UAB
Universitat Autònoma de Barcelona

Biostatistics and Data Analysis

2026/2027

Code: 101917
Credits: 6

Degree programme	Type	Course
Biomedical Sciences	FB	1

Contact lecturer

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Group languages

You can consult this information at the end of the document.

Prerequisites

There are no official prerequisites; however, prior knowledge of elementary mathematics, including the concepts of differentiation and integration, is recommended.

Objectives

Biostatistics and Data Analysis aims to provide students with the fundamental knowledge and tools required for the design, analysis and interpretation of data in the field of biomedical research, in accordance with the principles of the scientific method.

The course addresses research-related problems in the fields of Biology and Medicine through the application of statistical and probabilistic methods to biomedical research. This approach enables the precise quantification of significant relationships among the various phenomena related to health and human disease, as well as the assessment of the uncertainty inherent in biological and clinical processes.

To achieve these objectives, students will work with a variety of conceptual, methodological and instrumental tools that will enable them to develop a critical understanding of biomedical data and to interpret research findings in accordance with scientific rigor.

Learning outcomes

- CM14 (Evaluate biomedical processes, taking into account an appropriate experimental design.) Evaluate biomedical processes, taking into account an appropriate experimental design.
- CM15 (Evaluate diagnostic tests using sensitivity, specificity and predictive values.) Evaluate diagnostic tests using sensitivity, specificity and predictive values.
- CM16 (Estimate the existence of gender/sex-based inequalities using mathematical models and statistical analysis.) Estimate the existence of gender/sex-based inequalities using mathematical models and statistical analysis.
- KM19 (Describe the basic statistical concepts and techniques for analysing biological data and apply the fundamentals of statistics and experimental design.) Describe the basic statistical concepts and techniques for analysing biological data and apply the fundamentals of statistics and experimental design.
- KM20 (Calculate the sample size needed to test a hypothesis.) Calculate the sample size needed to test a hypothesis.
- SM17 (Manage digital tools, scientific literature and online resources for statistical analysis and experimental design in the field of biomedicine.) Manage digital tools, scientific literature and online

resources for statistical analysis and experimental design in the field of biomedicine.
- SM18 (Interpret the results of statistical tests.) Interpret the results of statistical tests.

Contents

UNIT 1. INTRODUCTION

1.1. Definition and objectives of Statistics

1.2. Population and sample

1.3. Descriptive statistics, probability theory and statistical inference

UNIT 2. MONOVARIANT DESCRIPTIVE STATISTICS

2.1. Qualitative variables and discrete quantitative variables. Absolute, relative and cumulative frequencies. Graphical representations

2.2. Continuous quantitative variables. Data grouping: frequency tables. Graphical representations. Measures of central tendency: mean, median and mode. Measures of dispersion: range, variance, standard deviation and coefficient of variation. Measures of shape: skewness and kurtosis

UNIT 3. BIVARIATE DESCRIPTIVE STATISTICS

3.1. Relationship between two qualitative variables. Relationship between a qualitative variable and a continuous quantitative variable. Relationship between two continuous quantitative variables (correlation coefficient)

3.2. Introduction to paired data (repeated measurements)

UNIT 4. PROBABILITY THEORY

4.1. Random experiment, sample space and event

4.2. Operations with events: union, intersection, complementary events and difference of events. Mutually exclusive events

4.3. Absolute and relative frequencies. Probability

4.4. Conditional probability. Independent events. Probability of the union and intersection of events

4.5. Bayes' theorem

4.6. Measurement of disease frequency in a population. Incidence and prevalence

4.7. Evaluation of diagnostic tests. Sensitivity, specificity, predictive values and the influence of prevalence. Determination of cut-off points. ROC curves and area under the curve (AUC)

4.8. Evaluation of risk factors and measures of association. Relative risk (RR) and odds ratio (OR)

UNIT 5. RANDOM VARIABLES

5.1. Discrete and continuous random variables

5.2. Probability density function and distribution function. Expected value and variance of discrete and continuous random variables

