

Academic Year/course: 2022/23

25209 - Statistics

Syllabus Information

Academic Year: 2022/23

Subject: 25209 - Statistics

Faculty / School: 201 - Escuela Politécnica Superior

Degree: 571 - Degree in Environmental Sciences

ECTS: 6.0

Year: 2

Semester: First Four-month period

Subject Type: Basic Education

Module:

1. General information

1.1. Aims of the course

The main aim of this course is that at the end of the course the student be able:

- To realize the situations and problems where the potential use of Statistics can be helpful or is required, in particular in the area of the Environmental Sciences.
- To know and to handle basic probability and statistical concepts and language.
- To know and to use basic probability and statistical tools to solve problems.
- To be proficient in the use of some basic statistical techniques. In particular to:
- Analyse environmental data
- Read and present the statistical results of the analysis

Goal 4: Quality Education.

o Target 4.4: By 2030, significantly increase the number of young people and adults who have the necessary skills, particularly technical and vocational, to access employment, training and skills, to access employment, decent work, and entrepreneurship.

Goal 7: Affordable and clean energy.

o Statistics is the main tool for assessing energy policies, as well as their effects on society. It is also a fundamental element in the research of new energy sources.

Goal 8: Decent work and economic growth.

o The skills and knowledge acquired through statistics have become a fundamental requirement or prerequisite for access to jobs in the field of science. In addition, statistics is not only a requirement, but it is also transforming high-skilled jobs and creating new job opportunities.

Objective 9: Industry, innovation and infrastructure.

o The correct and appropriate use of statistics is the cornerstone of innovation in the present and future.

As one of the many consequences of this of this fact, it is worth noting that statistics is one of the key pillars in the establishment of new industries and infrastructure, when it comes to establishing new industries and infrastructures.

Objective 13: Climate action.

During the course of the course, we work with real data, some of them of a climatic nature, in line with Goal 13 and more particularly with target 13.3.

o Target 13.3: Improve education, awareness and human and institutional capacity for climate change mitigation. institutional capacity with respect to climate change mitigation, adaptation, mitigation of its effects and early warning, mitigation and early warning.

In addition, it should be noted that all the training provided in this subject (theoretical and practical) contributes transversally to the AGENDA 2030 and SDGs, since its training enables the student to contribute to the development and to contribute to the development and management of the 245 SDG indicators proposed by UNEP.

UNEP.

1.2. Context and importance of this course in the degree

There is no doubt that statistical literacy is an ability that to some extent is needed nowadays along most professional

careers in modern societies. Nevertheless, for those whose aim is to develop a professional career in environmental sciences, statistics is an essential tool given the complexity of the qualitative and quantitative analysis the environmental data requires. From data observation to the implementation of a quantitative model to predict an environmental phenomenon the multivariate nature of information and its spatio-temporal occurrence and variability requires deep statistical tools and careful analysis before any conclusion be reached. The aim of this course is to introduce the basic techniques, concepts and methodology to set a grounded knowledge that will enable the student to further deepen in the statistical tools the environmental phenomena require.

1.3. Recommendations to take this course

While the contents of the course will be developed in a very simple and straight forward way, and it does not require more than some basic mathematics, some knowledge about integration, series summation and matrices would be desirable to get a wider knowledge or to deepen in the concepts addressed during the course.

2. Learning goals

2.1. Competences

When the student overcomes the course tests he will be better at

- Using the probabilistic and statistical language to express uncertainty and/or likelihood.
- Performing descriptive analysis of environmental data.
- Using inference analysis to take decisions.
- Explaining and presenting the results of the analysis

2.2. Learning goals

At the end of the course, the student will be able to:

- Handle a statistical software to summarize numerically and graphically the information in data.
- Use probabilistic language to express uncertainty and/or likelihood regarding events.
- Use statistical language to summarize and present most significant results regarding data analysis.
- Recognize and deal with basic distributions to compute probabilities.
- Use basic Inferential tools to answer questions regarding data.
- Work in a team to perform an analysis, writing a final report presenting it in public, arguing about its content.

2.3. Importance of learning goals

As has been said, Environmental Sciences are complex in nature, randomness and non determinism is present in almost all environmental phenomena. In this way, all these learning goals are truly relevant for the environmental scientist.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

To evaluate the student's degree of achievement of the goals, the student has to pass

Written tests (WT) that covers all the material explained during the two main parts of the course, the first one being Descriptive Statistic and Probability and the second one being Statistical Inference. Each WT has a weight of 35%. In order to pass these tests, the student must obtain a grade of at least 4 (out of 10) in each of them.

