Graph Analysis

Course title – Intitulé du cours	Graph Analysis
Level / Semester – Niveau /semestre	M2 / second semester
School – Composante	Ecole d'Economie de Toulouse
Teacher – Enseignant responsable	Marion Hoffman
Other teacher(s) – Autre(s) enseignant(s)	Marijn Keijzer (practicals)
Other teacher(s) – Autre(s) enseignant(s)	
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Other teacher(s) – Autre(s) enseignant(s)	
Lecture Hours – Volume Horaire CM	18
TA Hours – Volume horaire TD	
TP Hours – Volume horaire TP	
Course Language – Langue du cours	English / Anglais
TA and/or TP Language – Langue des TD et/ou TP	English and French / Anglais et français

Teaching staff contacts – Coordonnées de l'équipe pédagogique :

Email and office: marion.hoffman@tse-fr.eu, TSE/IAST
marijn.keijzer@iast.fr, TSE/IAST

Course Objectives – Objectifs du cours :

Social networks, internet routes, transport systems, biological networks, scientific co-authorship. These are just a few examples of the numerous real-life situations involving relational information, and illustrating how networks are everywhere! Understanding interactions within networks is a challenging and important topic, and so are the practical applications: recommendation systems, viral marketing, epidemics-spreading control, traffic control and optimization.

This lecture aims at giving an introduction to network and graph analysis, where a graph is understood as a mathematical object used to model relations, possibly complex, between entities. After having introduced the formal definition and notations, we will focus on five main topics: How to visualize a graph or a network? How to measure node centrality in a graph? How can we identify communities in graphs? What models can we use to represent random graphs? How to statistically test for specific network patterns?

The lecture is organized into six three-hour sessions. We will alternate between lecture sessions and practical sessions where the different notions and methods will be illustrated using simulated and real-life data, and the existing R libraries.

1. Introduction to networks and graphs, and to graph visualization (lecture)

2. Introduction to networks and graphs, and to graph visualization (practical session)

3. Centralities and graph clustering (lecture)

4. Centralities and graph clustering (practical session)

5. Random graphs and statistical testing (lecture)

6. Random graphs and statistical testing (practical session)

Prerequisites – Pré requis :

Basic knowledge of R and statistics.

Practical information about the sessions – Modalités pratiques de gestion du cours :

Students are expected to attend and actively participate in all lectures.

Grading system – Modalités d'évaluation :

The grading will be based on the participation during the practicals, and on a group project for which students will need to submit a written report.

Bibliography/references – Bibliographie/références :

Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2018). Analyzing social networks. Sage.

Brandes, U. (2005). Network analysis: methodological foundations (Vol. 3418). Springer Science & Business Media.

Carrington, P. J., Scott, J., & Wasserman, S. (Eds.). (2005). Models and methods in social network analysis (Vol. 28). Cambridge university press.

Kadushin, C. (2012). Understanding social networks: Theories, concepts, and findings. Oxford university press.

Jackson, M. O. (2019). The human network: how we're connected and why it matters. Atlantic Books.

Newman, M. (2018). Networks. Oxford university press.

Newman, M., Barabási, A. L., & Watts, D. J. (2011). The structure and dynamics of networks. Princeton university press.