5.3. Theoretical distributions of discrete random variables: Binomial and Poisson distributions

5.4. Theoretical distributions of continuous random variables: Normal, χ^2 and Student's t distributions

5.5. Sampling distributions. Central Limit Theorem. De Moivre theorem. Probability intervals

UNIT 6. PARAMETER ESTIMATION

6.1. Estimation methods: confidence intervals. Differences between probability intervals and confidence intervals

6.2. Estimation of population means, variances and proportions. Determination of sample size

UNIT 7. HYPOTHESIS TESTING

7.1. Null and alternative hypotheses. Rejection and non-rejection regions. Type I error (α risk) and Type II error (β risk). One-sided and two-sided tests. Significance level. Determination of sample size

7.2. Goodness-of-fit tests: tests of sample means, variances and proportions against population parameters

7.3. Tests for comparisons between independent samples: comparisons of means, variances and proportions. Fisher-Snedecor F distribution. Kolmogorov-Smirnov test. Non-parametric comparison of two samples: Mann-Whitney test

7.4. Hypothesis testing for paired data. Wilcoxon signed-rank test

UNIT 8. RELATIONSHIP BETWEEN QUANTITATIVE AND QUALITATIVE VARIABLES: ANALYSIS OF VARIANCE (ANOVA) AND REGRESSION

8.1. One-way ANOVA. A priori and a posteriori tests

8.2. Regression: least squares method, significance of the regression line and confidence intervals for population parameters. Linearity and usefulness tests

UNIT 9. RELATIONSHIP BETWEEN TWO RANDOM QUANTITATIVE VARIABLES: CORRELATION

9.1. Correlation coefficient. Significance of the correlation coefficient. Comparison between regression and correlation

UNIT 10. RELATIONSHIP BETWEEN QUALITATIVE VARIABLES: FREQUENCY ANALYSIS

10.1. Goodness-of-fit tests for frequency distributions against theoretical distributions

10.2. Contingency tables. Homogeneity and independence tests

10.3. McNemar test for paired data

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Completion of self-assessment activities	10	0.4	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Lectures	28	1.12	CM14, CM15, CM16, KM19, KM20, SM18
Practical session quizzes	7	0.28	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Practical classes	16	0.64	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Problem-solving seminars	8	0.32	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Personal study	42	1.68	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Completion of exercises	24	0.96	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Consolidation practical sessions	3	0.12	CM14, CM15, CM16, KM19, KM20, SM17, SM18

Lectures

The lectures will combine the presentation of the fundamental concepts by the teaching staff with activities aimed at fostering student participation and interaction. The sessions will be supported by audiovisual resources, and all teaching materials used in class will be made available through the Virtual Campus. Students are encouraged to have access to these materials during the sessions, either in printed or digital format, in order to facilitate note-taking and the follow-up of the explanations provided in class.

In addition to the activities carried out during class, students will be encouraged to deepen their understanding of the subject through the use of the recommended bibliography, digital resources, and simulation software related to the course contents.

Problem-Solving Sessions (Seminars)

Given the applied nature of the course, problem-solving sessions (seminars), coordinated with the lecture schedule, will play a central role in the learning process.

Collections of problems organized according to the different topics of the course will be made available through the Virtual Campus. These problems will be addressed both during class and through independent study and will mainly consist of practical cases related to the biomedical sciences. Their resolution will help students consolidate theoretical knowledge, develop analytical skills, and improve their ability to correctly interpret statistical results.

Interactive response tools (such as Kahoot) will also be used during the problem-solving sessions, both collectively and individually, to reinforce learning, promote active participation, and provide formative assessment of students' understanding of the course contents.

In addition, self-assessment quizzes developed in Moodle will be available through the Virtual Campus. These quizzes will allow students to reinforce their learning, practice the concepts covered in the course, and independently assess their level of achievement of the intended knowledge and competencies. Immediate feedback will be provided to help students identify areas requiring further study.

The final seminars will focus on the resolution of comprehensive cases integrating the different topics covered throughout the course. These activities will be based on questions similar to those used in previous examinations and will require students to critically interpret statistical results and software outputs, as well as to apply jointly the concepts acquired during the course.

Practical Sessions

Practical sessions constitute an essential component for achieving the learning objectives of the course. Students will solve previously selected practical cases using statistical software. Learning activities will include data entry and management, as well as the application of the main statistical techniques covered throughout the course.