An assignment (A) which consist in the analysis of a dataset related to an environmental phenomenon and the elaboration of the report of such analysis. This A has a weight of 30%. In order to pass this assignment the student must obtain a grade of at least 5 (out of 10).

While these tests can be passed in two main calls whose dates are published by the EPS and the assignment has to be submitted to the teacher in advance to any of these dates, to make the assessment process easier, and in some sense progressive or continuous in some sense, the student may optionally choose to do two tests covering each half of the material and/or a guided assignment instead of the regular assignment.

The final grade is the addition of the written test part (WT) and the assignment part (A). In order to pass the course the student must obtain a final grade of at least 5 points out of 10. The students who do not reach the minimum required, either in WT or in A, they will have as a final grade Fail and as a numerical grade the minimum between 4.5 and 4.5. final grade Failed and as numerical grade the minimum between 4.5 and the final grade.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, laboratory sessions, tests and assignments.

The main methodological tools to be used along the course will be lectures which will take place in class and the laboratory sessions at the Computer Lab. While the lectures will be more expository no matter which the topic is a theoretical content or just an example of the use of a technique, the practice sessions will consist basically on the elaboration of examples and problems by the student with the help of the teacher.

4.2. Learning tasks

This course is organized as follows:

- Lectures.
- Laboratory sessions.
- Written tests.
- Assignment elaboration.
- Report elaboration and oral presentation.

4.3. Syllabus

This course will address the following topics:

Section I: Introduction to statistics

- **Topic 1.** The course. Introduction to Statistics Analysis of environmental data.
- **Topic 2.** Fundamental concepts of Statistics. Population and Sample. Types of variables, Sample, Sampling.

Section II: Descriptive statistics

- **Topic 3.** Numerical summaries for one-dimensional variables.
- **Topic 4.** Graphical summaries for one-dimensional variables
- **Topic 5.** Numerical summaries and graphs for two-dimensional variables.
- **Topic 6.** Some specific problems: Atypical Data, Biased Data.

Section III: Probability

- **Topic 7.** Introduction to Probability.
- **Topic 8.** Random Variables.

Section IV: Statistical inference

- **Topic 9.** Introduction to statistical Inference.
- **Topic 10.** Point and interval estimation.
- **Topic 11.** Hypothesis Testing.
- **Topic 12.** Other statistical tests.

Section V: Other statistical techniques

- **Topic 13.** Simple Linear Regression. ANOVA, Linear Model.

4.4. Course planning and calendar

Lectures: 30 h. Problem solving: 15 h.
Resolution of practical cases with specific software: 15 h.
Tutorized work: 20 hours.
Personal study: 64 h.
Evaluation activities: 6 h.

The course divides its 6 credits in 3 ECTS in a complete group of theory exposition and examples-types that motivate its usefulness in the field of Environmental Sciences. The other 3 ECTS are aimed at developing skills in the approach (modeling) and resolution of problems that resemble real situations, divided into 15 hours of practice with statistical software and another 15 in a blackboard classroom.

Towards the middle of the course there will be a written test consisting of solving theoretical-practical questions and problems related to the subject taught in modules 2 and 3 of Probability and Descriptive Statistics. At the end of the semester there will be a similar test related to the inference modules (4 and 5).

The skills in exploratory analysis, decision making in situations of uncertainty and optimization will be evaluated complementarily with proposed activities or a report in the case of students who opt for the global evaluation, where a good part of the statistical techniques studied throughout the course will be applied with the appropriate software.

4.5. Bibliography and recommended resources

- BB** Devore, Jay L. Probabilidad y estadística para ingeniería y ciencias / Jay L. Devore. 7ª ed. Mexico [etc] : Cenange Learning, cop. 2008
- BB** Estadística básica con R y R-Commander / autores, A. J. Arriaza Gómez ... [et al.]. 1ª ed. Cádiz : Servicio de Publicaciones de la Universidad de Cádiz, 2008
- BB** Manly, Bryan F. J. Statistics for Enviromental Science and Management / Bryan F. J. Manly. 2nd. ed. Boca Raton (Estados Unidos), etc. : CRC Press, cop. 2009
- BB** Ugarte, María Dolores. Probability and statistics with R / María Dolores Ugarte, Ana F. Militino, Alan T. Arnholt. Boca Raton [etc.] : CRC Press, cop. 2008

LISTADO DE URLs:

Estadística básica con R y R-Commander
[<http://knuth.uca.es/moodle/course/view.php?id=37>]

The updated recommended bibliography can be consulted in:<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=25209>