Universitat Autònoma de Barcelona

2023/2024

Modelling and Simulation

Code: 104410
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OB	3	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

Gabriel Vicent Jover Mañas

External teachers

Aureli Alabert

Prerequisites

The contents of calculus, probability and linear algebra given in the 1st year should be known. It is alsoy necessary a fair command of the R and Python programming languages. It is advised to have followws the subjects Ordinary Differential Equations (2nd year) and Partial Differential Equations (3rd year).

Objectives and Contextualisation

To learn different points and alternatives related to the modelling of real world phenomena, as well as its formal and/or computational analysis according to the problem.

Competences

- Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.

- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic 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 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.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Use computer applications for statistical analysis, numerical and symbolic computation, graphic visualisation, optimisation and other to experiment and solve problems.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. "Mathematically identify and describe a problem; structure available information; select a suitable model."
2. Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
3. Contrast the solution obtained, after resolving the model, in terms of its adjustment to real phenomenon.
4. Contrast, if possible, the use of calculation with the use of abstraction in solving a problem.
5. Distinguish when calculations of analytical probabilities can be carried out and when to use stochastic simulation.
6. Evaluate the advantages and disadvantages of using calculation and abstraction.
7. Evaluate the difficulty of calculating analytical probabilities in complex situations.
8. Extract appropriate conclusions from the model result.
9. Find models of scientific or technological reality relating to a decision-making problem and express this with the mathematical language of optimisation problems with dynamic programming or stochastic queues.
10. Handle specific scientific software to solve problems with real data and to carry out simulations.
11. Know how to generate and manipulate reality-simulation models to establish and verify hypotheses in the study of problems or more complex realities.
12. Make effective use of bibliographical resources and electronic resources to obtain information.
13. Master the basics of theory and be able to combine these and use them to solve problems.
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. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
18. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
19. Within a problem, distinguish what is important from what is not so as to construct the mathematical model and its resolution.
20. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

Content

1. Modelitsation of physical phenomena

2. Discrete Event Simulation

Methodology

The metodology will combine ctheory and practical work with computers. In some chapters, the students will have material to study before the corresponding lecture.

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			
Problem lessons	14	0.56	6, 7, 3, 4, 5, 19, 13, 8, 1, 10, 16, 14, 15, 11
Theoretical lessons	28	1.12	6, 7, 4, 5, 19, 1, 18, 16, 14, 15
Type: Supervised			
Working seminars	8	0.32	2, 3, 8, 1, 10, 18, 17, 14, 11, 9
Type: Autonomous			
Solving problems and personal study	96	3.84	

Assessment

The evaluation is based on:

- Homework deliveries (30% of the final grade).
- Exams (70% of the final grade).

To pass the course you must:

- Get a minimum grade of 4.0/10 in each of the exams.
- Get a global mean of 5.0/10, which will be the final grade.

Grades not satisfying these conditions can be studied case by case.

Each exam will have a second call ("recuperació" in the official terminology of UAB). The attendamce to the second call shall automatically invalidate the grade of the first one. There is no second call for the homework deliveries.

Student that have attended exams or hand-in homework for a total of 50% or more of the course, according to the weight that appears in the Avaluation Activities table, will be evaluated. Otherwise will be considered "not evauable".

For the eventual award of Special Honours ("Matricula de Honor" in the official terminology) the grades of second exam calls will not be taken into account.

The plagiarism in the homework deliveries will be considered an offense as serious as any kind of cheating in and exam, and shall be penalised with an automatic course failure.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assignments Simulation	15%	0	0	2, 3, 4, 19, 8, 1, 10, 16, 15, 11, 20, 9, 12
Exam Modelling	35%	2	0.08	6, 7, 5, 13, 8, 1, 18, 17, 16, 14
Exam Simulation	35%	2	0.08	6, 7, 5, 13, 8, 1, 18, 16, 14
Modelling Assignments	15%	0	0	2, 3, 4, 19, 8, 1, 10, 16, 15, 11, 20, 9, 12

Bibliography

All necessary material will be provided during the course. bibliographical reference and other resourcer will be sugested at the appropriate moment.

Software

During the course, the software will be precised, and instructions to install it willbe given if necessary