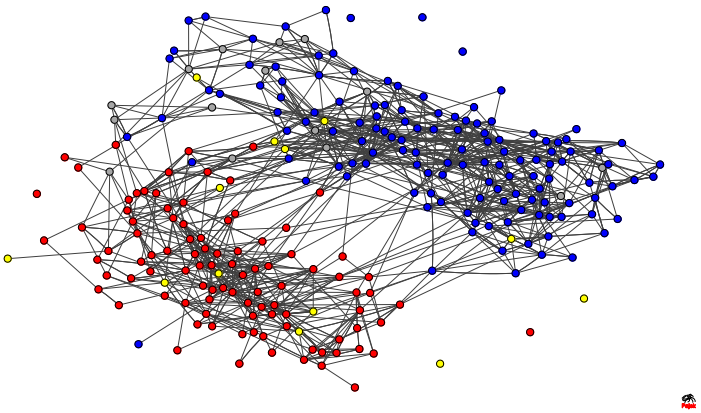
PhD topic course in Social Networks



Teacher: Paolo Pin (paolo.pin@unisi.it)

Hours: 4/6 hours

General outline

You are new in town, and invitations are going on for the party of the year: who should you try to get in contact with, in order to maximize the probability of being invited to the party? It could be very difficult to address directly one of the organizers, but maybe you may get in contact with someone, who knows someone else…

The general economic assumption of completeness is based on anonymity, i.e. the fact that every economic agent has the capability to trade and/or communicate with everyone else. This is not the case in the real world and relaxing this assumption, in many cases, may help in explaining heterogeneity and other biases in the empirical facts.
Whenever we distinguish between existing and non-existing relations we are actually handling an environment which is naturally analyzed with the mathematical tool of *networks*. A network is a structure which characterizes whether or not any two elements of a finite set of *nodes* are connected or not, if they are we call such connection a *link*.
We will consider *social networks*, in the sense that nodes will be economic agents, and with a link we may identify any formal or informal (such as a friendship) relation.

What happens in reality is that economic agents may have a cost in establishing and maintaining links, so that not everyone will be connected to everyone else, and a network structure will form. The shape of the network has been shown to influence outcomes and decision-making, e.g. the probability to find a job, to adopt a new technology, to make an investment decision, to get a career promotion, or to engage in criminal activity. Recently, a new branch of economics, 'network economics', has emerged, which takes the role of network interactions into account.

The purpose of this course is to get the students introduced in this developing field of research, putting emphasis on the interdisciplinarity of the subject, which is now studied also by economists, but has a long history in sociology and in applied physics.
We will analyze some of the following topics, depending on time availability and students' interest: (i) the statistical properties of social networks, introducing mechanical models of network formation; (ii) the effect of a network on the outcome of typical economic problems, applying game theory; (iii) how agents would strategically decide their connections, applying implicitly backward

induction, but also *ad hoc* definitions of equilibrium; and finally (iv) how econometrics should be adapted to deal with this type of environments when analysing real world data.

Papers from economics, but also other disciplines, will be discussed, then exercises will be proposed, based on the theoretical results.

Requirements

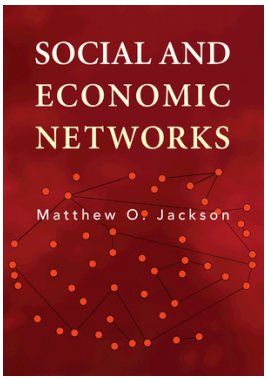
To attend this course you must be familiar with standard micro-economics and with the mathematical analysis needed in simple problems of optimization. The discrete mathematics we will need along the way will be presented in the course.
From the point of view of game theory, even if useful, no special requirement is needed as we will discuss at a non-rigorous level all the definitions that we will need.

Students will be required to read selected chapters from the text-book, but also additional published papers. They will also be asked to fulfil two homework sets, whose grade will be part of the final mark.

An important side-effect of the course should be that of giving the students the capability to approach, read and understand a scientific paper, getting them used to focus on the main points and understand the utility and the implications of a theoretical model. Given the fact that the topic of social networks is still new and growing, analytical tools are very heterogeneous and keep on developing: students should be able to form a critical attitude toward the adoption and applications of mathematical models.

Textbook

M. O. Jackson (2008) “Social and Economic Networks”, Princeton University Press.



Additional material and final papers to be commented will be made available by the teacher.

March 13th 2023