Universitat Autònoma de Barcelona

2019/2020

Statistics in the Health Sciences

Code: 104873
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	OB	3	1

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Other comments on languages

Tot el material didàctic és en anglès

Prerequisites

The student is supposed to be familiar with the binomial and the normal distributions, as well as with R.

Objectives and Contextualisation

The main aims of the course are:

- Learn about the main types of study designs in the field of Epidemiology.

- Learn about the potential impact of both missing data and error measurement on the results of a statistical analysis.

- Learn about the main indicators to measure the presence of a disease or an exposure.

- Learn about the main indicators to measure the association between exposure and disease, specially in the case where both exposure and outcome are binary.

- Be able to identify the appropriate statistical tools for the assessment of the association between a given exposure (potential risk or protective factor) and a given health outcome, according to the characteristics of the study design, in the context of epidemiological studies.

- Learn about the design and implementation of an exact test according to the study design.

- Learn about the design and implementation of simulation studies related to concepts such as empirical power or sample size calculation.

- Be able to search scientific papers using PubMed efficiently.

- Get familiar with the reading of scientific papers.

- Be able to apply the concepts studied in the subject to solve exercises based in true epidemiological data.

- Improve the efficiency when programming in R to solve the practical tasks proposed during the course.

- Be able to write reproducible statistical reports using LaTeX and the R package knitr.

Competences

- Analyse data using statistical methods and techniques, working with data of different types.
- Correctly use a wide range of statistical software and programming languages, choosing the best one for each analysis, and adapting it to new necessities.
- Critically and rigorously assess one's own work as well as that of others.
- Formulate statistical hypotheses and develop strategies to confirm or refute them.
- Identify the usefulness of statistics in different areas of knowledge and apply it correctly in order to obtain relevant conclusions.
- Interpret results, draw conclusions and write up technical reports in the field of statistics.
- Make efficient use of the literature and digital resources to obtain information.
- Select statistical models or techniques for application in studies and real-world problems, and know the tools for validating them.
- Select the sources and techniques for acquiring and managing data for statistical processing purposes.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Use quality criteria to critically assess the work done.
- Work cooperatively in a multidisciplinary context, respecting the roles of the different members of the team.

Learning Outcomes

1. Analyse data corresponding to epidemiological studies or clinical trials.
2. Carry out the most suitable sampling for epidemiological studies.
3. Critically assess the work done on the basis of quality criteria.
4. Design and conduct hypothesis tests in the different fields of application studied.
5. Draw conclusions that are consistent with the experimental context specific to the discipline, based on the results obtained.
6. Draw up technical reports that clearly express the results and conclusions of the study using vocabulary specific to the field of application.
7. Identify the most commonly statistical inference techniques used in epidemiology studies.
8. Interpret statistical results in applied contexts.
9. Justify the choice of method for each particular application context.
10. Make effective use of references and electronic resources to obtain information.
11. Reappraise one's own ideas and those of others through rigorous, critical reflection.
12. Recognize the importance of the statistical methods studied within each particular application.
13. Recognize the most commonly used databases in the Health Sciences.
14. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
15. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
16. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
17. Use different programmes, both open-source and commercial, associated with the different applied branches.
18. Work cooperatively in a multidisciplinary context, accepting and respecting the roles of the different team members.

Content

ii. Some bias sources

(c) Examples of the the impact of measurement error

7. Measures of disease presence

(a) Introduction

(b) Prevalence

i. Definition

ii. Estimation

iii. Comments

(c) Cumulative incidence

i. Definition

ii. Comments

(d) Incidence rate

i. Definition

ii. Comments

iii. Comparing two incidence rates

8. Measures of association between exposure and disease

(a) Introduction

(b) The relative risk

i. Definition

ii. Comments

(c) The odds ratio

i. The odds

ii. The odds ratio

iii. Comments

(d) Confidence intervals for OR and RR

(e) The attributable risk

i. Population attributable risk

ii. Exposure attributable risk

9. Causality, confusion and interaction

(a) Introduction

(b) Causality

(c) Confusion

(d) Interaction

10. Decision making: hypothesis testing

(a) Introduction

(b) Stating a hypothesis testing

(c) Type I and type II errors

(d) Decision and errors

(e) Statistical significance. The p-value

(f) The p-value as a decision tool

11. Power and sample size

(a) Concept of power

(b) Comparisons

i. Of two proportions (prevalences or risks)

ii. Of two rates

iii. Of two odds

(c) Introduction to sample size estimation based on empirical power

Methodology

- Theory sessions: In these sessions, the different concepts of the subject as well as illustrative examples are introduced. Also, some exercises are proposed to be solved (usually requiring R usage). The methodology is based in the presentation and discussion of slides as well as the presentation of some additional materials (mainly news published in online media and scientific papers searched in PubMed).

- Practice sessions: In these sessions, several practical examples and exercises will be proposed. Activities related to R usage, PubMed search, papers reading and statistical analyses will be developed. Some of the proposed exercises will be mandatory.

- Seminars attendance: The Department of Mathematics and the UAB Statistical Service organize statistical seminars. The students and the teacher would attend some of them, depending on the topic and the schedule.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory sessions	28	1.12	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10
Type: Supervised			
Practice sessions	28	1.12	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10
Type: Autonomous			

Personal work	94	3.76	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10

Assessment

- Personal assignments during the course

- Exam (face-to-face)

- Optional compensatory exam (face-to-face). If the student attend the compensatory exam, its qualification will substitute the score in the previous, ordinary exam, regardless of the score obtained in the compensatory exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam (or compensatory exam)	40%	0	0	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10
Personal assignments	30%	0	0	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10
Personal exercises	30%	0	0	1, 11, 3, 4, 6, 5, 2, 7, 8, 9, 16, 14, 15, 12, 13, 18, 17, 10

Bibliography

Basic: All concepts developed in the class sessions will be published at Moodle, including the slides that will be discussed in the theory sessions.

Further readings: Students interested in going further can explore the following items.

- Agresti, Alan. Categorical Data Analysis. Wiley, 3rd Edition, 2013.

- Breslow, N., N. Day. Statistical methods in cancer research. International Agency for Research on Cancer, 1980.

- Clayton D., Hills, M. Statistical models in epidemiology. Oxford University Press, 1993.

- Dalgaard, P. Introductory Statistics with R. Springer, 3rd Edition, 2002.

- dos Santos, I. Cancer epidemiology: principles and methods. International Agency for Research on Cancer, 1999.

- Gordis, L. Epidemiology. W.B. Saunders, 2004.

- Lachin, J.M. Biostatistical Methods: The Assessment of Relative Risks. Wiley, 2000.

- Motulsky, H.J. Intuitive Biostatistics. Oxford University Press, 1995.

- Rothman, K., Greenland, S. Modern epidemiology. Lippincott Williams & Wilkins, 1998.

- Rothman, K. Epidemiology: an introduction. Oxford University Press, 2002.

- Wassertheil-Smoller, S. Biostatistics and epidemiology: a primer for health and biomedical prefessionals. Springer, 3rd Edition, 2004.