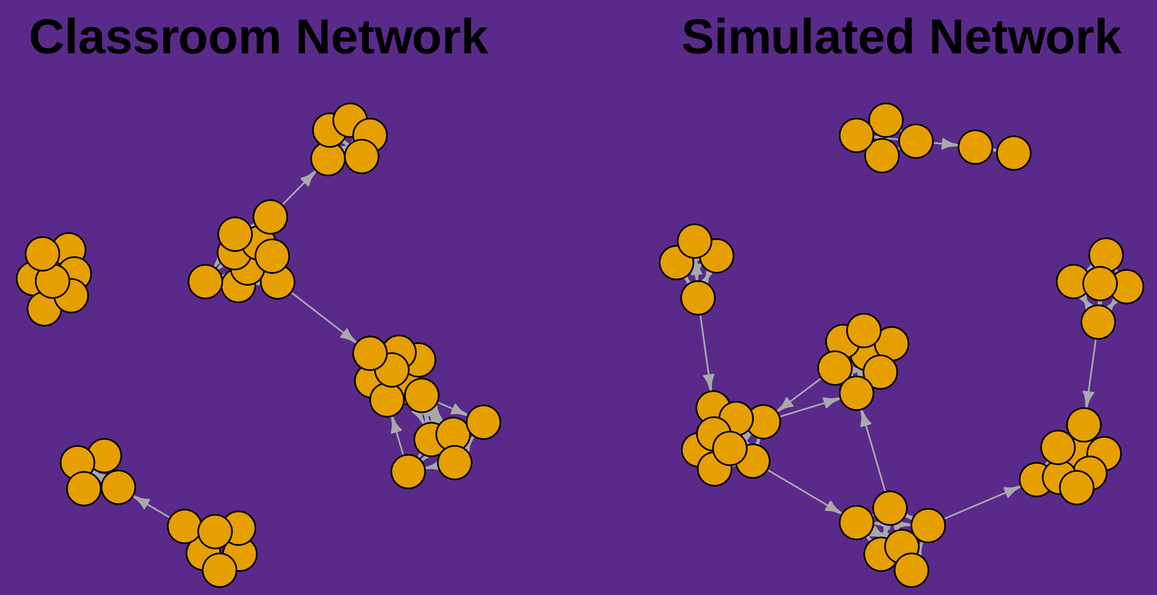
Comparison metric

Dissimilarity: The overall differences between the model and the class network

$$D = \langle KS_{\text{degree}} \rangle + \langle KS_{betweenness} \rangle + |z_{transitivity}| + |z_{reciprocity}|$$

KS is the KS-statistic (kolmogorov smirnov)

We *developed* and *optimized a model* describing the social network of a *collaborative* classroom.



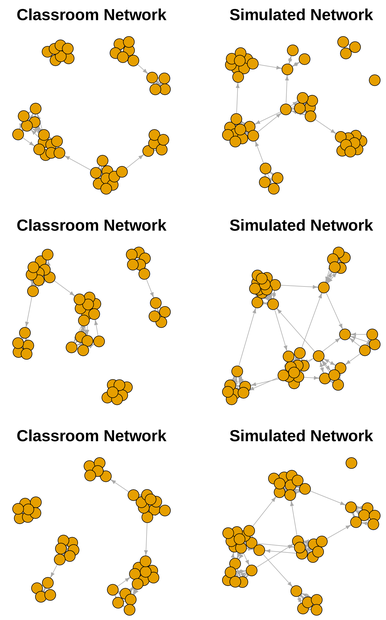
Take a picture to learn more

Optimization

- We used `optimr` to optimize our model
- A logit transformation was applied to conduct an unconstrained optimization, specifically on pGroup and pOther as their probability is between 0 and 1
- $\text{logit}(P) = \log\left(\frac{P}{1-P}\right)$

More Networks

these show data from fall 2015 exam 1 in comparison to our random model



Future Directions

- Optimize more exams and compare student trends between exams
- Test the assumption that students connect depending on their position in a group or outside a group.
  – Are we *Fermions* or are we *Bosons*
- Add more detailed information about the students, such as gender and major

References

[1] Wolf, Steven & Blakeney, Cody & Close, Hunter. (2016). Group Formation on Physics Exams. 400-403. 10.1119/perc.2016.pr.095.

[2] Wolf, Steven & M. Sault, Timothy & Close, Hunter. (2018). Information flow in group exams. 444-447. 10.1119/perc.2017.pr.106.