

Network Analysis and International Trade Flows

Density

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Lezione 3

(Social) Network Analysis and International Trade

Main characteristics and insights:

- ▶ In this lectures we describe international trade in its structural dimension which is characterized as a network of trade flows. Countries are **nodes** and trade flows are **ties**.
- ▶ We assume that **inter-country ties matter**: (1) to the individual countries in the network; (2) to understand the evolution of the world trade system.
- ▶ **(Social) Network Analysis**
 - ▶ Sociology and Anthropology work on small social networks ($\cong 10 - 50$ nodes).
 - ▶ We work on large datasets (the number of countries in around 190).
 - ▶ The macro-level of the data hides the social dimension of the analysis.
- ▶ In this introduction we will focus on **visual exploration** and summary statistics, with the objective of detecting and interpreting patterns of social ties among countries.

Part I

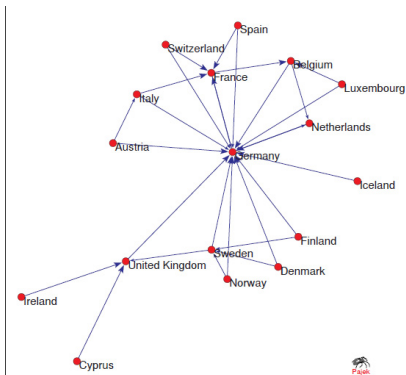
Introduction: Sociometry and visual exploration

Sociometry

- ▶ **Sociometry**, the quantitative social science which studies interpersonal relations, was founded by J. L. Moreno (1960). See Scott (2000) for a review.
- ▶ **Society** is not an aggregate of individuals and their characteristics, as statisticians assume, but a structure of interpersonal ties. “The whole is more than the sum of its parts” (Aristotele).
- ▶ The individual is not the basic social unit. The social atom consists of an individual and his or her social, economic, or cultural ties. Social atoms are linked into groups, and, ultimately, society consists of interrelated groups.
- ▶ **Individual characteristics** + **social ties**
- ▶ Both elements were represented with the use of a **sociogram**.

The Sociogram

- ▶ The figure is an example of a **sociogram**, which is a **graphical representation of group structure** of European countries.
- ▶ Links indicate the **two main trade partners** (some are not visible).



The Sociogram

What is new and what is not?

- ▶ Germany is at the center of the sociogram. Why?
- ▶ Why Iceland is more at the center of the network than Ireland is?.
- ▶ Comment the position of the Northern countries.
- ▶ Italy?

The **position of each country** in the network depends on the trading partners it is trading with and their position in the network.

The Netherlands, that is chosen only by Germany, is located at the center of the network, whereas the UK, who is chosen by Ireland and Cyprus, is more peripheric because she is chosen by “less central” countries. A simple count of choices does not reveal this, whereas a sociogram does.

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The Data: The Adjacency matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
United Kin	1.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Austria	2.	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
Belgium	3.	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0
Denmark	4.	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
France	5.	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Germany	6.	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0
Italy	7.	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	8.	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Netherland	9.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Norway	10.	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
Sweden	11.	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Switzerlan	12.	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Finland	13.	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0
Iceland	14.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Ireland	15.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	16.	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Cyprus	17.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Data: The Adjacency matrix

- ▶ The data came from the UN Comtrade database.
- ▶ The information on trade flows (exports) has been enormously reduced.
- ▶ Ranking for each country the number of its trade partners and selecting only the first and the second partner in terms of trade flows we obtain the adjacency matrix reported in the previous slide.

Part II

Application: Visualizing a sociogram in Pajek

The structure of the data (0)

- ▶ In Pajek, a network is defined in accordance with graph theory: a list of vertices and lists of arcs and edges, where each arc or edge has a value.
- ▶ Take a look at the partial listing of the data file for the SW2000 trade partners network (part of the vertices and arcs are replaced by [...]).
- ▶ Open the file SW2000recoded.paj , which you have downloaded from the homepage of this class in a text reader () to see the entire data file.

```
*Network SW2000rec.net
*Vertices      152
   1 "United States"           0.0000    0.0000    0.5000
   2 "United Kingdom"         0.3267    0.6850    0.5000
[...] [...]
 151 "Poland"                  0.0000    0.0000    0.5000
 152 "Romania"                 0.0000    0.0000    0.5000
*Arcs
 1  14  2
 1  15  1
[...]
152  7  2
152  8  1
*Edges

*Partition Regions.clu
*Vertices 152
5
8
[...]
2
2
```

The structure of the data (1)

- ▶ First, the data file specifies the **number of vertices** (152).
- ▶ Then, each vertex is **identified** on a separate line by a serial number, a textual label [enclosed in quotation marks (" ")] and three real numbers between 0 and 1, which indicate the position of the vertex in three-dimensional space if the network is drawn.
 - ▶ The first number specifies the horizontal position of a vertex (0 is at the left of the screen and 1 at the right) and the second number gives the vertical position of a vertex (0 is the top of the screen and 1 is the bottom).
- ▶ The list of vertices is followed by a **list of arcs**. Each line identifies an arc by the serial number of the sending vertex, followed by the number of the receiving vertex and the value of the arc.
- ▶ A **list of edges** is similar to a list of arcs with the exception that the order of the two vertices that identify an edge is disregarded in computations. In this data file, no edges are listed.
- ▶

The structure of the data (2)

- ▶ The graph is fully defined by the list of vertex numbers and the list of pairs of vertices, which defines its arcs and edges.
- ▶ The vertex labels, coordinates, and line values (in italics) specify the additional properties of vertices and lines that make these data a network.
 - ▶ Although this information is extremely useful, it is not required: Pajek will use vertex numbers as default labels and set line values to 1 if they are not specified in the data file. In addition, Pajek can use several other data formats (e.g., the matrix format), which we do not discuss here. They are briefly described in Appendix 1.
- ▶ Please, read ch.1 of the book by de Nooy, Mrvar and Batagelj (2008) and do some practice.

Part III

Exercises:

Visualizing a trade network in Pajek

Visualizing, reducing and selecting

- ▶ Exercise 1 (segmentation). Using SW2000recoded.paj Remove all second choices from the original network:
[Net>Transform>Remove>lines with value> higher than]. Impute 1. Save the new network and plot it. What is the result?
- ▶ Exercise 2 (integration). Using SW2000recoded.paj Remove all first choices from the original network:
[Net>Transform>Remove>lines with value> smaller than]. Impute 2. Save the new network and plot it. What is the result?
- ▶ How can we obtain this summary table?

3. D:\Luca\Università\LEZIONI\Laboratorio di economia internazionale\Networks\Europe.net (17)

Number of vertices (n): 17

	Arcs	Edges
Number of lines with value=1	12	0
Number of lines with value#1	17	0

Total number of lines	29	0

Number of loops	0	0
Number of multiple lines	0	0

Density1 [loops allowed] = 0.1003460

Density2 [no loops allowed] = 0.1066176

Average Degree = 3.4117647

DFS Model: comparative statics

- ▶ Let's now introduce **trade costs**.
- ▶ If melting iceberg transport costs are present. In this event the specialization pattern is as follows: