Network Analysis

Academic Year: (2022 / 2023) **Review date: 17-05-2022**

Department assigned to the subject: Statistics Department

Coordinating teacher: GALEANO SAN MIGUEL, PEDRO

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Mathematics for Data Science
Probability
Statistical Inference
Programming in R
Numerical Methods for Data Science
Multivariate Statistics

OBJECTIVES

Competences that the student acquires:

CB6 Possess 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.

CB7 Applications of the acquired knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of ¿¿study.

CB9 Ability to communicate their conclusions and the knowledge and ultimate reasons that sustain them to specialized and non-specialized audiences in a clear and unambiguous way.

CB10 Learn skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

CG1 Ability to apply the techniques of analysis and representation of information, in order to adapt it to real problems.

CG2 Ability to identify the most appropriate statistical model for each real problem and know how to apply it for the analysis, design and solution of it.

CG3 Ability to obtain scientifically viable solutions for complex real statistical problems, both individually and as a team.

CG4 Ability to synthesize the conclusions obtained from these analyzes and present them clearly and convincingly in a bilingual environment (Spanish and English) both in writing and orally.

CG5 Being able to generate new ideas (creativity) and anticipate new situations, in the contexts of data analysis and decision making.

CG6 Apply social skills for teamwork and to relate to others autonomously.

CG7 Apply the advanced techniques of analysis and representation of information, in order to adapt it to real problems.

CE1 Apply in the development of methods of analysis of real problems, advanced knowledge of statistical inference.

CE2 Use free software such as R and Python for the implementation of statistical analysis.

CE9 To correctly identify the type of statistical analysis corresponding to certain objectives and data.

CE10 Apply statistical modeling in the treatment of relevant problems in the scientific field.

Learning results

1. Network analysis.
2. Visualization in networks.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction and preliminaries.
   1.1 Introduction.
   1.2 Examples of networks.
   1.3 Graphs.
   1.4 Families of graphs.
   1.5 The adjacency matrix.
2. Network visualization.
   2.1 Introduction.
   2.2 Network design.
   2.3 Decorating networks.
   2.4 Large networks.
3. Descriptive analysis of networks.
   3.1 Introduction.
   3.2 Characteristics of vertices: centrality, influencers, ...
   3.3 Characteristics of the edges: centrality.
   3.4 Cohesion of networks.
   3.5 Detection of communities in networks.
   3.6 Assortativity.
   3.7 Applications.
4. Models and inference for networks.
   4.1 Introduction.
   4.2 Classical models.
   4.3 Generalized models.
   4.4 Small world models.
   4.5 Applications.
5. Prediction in networks.
   5.1 Introduction.
   5.2 Methods of nearest neighbors.
   5.3 Alternatives.

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities:

Theoretical classes
Practical classes
Tutorials
Team work
Individual work of the student
In-person evaluation tests

Methodology to be used:

Theoretical classes with support material available on the Web.
Problem solving classes. Computational practices in computer rooms. Oral exhibitions

Tutorial regime:

Individual tutorials throughout the course.

ASSESSMENT SYSTEM

Group project (70%)
Conceptual exercises (20%)
Oral presentations (10%)

Extraordinary evaluation similar to the ordinary one.

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

BASIC BIBLIOGRAPHY

- Albert László Barabási Network Science, Cambridge University Press, 2016
- Erci D. Kolaczyk Statistical Analysis of Network Data, Springer, 2009