

**COURSE DATA****Data Subject**

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| Code | 34177 |
| Name | Statistical modelling |
| Cycle | Grade |
| ECTS Credits | 6.0 |
| Academic year | 2019 - 2020 |

Study (s)

| Degree | Center | Acad. year | Period |
|------------------------------|------------------------|-------------------|---------------|
| 1107 - Degree in Mathematics | Faculty of Mathematics | 4 | Second term |

Subject-matter

| Degree | Subject-matter | Character |
|------------------------------|---|------------------|
| 1107 - Degree in Mathematics | 17 - Models of statistics and operations research | Optional |

Coordination

| Name | Department |
|--------------------------|---|
| AYALA GALLEGU, GUILLERMO | 130 - Statistics and Operational Research |

SUMMARY

This course aims to give an overview of how to perform a complete statistical analysis, specifically how to perform previously the most essential part correctly modeling the situation to be studied and the selection of the best model that fits the data analyzed.

To do so, the basics of modeling and the most important techniques available to perform the appropriate statistical analysis are introduced. The course describes with more detail those concepts of statistical inference previously introduced on the first year course on "Basic Statistics". It will also make use of the basic concepts and techniques of estimation (point and confidence intervals) and contrast hypothesis presented in the course of "Mathematical Statistics" (third year of the degree).



PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Have studied the subjects of Basic Statistics (1st year of the degree), Probability (2nd year) and Statistics Mathematics (3rd year).

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1107 - Degree in Mathematics

- Learn autonomously.
- Adapting to new situations.
- Apply the knowledge in the professional world.
- Argue logically in decision-making.
- Expressing mathematically in a rigorous and clear manner.
- Reason logically and identify errors in the procedures.
- Capacity of abstraction and modeling.
- Participate in the implementation of software and learn mathematical software.
- Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.
- Visualize and interpret the solutions obtained.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

- Formulate and solve problems of various types using statistical models.
- Learn to assess the conditions of application of statistical models.
- Use statistical analysis software.
- Correctly interpret the results provided by statistical packages.

DESCRIPTION OF CONTENTS



1. Introduction to Statistical Modeling

- 1.1 Basics.
- 1.2 Response and explanatory variables. Factors. Types of effects.
- 1.3 Explanatory variables: continuous.
- 1.4 Linearity.
- 1.5 Basic models.
- 1.6 Introduction to R.

2. Regression models

- 2.1 Simple linear regression model.
- 2.2 Multiple linear regression model.
- 2.3 Model validation.
- 2.4 Variable selection.
- 2.5 Predicting.

3. Experimental Design

- 3.1 One way ANOVA.
- 3.2 Two way ANOVA.
- 3.3 Multiple comparisons.
- 3.4 Analysis of covariance.

4. An introduction to categorical data analysis

- 4.1 Estimating and comparing proportions.
- 4.2 Contingency tables.
- 4.3 Independency and homogeneity test.
- 4.4 Fisher's test.

5. Generalized lineal model

- 5.1 General linear model as a generalized linear model.
- 5.2 Generalized lineal model.
- 5.3 Bernoulli, Poisson and Negative binomial responses.
- 5.4 Model validation.
- 5.5 Variable selection.



6. Other models

6.1 Local regression.

6.2 Nonlinear models.

6.3 Spatio-temporal models.

WORKLOAD

| ACTIVITY | Hours | % To be attended |
|--|---------------|------------------|
| Theory classes | 37,50 | 100 |
| Computer classroom practice | 15,00 | 100 |
| Other activities | 7,50 | 100 |
| Attendance at events and external activities | 2,00 | 0 |
| Development of group work | 10,00 | 0 |
| Development of individual work | 10,00 | 0 |
| Study and independent work | 20,00 | 0 |
| Preparation of evaluation activities | 20,00 | 0 |
| Preparing lectures | 10,00 | 0 |
| Preparation of practical classes and problem | 10,00 | 0 |
| Resolution of case studies | 8,00 | 0 |
| TOTAL | 150,00 | |

TEACHING METHODOLOGY

The teacher will introduce and develop the content of each topic in the lectures. In the practical classes, concepts presented in the lectures will be apply using statistical software. Students will be proposed to solve homeworks requiring the use of the techniques learned in lectures.

EVALUATION

The evaluation of the learning of the knowledge and competences achieved by the students will be done continuously throughout the course, and will consist of the following evaluations method:

a) **Evaluation of participation in the practical sessions.** This evaluation will represent 40 % of the grade and will be based on the completion of questionnaires. These questionnaires will be made during the course and on the same day of the theoretical exam the last of them will take place. All of them will be used for the evaluation of the practices.



b) **Evaluation of the knowledge acquired.** It will consist of a theoretical examination with questions, where the resolution of the same may require the interpretation of different results presented in the standard form of the statistical software used during the course. This evaluation will represent 60% of the final grade. To pass the subject, it will be necessary to obtain a grade equal to or greater than 5 points (out of 10) of this exam.

The grades obtained in (a) will be kept in the two calls of the academic year in which they were made. Its qualification is not recoverable, since its evaluation is only possible in the teaching period.

REFERENCES

Basic

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Referència b1: Faraway, J. J. Linear Models with R, Second Edition (Chapman & Hall/CRC Texts in Statistical Science) Chapman and Hall/CRC, 2016

Referència b2: Faraway, J. J. Extending the Linear Model with R . Taylor & Francis, 2016

Referència b3: Agresti, A. Categorical Data Analysis Wiley-Interscience, 2013

Additional

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Referència c1: Agresti, A. Foundations of Linear and Generalized Linear Models John Wiley & Sons Inc, 2015

Referència c2: Sheather, S. J. A Modern Approach to Regression with R . Springer,

Referència c3: Christian Ritz, J. C. S. Nonlinear Regression with R . SPRINGER VERLAG GMBH, 2008

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contents

The contents initially collected in the teaching guide are maintained.

2. Workload and time planning

The dates and timetable of the face-to-face classes are maintained, replacing them with synchronous teaching using the BBC.

The number of online questionnaires initially planned increases.

The realization of a practical work that will be delivered the same day of the theoretical exam is added. Later, the student will meet the teacher using the BBC to explain him the work done. The teacher may ask questions about it. These questions will be used for the evaluation of the work.



On the day of the theoretical exam, a special questionnaire will be carried out with greater difficulty and duration.

3. Teaching methodology

The student already has a manual with the development of the subject in Virtual Classroom from the beginning of the semester. More problems and details are added as a consequence of the situation. Beamer presentations will be available for theory classes on the BBC.

These theoretical classes on the BBC are recorded with the possibility of being downloaded.

The practical classes at BBC consist of carrying out practical exercises to analyze real data using linear and generalized linear models. The performance of more theoretical exercises has had to be reduced. The practical exercises are solved by the teacher together with the students in the BBC synchronous sessions. The code and results that are generated are later incorporated into the manual so that they have the most organized material.

It is essential that they be done online. The practical sessions are recorded and can be downloaded later.

4. Evaluation

More importance to questionnaires and practical work is given.

The weight of questionnaires is 70% and practical work is 30%.

Within the 70% of the questionnaires, the one carried out by the exam has a weight of 30% and the rest distributes the remaining 40% with the same weight for each of the questionnaires evaluated during the continuous evaluation process.

5. Bibliography

Maintained since it is available.