

MATHEMATICS

Bachelor in Philosophy, Politics, Law and Economics PPLE SEP-2023 M-PP.1.S.A

Area Applied Mathematics

Number of sessions: 30

Academic year: 23-24

Degree course: FIRST

Number of credits: 6.0

Semester: 1^o

Category: BASIC

Language: English

Professor: **ANTONIO GARCIA ROMERO**

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Antonio is a Full-time Professor in the Area of Operations & Technology (IE Business School). He holds a Ph.D. in Economics from the Universidad Autonomous University of Madrid, an MSc. in Applied Economics (U. Carlos III), and a BSc. in Physics (U. Granada). His professional experience is a blend of academic activity, advisory positions in public administration, and consultancy. Before joining IE Business School, Antonio worked in the Healthcare sector for ten years. He was the Head of the Health Innovation Policy in the Madrid Healthcare system. During this career stage, he developed a system of indicators for measuring hospital innovation. He also participated in several projects to foster medical research's impact on hospital outcomes.

Currently, Antonio maintains a consultancy activity in the field of Healthcare Innovation. Among other projects, Antonio has designed the KPI of the Spanish Health Technologies Network (ITEMAS). Besides, he has led a project to help a Spanish group of private hospitals improve their surgical facilities' efficiency. In October 2022, Antonio was awarded the E-Innova 2022 Prize in Health Care in Big Data and Artificial Intelligence. He is currently involved in an international project in collaboration with the Stevens Institute of Technology (USA) to optimize some pay-for-performance mechanisms included in the Patient Protection and Affordable Care Act (Obamacare).

Academic Background

- BSc. (Physics), Universidad de Granada
- MSc, (Economics), Universidad Carlos III
- PhD. (Economics), Universidad Autónoma de Madrid

Academic and Corporate Experience

- Assistant Professor, Area of Operations & Technology. IE Business School (since 2015)
- Visiting Fellow Health Economics Research Group (HERG), Brunel Univ. (London, 2018)
- Adjunct Professor, IE University (2013-2015)
- Head of Health Research and Innovation Policy Unit, Regional Gov. of Madrid (2002-2013)
- Adjunct Professor, Department of Economics U. Carlos III de Madrid (1998-2013)

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SUBJECT DESCRIPTION

The conception of Mathematics, or at least of what we could call “applied mathematics in social sciences,” has changed over the last decades. From this new point of view, one must think of Mathematics not as a subject but as a collection of tools needed in any rigorous and complete analysis of complex problems in different contexts such as the economy, business, society, or public policies.

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?A recently published report from the World Economic Forum states that solving complex problems will be the most valuable skill in the coming years. A lack of proficiency in Mathematics is the primary limitation to improving the power of abstraction, a crucial requirement for complex problem-solving. Students following this course will learn valuable tools to analyze economic and management problems.?

LEARNING OBJECTIVES

- The objective of this course is to provide the student with the quantitative tools required to analyze economic, business, or political problems. At the end of the term, students will take a good knowledge of relevant tools and methods. They will be able to know when and how to use them. We will guide the students through a new approach to Math learning with an entirely practical approach. Why should you learn Math? Math is critical to:
 - Address economic problems through abstract models.
 - State and solve formal models.
 - Use the tools required to analyze economic and business issues.
 - Discover the multiple applications of matrix algebra to real-life applications.
 - Economic analysis, cryptography, 3D graph animation.
 - Know when and how to use a specific function to model some social and business phenomena. For example, logarithms are essential to model growth, innovation adoption, or even pandemics.
 - Use derivatives for finding critical information for decision-making.
 - Elasticities, MRS, maximizing revenues and profit or minimizing costs.
 - Marginal products of labor and capital.
 - Connect math tools with economic policy or management decisions.
 - Use Math in real-life scenarios by adding constraints to any problem.
 - How to deal with budget constraints or scheduling workers.
 - Perform a dynamic analysis by using integration and differential equations.
 - Interpret everything. Math is a language.
 - You must be able to translate a real-life problem into Math and interpret the results.

TEACHING METHODOLOGY

IE University teaching method is defined by its collaborative, active, and applied nature. Students actively participate in the whole process to build their knowledge and sharpen their skills. Professor's main role is to lead and guide students to achieve the learning objectives of the course. This is done by engaging in a diverse range of teaching techniques and different types of learning activities such as the following:

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	20.0 %	30.0 hours
Discussions	5.0 %	7.5 hours
Exercises in class, Asynchronous sessions, Field Work	25.0 %	37.5 hours
Group work	25.0 %	37.5 hours
Individual studying	25.0 %	37.5 hours
TOTAL	100.0 %	150.0 hours

PROGRAM

SESSION 1 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Introduction to Applied Business Mathematics Matrix Algebra. Basic matrix operations.?

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 2 (LIVE IN-PERSON)

Determinants. Matrix inversion.?

?Before the session, you must watch the video using the link published on Blackboard?.