The practical activities have been designed around biomedical case studies and will focus on problem-solving and the interpretation of results. They will enable students to develop competencies related to the selection of appropriate statistical procedures, data analysis, and the critical interpretation of results, always in connection with the theoretical concepts covered in the course.

Activities will be carried out individually or in pairs, depending on the characteristics of each practical session. In addition, the practical sessions corresponding to the second part of the course will include an optional second version, allowing students to reinforce their knowledge, gain further experience in data analysis, and deepen their understanding of the topics covered.

The practical sessions will be closely coordinated with both lectures and problem-solving sessions, ensuring an appropriate temporal alignment between the different course contents.

Note

Fifteen minutes of one class session, within the timetable established by the Faculty or Degree Program, will be reserved for students to complete the institutional surveys evaluating both the teaching performance of the academic staff and the course itself.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Second computer-based practical examination - 2nd partial (P2)	15%	2	0.08	CM14, CM16, KM19, KM20, SM17, SM18
Attendance and completion of practical activities and associated quizzes (Qs)	10%	2	0.08	CM14, CM15, CM16, KM19, KM20, SM17, SM18
Second theoretical and problem-solving examination (T2)	35%	3	0.12	CM14, CM16, KM19, KM20, SM17, SM18
First theoretical and problem-solving examination (T1)	30%	3	0.12	CM15, KM19, KM20, SM17, SM18
First computer-based practical examination (P1)	10%	2	0.08	CM15, KM19, SM17, SM18

Students Following CONTINUOUS ASSESSMENT (CA)

The course is delivered through TE, SEM, and PLAB activities. PLAB activities are mandatory.

Course competencies will be assessed through:

Two multiple-choice theoretical examinations with penalties for incorrect answers (with one or more correct

answers per question), corresponding to the contents covered in TE and SEM activities and including both conceptual questions and problem-solving exercises:

- First theoretical examination (T1): 30%
- Second theoretical examination (T2): 35%

Two computer-based practical examinations:

- First practical examination (P1): 10%
- Second practical examination (P2): 15%

Attendance and completion of practical activities, including the associated quizzes (Qs): 10%

Students Following SINGLE ASSESSMENT (SA)

The course is delivered through TE, SEM, and PLAB activities. PLAB activities are mandatory.

For the completion of PLAB activities, students may choose between:

- Attending the sessions scheduled together with continuous assessment students.
- Completing the activities independently in the computer laboratories or on their own computers, provided they have access to the required software.

The quizzes associated with PLAB activities must be submitted before the corresponding practical examinations (P1 and P2).

Course competencies will be assessed through:

A single multiple-choice theoretical examination with penalties for incorrect answers (with one or more correct answers per question), corresponding to the contents covered in TE and SEM activities and including conceptual questions and problem-solving exercises:

- Examination T: 65%

Two computer-based practical examinations:

- First practical examination (P1): 10%
- Second practical examination (P2): 15%

Attendance and completion of practical activities, including the associated quizzes (Qs): 10%

Examination T will assess the contents corresponding to the entire theoretical syllabus covered in TE and SEM activities. It will be held on the same date as the second theoretical examination (T2) of the continuous assessment pathway.

Practical examinations P1 and P2 will be taken together with continuous assessment students.

The same resit system will apply as for continuous assessment.

The same "Not Assessable" criterion will apply as for continuous assessment.

The review of the final grade follows the same procedure as for continuous assessment.

Final Grade

The minimum overall grade required to pass the course is 5.0 points.

Additional Requirements

Continuous Assessment (CA) Students

To pass the course through continuous assessment, students must obtain a minimum grade of 3.0 points in each of the theoretical examinations T1 and T2.

Single Assessment (SA) Students

The grade corresponding to practical examinations P1 and P2, calculated as their weighted average, must be equal to or higher than 4.0 points.

Likewise, the grade corresponding to attendance and completion of practical activities and the associated quizzes (Qs) must be equal to or higher than 4.0 points.

Failure to meet any of the above requirements will result in a maximum final course grade of 4.0 points.

"Not Assessable" Grade

A student will receive a "Not Assessable" grade when the assessment activities completed do not provide sufficient evidence for the student to achieve a final grade of 5.0 points, even if the maximum possible score were obtained in all remaining assessment activities.

