**Script**

* Personal friendship
* Faculty of a UK university
* 81 vertices (individuals) and 817 directed and weighted connections.

# Settings

1. Introduction (slides) (3 mins) - 3
   1. What are networks
   2. The promise of network science
      1. Map and understand complex systems, where the pattern of connections is not apparent based solely on our intuitions. See the big picture.
      2. Empirically extend our theoretical intuition of the patterns that compose social structure.
   3. Some examples
      1. Health - Christakis & Fowler – obesity
      2. Covid network
      3. Jim political polarization
      4. Food network
      5. Coral network
      6. Connectome
      7. Gene coexpression

Sometimes the relationships are important (and sometimes even more important) than the properties of the things they connect.

1. Description of the dataset and what we will achieve in the workshop Make pretty plot to introduce the topic from the graph (2 mins) – 5
   1. We are going to work with the package igraph and we’re going to start with a network object. We can check this is a network object with the class() function. If your data is not a network object yet, you can turn it into a network and I have a workshop for that.
2. Elements of a Network (slides) (5 mins) – 10

Nodes (also called vertices or vertex)

Edges (also called ties)

Node attributes

Edge attributes

Directed networks

Undirected networks

Weighted networks

Unweighted networks

1. Exploring our network (5 mins) - 15
   1. Network overview

Igraph – object

D -> directed (U – undirected)

W -> has a weight attribute (nothing if there is no weight)

Displays the number of nodes and edges

Attributes

Graph attributes (and the type – character, numeric being the most common)

Vertex attributes

Edge attributes

Group is the numeric id of the school affiliation. The weight is based on the strength of the relationship.

Nepusz T., Petroczi A., Negyessy L., Bazso F.: Fuzzy communities and the concept of bridgeness in complex networks. Physical Review E 77:016107, 2008.

Overall characteristics:

Is the network directed or undirected?

Is the network weighted?

How many nodes do we have?

How many edges do we have?

What are the attributes?

Seeing if the graph is a simple graph

Exercise 1: Give us an overview of the air network (2 mins) - 17

Qs such as: How many edges does the graph have?

* 1. More in-depth exploration (15 mins) – 32
     1. Attributes

V() -> vertices and attributes

E() -> edges and edge attributes

* + - 1. Exploring vertex attributes
         1. Do a head V()[[1:5]]
         2. Look at the distribution per attribute
      2. Exploring edge attributes
         1. Do a head V()[[1:5]]
         2. Look at the distribution per attribute
    1. Specific elements
       1. Explore vertices
          1. All vertices
          2. Specific vertices

Through naming them

Through a condition

* + - * 1. Specific vertices connections

Which nodes are connected to 57?

* + - 1. Exploring specific edges
         1. Does a given edge exist? (will give you the weight if weighted)
         2. Specific edges
         3. Incoming edges of a vertex
         4. Outgoing edges of a vertex
  1. Quick manipulation tasks
     + 1. Add edges
       2. Remove edges
       3. Add vertices?
       4. Remove vertices?

Exercise 2: Attributes, edges and vertices of the air network (5 mins) – 37

1. Basics of Visualization (15 mins) 53
   1. First ugly plot
   2. General changes (10 mins)
      1. Settings outside the graph versus inside the graph
         1. Inside the graph -> as arguments of the plot function
         2. Outside the graph -> as vertex and edge attributes
   3. Using selection to change the visuals of specific elements of the graph
   4. Graph layouts (5 mins)

Exercise (reproduce this plot) (5 mins) - 58

1. Descriptive Statistics (15 mins) - 75
   1. Density
   2. Transitivity
   3. Reciprocity
   4. Transitivity
   5. Average path length
2. Centrality (15 mins) – 90
   1. Degree
      1. histogram
      2. graph nodes high centrality
   2. Strength
      1. Histogram
      2. Graph nodes high centrality
   3. Closeness centrality
      1. Histogram
      2. Graph nodes high centrality
   4. Betweenness centrality
      1. Graph nodes high centrality

Exercise (5 mins) – 95

1. Community Detection (10 mins) – 105
   1. Hierarchical clustering

Exercise (5 mins) 110

Wrap up and Qs - 120.