SESSION 3 (LIVE IN-PERSON)

Systems of Linear Equations. Cramer's rule.?

?Before the session, you must watch the video using the link published on Blackboard?.

SESSION 4 (LIVE IN-PERSON)

??In this session, you will work in groups to discover some of the fantastic applications of matrices to real-life problems. The groups will compete to solve the case, and their results will determine the grade obtained by each team member.??

?Review contents and exercises corresponding to the previous sessions to be ready for this session.?

SESSION 5 (LIVE IN-PERSON)

Linear Functions. Graphs of linear equations.?

Teaching comments: ?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 6 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

?Demand and Supply analysis: Market equilibrium.?

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 7 (LIVE IN-PERSON)

Non-linear Equations.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 8 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Revenue, Cost and Profit??.

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 9 (LIVE IN-PERSON)

?Indices and logarithms?.

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 10 (LIVE IN-PERSON)

The exponential and natural logarithms functions ($\ln x$).?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 11 (ASYNCHRONOUS)

?In this session, you will solve a mock midterm exam comprising questions covering contents from sessions 1-10.?

?Review the topics studied in previous sessions.?

?During this session, you will work at home to solve some exercises. Be aware that the exercises will be available online only on the day the session is scheduled.?

SESSION 12 (LIVE IN-PERSON)

Derivatives. Rules of Differentiation?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 13 (LIVE IN-PERSON)

Midterm Exam.

The mid-term exam consists of three questions from Sessions 1-10. This exam will be deployed through Blackboard, and it will take 35 minutes.?

No calculators are allowed. You may use EXCEL and EMATH HELP.?

SESSION 14 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Marginal Functions?.

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 15 (LIVE IN-PERSON)

Further rules of differentiation.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 16 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Applications of the derivative to real-life problems: Elasticity.?

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 17 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Applications of the derivative to real-life problems: Optimisation of economic functions.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 18 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Further optimization of economic functions.?

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 19 (LIVE IN-PERSON)

Functions of several variables. Partial differentiation.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 20 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

?Partial elasticity and marginal functions.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 21 (ASYNCHRONOUS)

In this session, you will solve a set of questions covering contents from sessions 14-20.??

?Review the topics studied in previous sessions.?

??During this session, you will work at home to solve some exercises. Be aware that the exercises will be available online only on the day the session is scheduled.??

SESSION 22 (LIVE IN-PERSON)

Unconstrained Optimization.

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 23 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Constrained optimization.?

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 24 (LIVE IN-PERSON)

Economic Applications of Constraint Optimization?.

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 25 (LIVE IN-PERSON)

Sustainability Topics:

- Environment
- Economic Development

Linear Programming?.

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 26 (LIVE IN-PERSON)

Sustainability Topics:

- Environment
- Economic Development

Case: Solving real-life problems using Solver. ??In this session, you will work in groups to use Solver in a real-life problem. The groups will compete to solve the case, and their results will determine the grade obtained by each team member.???

?Review contents and exercises corresponding to the previous sessions to be ready for this session.?

SESSION 27 (LIVE IN-PERSON)

?Indefinite Integration?.

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 28 (LIVE IN-PERSON)

Definite Integration?.

?Before the session, you must watch the video using the link published on Blackboard.?

SESSION 29 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Consumer and producer surplus.?

Before the session, you must watch the video using the link published on Blackboard.?

SESSION 30 (LIVE IN-PERSON)

FINAL EXAM.

The exam covers the whole subject and it will consist of 5 questions worth 2 points each, plus a bonus question that allows you to get an extra point. Hence, in this exam, you may get up to 11 points out of 10. The final exam will be deployed through Blackboard, and it will take 65 minutes.?

?No calculators are allowed. You may use EXCEL and EMATH HELP.?

EVALUATION CRITERIA

CLASS PARTICIPATION It will be worth 20% of the overall grade - students are expected to come prepared and participate actively (and voluntarily) during lectures. Your class grade will be based on your responses to the Quizzes that you will take during the face-to-face sessions. The class participation grade will also consider other aspects such as attendance, punctuality, and class conduct. There will be penalties for those who disturb their classmates or the professor, talk excessively, or use electronic devices for non-academic purposes (i.e., Whatsapp, Instagram, etc.). The results of the group case activities organized during session #4 will be considered a bonus grade that will be put on top of your final grade.

HOMEWORK It is worth 25% of the final grade. There will be a problem set assigned for each session. Each problem set will be graded after the due date. Be aware there won't be exceptions or deadlines changes. If you miss a due date, your grade for the assignment will be 0 points. However, before computing your overall "Homework" grade we will exclude the worst FOUR scores over the semester.

MIDTERM The mid-term exam will take place on Session #13, and it is worth 20% of the overall grade. This exam will be deployed through IE Campus, and it will take 35 minutes. It will consist of THREE questions.

