UAB
Universitat Autònoma de Barcelona

Calculus 2

Code: 104845
Credits: 6

2026/2027

Degree programme	Type	Course
Applied Statistics	FB	1

Contact lecturer

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Teaching staff

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Group languages

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

Prerequisites

The student should have completed the course "Càlcul 1". It is required to have practice in differentiating and integrating one-variable functions.

Objectives

The objective of this subject is that the student assimilates and learns the concepts and tools in analysis that will be necessary to understand important results in Statistics (least-square minimization, joint probability densities, central limit theorem, simulation of variables, determination of laws through moments or the characteristic function, stochastic equations, etc.). These knowledge is classified into four sections:

1. Complex numbers.

2. Integral transforms.

3. Differential calculus in several variables.

4. Integral Calculus in several variables.

Learning outcomes

- KM01 (Recognise the language and basic tools of calculus in one and various variables.) Recognise the language and basic tools of calculus in one and various variables.
- SM03 (Solve, using numerical methods, optimisation problems, linear algebra and analysis in general that appear in science and, especially, in statistics.) Solve, using numerical methods, optimisation problems, linear algebra and analysis in general that appear in science and, especially, in statistics.

- SM04 (Resolve problems associated with the extreme points of functions of one and several variables, and the calculation of moments.) Resolve problems associated with the extreme points of functions of one and several variables, and the calculation of moments.

Contents

1. Complex Numbers

The imaginary unit. Complex arithmetic. The Fundamental Theorem of Algebra.

Polar form of a complex number. Roots. Exponential and logarithmic functions.

Differentiation and integration of complex-valued functions.

2. Power Series

Taylor's formula. The concept of a power series.

Power series expansions. Examples.

Euler's formula and the complex exponential function.

3. Improper Integrals

Types of improper integrals. Probability laws.

The Gaussian bell curve. Random variables with infinite expectation.

Convergence criteria for positive integrands. Criteria for general integrands, including complex-valued ones.

The Laplace transform and the characteristic function of a probability density. Region of convergence. Examples.

Moment-generating functions.

4. Differential and Integral Calculus of Several Variables

Coordinate systems in Euclidean space: polar, cylindrical, and spherical coordinates.

Functions of several variables. Methods of representation (graphs, level curves, and level surfaces).

Curves and surfaces: parametric and implicit representations.

Linear approximation at a point: differential and tangent plane.

Partial derivatives, gradient, and the chain rule.

Unconstrained optimization.

The concept of an implicit function. Constrained optimization.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Seminars	5	0.2	

Theory class	30	1.2
Personal Study	30	1.2
Solving problems sessions	15	0.6
Solving problems	62	2.48

In the learning process it is fundamental the own work of the student, who at all times will have the help of the professor.

The hours of class are distributed in:

Theory: The teacher introduces the basic concepts corresponding to the subject, showing examples of their application. The student will have to complement the explanations of the professors with the personal study.

Problems: Bycompleting sets of exercises, the comprehension and application of the concepts and tools introduced in the theory class is attained . The student will have lists of problems, a part of which will be solved in the problem classes. Students should work on the remaining ones as part of their autonomous work.

Seminars: to reach a deeper understanding of the subject the students work o in group on more complex practical problems. Some seminars will deal with computer-aid approach to solving problems.

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 graded seminar	10%	1.5	0.06	KM01, SM03, SM04
Second mid-term exam	40%	2.5	0.1	KM01, SM03, SM04
First mid-term exam	40%	2.5	0.1	KM01, SM03, SM04
First graded seminar	10%	1.5	0.06	KM01, SM03, SM04

Continuous assessment

The continuous assessment of the course will be based on:

a) Two individual written examinations covering theory and/or problem-solving (midterm exams), graded as P1 and P2.

b) Two assessed seminars, graded as S1 and S2. These seminars are not recoverable.

If both midterm exams have been taken, the following grade will be computed:

[

Q1 = 0.1,(S1+S2) + 0.4,(P1+P2).

]

If Q1 is equal to or greater than 5, the final grade will be Q1.

To pass the course, each of the grades P1 and P2 must be at least 3.

Students whose Q1 is below 5 may take a resit examination at the end of the semester, graded as R.

The final grade will then be

[

Q2 = 0.1,(S1+S2) + 0.80,R.

]

Students who do not sit the two midterm examinations will receive the status NOT ASSESSED.

Single assessment

Students who have opted for the single-assessment modality must take a final examination, from which they will obtain a grade A. They must subsequently take an examination corresponding to the seminar component, from which they will obtain a grade S.

The final grade will be

[

\text{GRADE}_1 = 0.2,S + 0.8,A.

]

If the final grade is below 5, the student will have a further opportunity to pass the course through the resit examination held on the date specified in the examination calendar. In this examination, only grade A may be recovered. Grade S is not recoverable.

Use of Artificial Intelligence

Model 1 - Prohibited use: "In this course, the use of Artificial Intelligence (AI) technologies is not permitted at any stage. Any work containing AI-generated content will be considered a breach of academic integrity and may result in a partial or total reduction of the grade for the assessment activity, or in more severe sanctions in serious cases.

Any irregularity committed during an assessment activity (academic fraud, plagiarism, or improper use of AI, unless such use has been explicitly authorized in the course guide) that may lead to a significant alteration of the assessment outcome will result in that activity being graded with a mark of 0. If the course guide establishes that obtaining a minimum grade in that assessment activity is a mandatory requirement to pass the course, or if multiple irregularities occur in assessment activities within the same course, the final grade for the course will be 0.

Furthermore, disciplinary proceedings may be initiated against any student involved in such irregularities."

Bibliography

The professor in charge will publish studying material in the online campus CV. Besides, at the website

https://mirades.uab.cat/ebs/

the following books are recommended:

1. M. Brokate, P.Manchanda,A.H.Siddiqi, Calculus for Scientists and Engineers,

http://link.springer.com/openurl?genre=book&isbn=978-981-13-8464-6

2. A.I. Khuri, Advanced Calculus with Applications in Statistics, https://onlinelibrary.wiley.com/doi/book/10.1002/0471394882

3. P. Dyke, Two and three dimensional Calculus with applications in science and engineering, https://onlinelibrary.wiley.com/doi/book/10.1002/9781119483731

Other useful references are:

4. A.Reventos, Temes diversos de fonaments de les Matemàtiques, pdf accessible al CV.

S. L. Salas, E. Hille. Cálculo de una y varias variables. Ed. Reverté, 1994.

Software

No software is needed

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	1	Catalan	second semester	afternoon
(PAUL) Classroom practices	1	Catalan	second semester	afternoon
(PAUL) Classroom practices	2	Catalan	second semester	afternoon