Universitat Autònoma de Barcelona

2023/2024

Calculus 2

Code: 104845
ECTS Credits: 6

Degree	Type	Year	Semester
2503852 Applied Statistics	FB	1	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

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Prerequisites

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

Objectives and Contextualisation

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.

Competences

- Calculate and reproduce certain mathematical routines and processes with agility.
- Critically and rigorously assess one's own work as well as that of others.
- Make efficient use of the literature and digital resources to obtain information.
- 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 communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Use quality criteria to critically assess the work done.

Learning Outcomes

1. Calculate and study extrema of functions.
2. Critically assess the work done on the basis of quality criteria.
3. Make effective use of references and electronic resources to obtain information.
4. Master the basic language and tools of calculus (one or more variables).
5. Reappraise one's own ideas and those of others through rigorous, critical reflection.
6. 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.
7. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

Content

1. Complex numbers.

The imaginary unit. Complex arithmetic .Fundamental theorem of algebra.

Polar form of a compex number, roots. Exponential and logarithmic function.

Differentiation and integration of complex-valued functions.

2. Power series

Taylor's formula. Concept of power series.

Power series expansions. Examples.

Euler's formula, the complex exponential.

3. Improper integrals.

Different kinds of improper integrals. Probability laws. Expected value.

The Gaussian law.

Convergence criteria for positive functions. Convergence criteria for (complex) valued functions.

Laplace transform and characteristic function of a density. The domain of definition, examples.

Moment generating function. Statement of the unicity theorem.

Convolution, law of the sum of independent variables.

4. Integral calculus in several variables.

Coordinate systems in Euclidean space. Polar, cylindric and spherical coordinates.

Functions of several variables, representation methods (graphics, level sets).

Curves and surfaces, parametric and continuous form.

Riemann sums in several variables. Multiple integrals.

The fundamental theorem of calculus in several variables, densities.

Calculus of integrals: Fubini's theorem and change of variable.

5. Differential calculus in several variables.

Linear approximation at apoint: differential and tangent plane.

Partial derivatives, gradient, the chain rule.

Non constrained optimization.

Implicit functions.

Constrained optimization.

Methodology

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.

The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Solving problems sessions	15	0.6	5, 2, 1, 4, 7, 6, 3

Theory class	30	1.2	5, 2, 1, 4, 7, 6, 3
Type: Supervised			
Seminars	5	0.2	5, 2, 1, 4, 7, 6, 3
Type: Autonomous			
Personal Study	30	1.2	5, 2, 1, 4, 7, 6, 3
Solving problems	62	2.48	5, 2, 1, 4, 7, 6, 3

Assessment

A continuous assessment is performed based on:

a) Two written tests combining theory and problems, with grades P1 and P2

b) Submission of two sets of exercises, with grades LL1,LL2. Can be completed at home and uploaded to Campus Virtual.

Submissions in b) are manadatory with no resit assesment.

If both P1,P2 have been attended, a grade C1 is generated according to C1=(0,15)(LL1+LL2)+(0,35)(P1+P2).If C1 is at least 5, the final grade is C1.

Students with C1<5 and having submitted b), and students willing to improve their grade, may attend a resit exam, with grade R.

Single evaluation: see catalan version.

The final grade C2 after the resit exam is C2=(0,15)(LL1+LL2)+(0,70) R.

For students improving their grade, the final score is MAX(C1,C2).

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
First mid-term exam	35%	2.5	0.1	5, 2, 1, 4, 7, 6, 3
First submission of exercises	15%	1.5	0.06	5, 2, 1, 4, 7, 6, 3
Second mid-term exam	35%	2.5	0.1	5, 2, 1, 4, 7, 6, 3
Second submission of exercises	15%	1.5	0.06	5, 2, 1, 4, 7, 6, 3

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