Barcelona GSE Graduate School of Economics

18D029

Networks: Models and Applications

Spring Term - 3 ECTS

Elective Course

Prof. Joan de Martí

Prerequisites to Enroll

Some of the ideas developed in "Networks: Concepts and Algorithms" are going to be used in specific applications. Elements of linear algebra, probability theory, and game theory are strongly recommended.

Overview and Objectives

Nowadays, networks are pervasive and influence many of our decisions and outcomes. We are going to explore models about how networks form (both from a random and incentive point of view), about how they influence individual and aggregate behavior (through, for example, social learning or peer effects, among other kind of influence factors), or about how dynamic processes evolve (like the spread of viruses and information, social revolts,...).

Together with the first part, Networks: Concepts and Algortihms, the two courses on networks provide a multifaceted approach to the study of networks, bringing together concepts, models, algorithms, and tools from graph theory, game theory, sociology, economics, computer science, and statistics, among other areas.

Prerequisite reading

Some basic knowledge of classical concepts, models, and algorithms from networks/graph theory is recommended. Such ideas are covered in the previous course Networks: Concepts and Algorithms.

Course Outline

Individual and Aggregate Behavior in Networks

Peer Effects and the Econometrics of Social Interactions

Network Formation. Incentives and Matching

Socioeconomic Applications

Required Activities

Attendance to theory class and problem sets (that may include theory problems as well as practice with software and data sets).

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Evaluation

60% Problem Sets, 40% Project/Literature Review

Competences

☐ Construct a global vision of the situation of the problem based on knowledge of the synergies between advanced statistical methods, computing and business analysis to generate added value.

☐ Modeling and predicting high-dimensional data with advanced statistical methods in the field of data science in order to improve strategic decision making.

☐ Apply the knowledge of programming languages, computer programs and advanced services in the Cloud to solve the problems that are presented to the data scientist.

☒ Solve the real problems that arise in the fields of study through the accurate analysis of the data.

☒ Communicate with conviction in English the results and implications of the required analytical study using a language related to the receiver.

☐ Work in a heterogeneous team of researchers in the field of the economic analyst using specific group techniques.

☒ Own and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.

☒ That students know how to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

☒ That the students be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, include reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

☒ That the students know to communicate their conclusions and the knowledge and last reasons that sustain them to specialized and non-specialized publics in a clear and unambiguous way.

☒ That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

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Learning Outcomes

☒ Apply mathematical and computational analysis of social, business and economic networks knowing the theory and optimization algorithms.

☒ Apply search algorithms and estimation methodologies in networks through observation of data.

☐ Apply optimization algorithms in business and marketing problems.

☐ Apply learning and optimization methods in marketing environments.

☒ Apply mathematical and statistical analysis using economic theory in complex problems with high-dimensional data.

☒ Apply mathematical theory and statistics on data sets from disparate disciplines.

Materials

Books:

D. Easley and J. Kleinberg, Networks, Crowds, and Markets, Cambridge University Press 2010

Matthew Jackson, Social and Economic Networks, Princeton University Press 2010

Mark Newman, Networks: An Introduction, Oxford University Press 2010

S. Wasserman and K. Faust, Social Network Analysis: Methods and Applications, Cambridge University Press 1994

Barabási, A. L. (2016). *Network science*. Cambridge university press

Zafarani, R., Abbasi, M. A., & Liu, H. (2014). *Social media mining: an introduction*. Cambridge University Press.

Other:

A list of other resources (data sets, papers,...) will be provided as the course progresses.

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