Universidad Zaragoza

Year : 2019/20

25209 - Statistics

Syllabus Information

Academic Year: 2019/20
Subject: 25209 - Statistics
Faculty / School: 201 -

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

According to what has been previously said, 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:

Analise environmental data
Read and present the statistical results of the analysis

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

A 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 with a duration of about four hours and both will be developed in the Computer Lab.

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.

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. If the student chooses one these options or both, then:

- Each Evaluation Test will be written, with a duration of two hours and both will be developed in the Computer Lab. The student should answer a series of questions regarding the Descriptive Statistics and Probability topics in the first one (WT1) and Statistical Inference in the second one (WT2). The first of these tests will be done at the middle and at the end of the course. If the student does not pass (grade less than 3.5) one (or both) of these test he can do it at any of the main calls.

- The Guided Assignment (GA) will be developed by groups of 4 or 5 students, which must explicitly agree to develop this guided work in due time. This optional guided assignment will be worked up during the course answering a series of questions about a given dataset. At the end, the group of students should elaborate a brief report using those answers and this report should be presented and discussed with other students. If a group of students fails to pass the guided assignment all members have to present a regular assignment at any of the calls mentioned above.

Regarding grading:

- Any of the written test (WT, WT1 and WT2) will be graded between 0 and 7. To pass any of these a grade larger than 3.5 is required.

- The assignment (A, GA) will be graded between 0 and 3. To pass any of these a grade larger than 1.5 is required.

The final grade is the addition of the written test part (WT) and the assignment part (A). In case the student chose the two written tests option the grade of the written tests part will be the average of the written tests ((WT1+WT2)/2).

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 expositive 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.
- **Practice 1**. Introduction to R: CRAN, installation, main elements. (1/2 Sess.).

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.
- **Practice 2.** Exploratory data analysis. (3 and 1/2 Sess.).

Section III: Probability

- **Topic 7.** Introduction to Probability.
- **Topic 8.** Random Variables.
- **Practice 3.** Probability calculations with R. (3 Sess.).

Section IV: Statistical inference

- **Topic 9.** Introduction to statistical Inference.
- **Topic 10.** Point and interval estimation.
- **Topic 11.** Hypothesis Testing.
- **Topic 12.** Some other tests.
- **Practice 4.** Simulation. Sampling distribution (1 Sess.)
- **Practice 5.** Point and Interval estimation. (1 Sess.)
- **Practice 6.** Hypothesis tests. (2 Sess.)
- **Practice 7.** Nonparametric tests. (1 Sess.)

Section V: Other statistical techniques

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

4.4.Course planning and calendar

- **1st. Week: Sept., 20th and 21st**
    - Theory: Topic 1 y Topic 2.
    - Lab: Introduction to R and Exploratory data analysis.
    - Assignment: Group Formation and assignment data presentation.
- **2nd. Week: Sept., 27th y 28th**
    - Theory: Topic 3 y Topic 4.
    - Lab: Exploratory data analysis (1st part).
- **3rd. Week: Oct., 4th and 5th**
    - Theory: Topics 4, 5 y 6.
    - Lab: Exploratory data analysis (2nd part)
    - Assignment: 1st task
- **Tuesday Oct. 17th (Thursday timetable)**
    - Theory: Topic 7.
    - Lab: Exploratory data analysis.
- **4th. Week: Oct., 18th and 19th**
    - Theory: Topic 7 y Topic 8.
    - Lab: Probability calculations with R
    - Assignment: 2nd task.
- **5th. Week: Oct., 25th and 26th**
    - Theory: Topic 8.

    - Lab: Probability calculations with R
- **Monday Nov. 6th**
    - Theory: Topic 9.
    - Lab: Review.
    - Assignment: 3rd. task.
- **6th. Week: Nov., 8th and 9th**
    - Theory: Topic 10.
    - Lab: First Written test (WT1).
- **7th. Week: Nov., 15th and 16th**
    - Theory: Topic 11.
    - Lab: Point and Interval estimation.
    - Assignment: 4th task.
- **8th. Week: Nov., 22th and 23th**
    - Theory: Topic 11.
    - Lab: Hypothesis Testing (1st part).
    - Assignment: 3rd task.
- **9th. Week: Nov., 29th and 30th**
    - Theory: Topic 11.
    - Lab: Hypothesis Testing (2nd part).
- **10th. Week: Dec., 13th and 14th**
    - Theory: Topic 12.
    - Lab: Hypothesis Testing (3rd part).
    - Assignment: 4ta task.
- **11th. Week: Dec., 20th and 21th**
    - Theory: Topic 13.
    - Lab: Nonparametric test.
    - Assignment: Submit reports.
- **12th. Week: Jan. 2018, 10th and 11th**
    - Theory: Review Theory
    - Lab: Review Lab
    - Assignment: Report presentation.

An activity calendar can be find in section 5.4 (Course planning and calendar). The examination tests dates will be published in http://www.unizar.es/centros/eps.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website and Moodle.

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://psfunizar7.unizar.es/br13/egAsignaturas.php?codigo=25209&Identificador=C70902