Do doctors influence their friends?

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Introduction

In a community of doctors, do friendships and professional relationships affect how drugs are prescribed?
This poster seeks to answer this question.
Why is this question important?

- Drug treatments should always match the patient, and not be influenced by the doctor's social circle
- By analysing how different doctors affect each other (and the whole community), we can decide how suitably they are making important prescriptions decisions.

The dataset

- 242 doctors
- Information for each about what city they are from, their professional and social relationships, and when they prescribed a new drug.

The following is a plot of the dataset as a network:

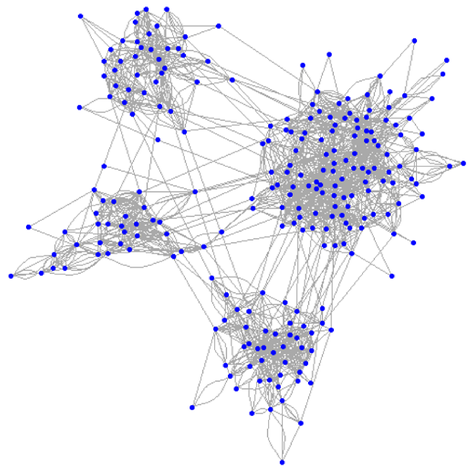

Figure 1: The full network, one node per doctor

Two nodes (doctors) are connected by an edge based on working together, being friends, or giving each other advice.

Clustering

- We can try to split the network in to 'communities'.
- There should be many edges in each community, but few between them.
- We can use random walks (which tend to stay within one community) to choose the clustering.

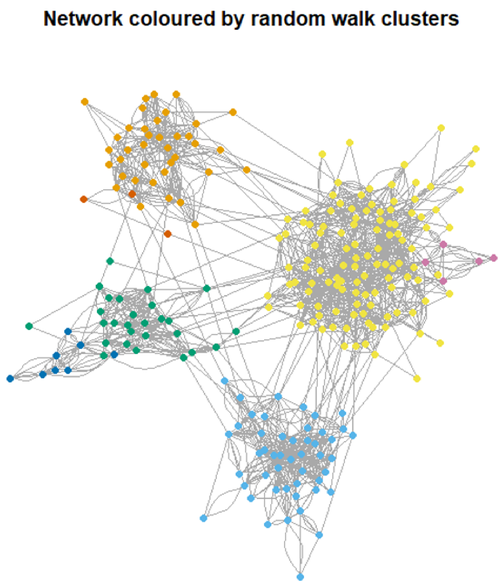

Figure 2: The network coloured by a clustering algorithm based on random walks

- We can see that the algorithm has found distinct communities
- There is clearly lots of social structure within the whole community of doctors
- Assignment of drugs may be influenced by a doctor's friends and colleagues

Relationship importance

- We can investigate the effect of removing individual relationships (edges) from the graph.
- The following shows the largest community size as we randomly remove edges from the graph.

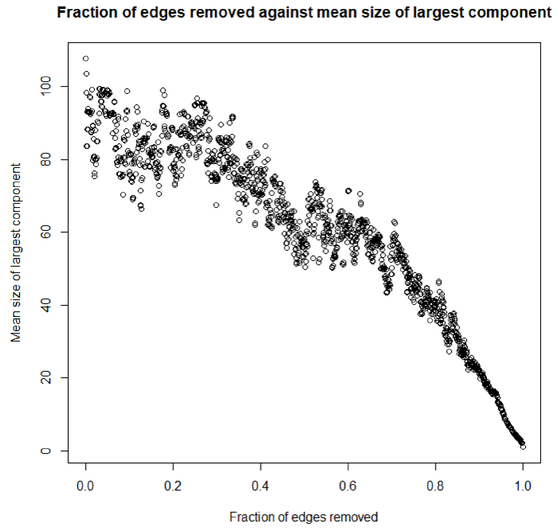

Figure 3: Size of largest community as edges are randomly removed

- The largest community size starts high and variable, then gradually drops to falling almost linearly (as structure disappears).
- This happens is a bit sooner than you might expect from a random (Erdos-Renyi) graph.
- This again shows that there is more structure within the network than expected from a random network of the same size.

Individual importance

- We can also investigate the influence of individual doctors.
- The following shows the network having removed the 10% of nodes with the most edges:

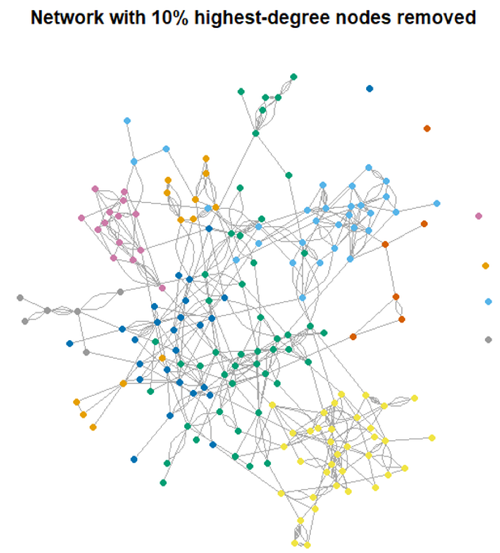

Figure 4: Network with the 10% highest degree-centrality nodes removed

Even with such a small portion of doctors removed, the network loses all its structure. Perhaps just a few individuals' actions control how the whole community behaves.

Deduction

The presence of tight clusters, 'giant components', and important edges suggests that certain relationships and sub-communities have an impact on how other doctors behave. This might imply that assigning the new drug was not always done independently of other doctors, as it should be in practice.

Summary and discussion

In summary, there is much more community structure within the network than one would expect from a random graph.
Additionally, certain relationships and even certain individuals have a big impact on how the whole network behaves.
This might have implications for how drugs are prescribed, and expectations of doctors. With a larger dataset, we could investigate this further.
The contents of this work and the associated code are my own unless otherwise stated