Resit / Final Examination

A resit examination will be available both to students who have not passed the course during the semester and to those who wish to improve their grade. In the latter case, the grade obtained in the resit examination will replace the grades previously obtained in the theoretical examinations, regardless of whether it is higher or lower.

The resit/final examination will cover all theoretical contents of the course. The grade obtained will account for 65% of the final course grade, while the remaining 35% will continue to correspond to the practical component (P1, P2, and Qs).

Only students who have previously completed assessment activities representing at least two-thirds of the total course grade will be eligible to sit the resit examination.

Repeat Students

From the second enrollment onward, students who have passed the practical component of the course within the previous three academic years may choose between the following options:

Option 1: Repeat the practical activities and follow the same assessment system as newly enrolled students.

Option 2: Take only the theoretical examinations and be assessed exclusively on the theoretical contents.

In this case:

CA Students

- T1: 40%

- T2: 60%
- Final/resit examination: 100%

SA Students

- T: 100%

Irregularities in Assessment Activities

Any irregularity in an assessment activity (academic misconduct, plagiarism, or improper use of artificial intelligence, unless such use has been explicitly authorized) that may lead to a significant alteration of the grade will result in a grade of 0 for that assessment activity.

If passing the course requires a minimum grade in the affected assessment activity, or if multiple irregularities are detected in assessment activities of the same course, the final course grade will be 0.

Without prejudice to the assigned grade, disciplinary proceedings may be initiated in accordance with current University regulations.

Review of Assessment Activities

In accordance with University regulations, the procedure, location, date, and time for reviewing assessment activities will be announced in due course.

Bibliography

Basic Bibliography

- Milton JS. *Estadística para biología y ciencias de la salud*. 3rd ed. Madrid: Interamericana McGraw-Hill; 2007.
- Taylor RA, Blair RC. *Bioestadística*. Mexico: Pearson Education; 2008.
- Daniel WW. *Bioestadística. Base para el análisis de las ciencias de la salud*. 4th ed. Mexico: Limusa Wiley; 2002.
- Sentís J, Pardell H, Cobo E, Canela J. *Manual de Bioestadística*. 3rd ed. Barcelona: Masson; 2003.
- Martínez-González MA, Sánchez-Villegas A, Toledo E, Faulin FJ. *Bioestadística amigable*. 4th ed. Elsevier; 2020.

Supplementary Bibliography

- Sorribas A, Abella F, Gómez X, March J. *Metodologia estadística en ciències de la salut: del disseny de l'estudi a l'anàlisi de resultats*. Lleida: Edicions de la Universitat de Lleida i F.V. Libros; 1998.
- Ferrán M. *SPSS para Windows. Análisis Estadístico*. McGraw-Hill; 2001.
- Visauta B. *Análisis estadístico con SPSS 14. Estadística básica*. 3rd ed. McGraw-Hill; 2007.

Web Resources

- IBM SPSS Statistics Brief Guide: https://www.ibm.com/docs/SSLVMB_27.0.0/pdf/es/IBM_SPSS_Statistics_Brief_Guide.pdf
- HyperStat Online: http://davidmlane.com/hyperstat/index.html
- Seeing Theory: https://seeing-theory.brown.edu
- VassarStats: http://vassarstats.net
- Biostatistics Teaching Materials (Hospital Ramón y Cajal): http://www.hrc.es/bioest/M_docente.html

Digital Learning Resources

- StatDistributions: http://Statdistributions.com/
- Wolfram Demonstrations Project (Statistics): http://demonstrations.wolfram.com/ - http://demonstrations.wolfram.com/topic.html?topic=Statistics&limit=20
- SOCR (Statistics Online Computational Resource): http://socr.ucla.edu/SOCR.html

Software

In practical classes, IBM SPSS Statistics or other equivalent software packages will be used primarily for data management, analysis, and interpretation.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	51	Catalan/Spanish	second semester	afternoon
(PAUL) Classroom practices	511	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	511	Catalan/Spanish	second semester	morning-mixed
(PAUL) Classroom practices	512	Catalan/Spanish	second semester	afternoon
(PLAB) Practical laboratories	512	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	513	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	514	Catalan/Spanish	second semester	morning-mixed