FINAL EXAM It is worth 35% of the overall grade. You need to score at least 3.5 on the final exam to pass the general course, even if you have already passed the continuous evaluation (i.e., class participation, homework, and midterm exam). The final exam will be deployed through IE Campus, and it will take 60 minutes.

The exam covers the whole subject. and it will consist of 5 questions worth 2 points each, plus a bonus question that allows you to get an extra point. Hence, in this exam, you may get up to 11 points out of 10.

No calculators are allowed. You may use EXCEL and EMATH HELP.

?Your final grade in the course will be based on both individual and group work of different characteristics that will be weighted in the following way:?

criteria	percentage	Learning Objectives	Comments
Final Exam	35 %		(Session #30)
Homework	25 %		(Home Exercises)
Class Participation	20 %		(Ongoing)
Intermediate tests	20 %		(Session #13)
Individual presentation	0 %		
Other	0 %		
Group Presentation	0 %		

RE-SIT / RE-TAKE POLICY

The Extraordinary Call Evaluation criteria will be subject to the following rules:

Students failing the course in the ordinary call (during the semester) will have to re-sit evaluation for the course in June / July (except those students who do not comply with the attendance rule, and therefore will not have that opportunity, since they will fail both calls and must directly re-enroll in the course during the next Academic Year).

It is not permitted to change the format nor the date of the extraordinary call exams or deadlines under any circumstance. All extraordinary call evaluation dates will be announced in advance and must be taken into consideration before planning the summer (e.g. internships, trips, holidays, etc.) The June/July re-sit will consist of a comprehensive evaluation of the course. Your final grade for the course will depend on your performance in this exam or evaluation only. I.e., continuous evaluation over the semester (e.g. participation, quizzes, projects, and/or other grade components over the semester) will not be taken into consideration on the extraordinary call. Students will have to achieve the minimum passing grade of 5 and the maximum grade will be capped at 8.0 (out of 10.0) – i.e., “notable” in the extraordinary call.

Re-takers: Students who failed the subject in a previous Academic Year and are now reenrolled as re-takers in a course will need to check the syllabus of the assigned professor, as well as contact the professor individually, regarding the specific evaluation criteria for them as re-takers in the course during that semester (ordinary call of that Academic Year). The maximum grade that may be obtained as a retaker during the ordinary call (i.e., the 3rd call) is 10.0 (out of 10.0).

After exams and other assessments are graded by the professor (on either the ordinary or extraordinary call), students will have a possibility to attend a review session (whether it be a final exam, a final project, or the final overall grade in a given course). Please be available to attend the session in order to clarify any concerns you might have regarding your grade. Your professor will inform you about the time and place of the review session.

Students failing more than 18 ECTS credits after the June/July re-sits will be asked to leave the Program. Please, make sure to prepare yourself well for the exams in order to pass your failed subjects. In case you decide to skip the opportunity to re-sit for an exam or evaluation during the June/July extraordinary call, you will need to enroll in that course again for the next Academic Year as a re-taker, and pay the corresponding tuition fees. As you know, students have a total of four (4) allowed calls to pass a given subject or course, in order to remain in the program.

The third attempt final grade will be computed as follows:

Deliverables: (Only sessions #11 and #21) (20 %)

Midterm (35%)

Final exam (45%)

To pass the subject in this attempt, you need a minimum grade of 5 points in the retake.

Be aware that you need to score at least 3.5 on the final exam to pass the overall course, even if you have already passed the course through the other course assessments.

BEHAVIOR RULES

Please, check the University's Code of Conduct [here](#). The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy [here](#). The Program Director may provide further indications.

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UNIVERSITY

1. ??Students have the obligation to attend at least 70% of sessions. For in person programs, they are required to attend?on Campus.
2. ?In each session the professor must mark as?Absent?any student who is not present in the classroom, even if he/she is connected online. It is recommended to take roll call first and then open Zoom.
3. ?When a student approaches the professor to excuse the absence, the professor must refer the student to the Program Management (PM), which is the only one able to determine if the case is among the allowed exceptions. The professor CANNOT justify any type of absence from the classroom.
4. ?PM will only grant exceptions for reasons of force majeure of a prolonged nature.
5. ?PM will inform the professor of the approved exceptions specifying the name of the student, subject, group and, if applicable, the sessions affected (session number and date). The professor must mark these sessions as?Excused?in the control system he/she is using.
6. ?Sessions marked as?Excused?are excluded in the calculation of 70% (example: If in a class of 30 sessions, 3 sessions have been marked as?Excused, the student cannot miss more than 8, instead of the 9 that would correspond if there were no?Excused?sessions).
7. ?Retaker students are nor required to attend class. PM will notify the professors and they will marked them as?Excused.
8. ?If two sessions are scheduled back to back, attendance must be completed for each of them so that the % is calculated correctly.
9. ?Late?mode should not be used.

ETHICAL POLICY

Please, check the University's Ethics Code [here](#). The Program Director may provide further indications.