

APPLIED BUSINESS MATHEMATICS

Dual Degree in Business Administration and Design/Dual Degree in Business Administration and Design BBABID SEP-2024 ABMn-NBAD.1.S.A

Area Operations and Business Analytics

Number of sessions: 25 Academic year: 24-25 Degree course: FIRST Number of credits: 6.0 Semester: 1° Category: BASIC Language: English

Professor: ANA MARIA GLAVAN

E-mail: aglavan@faculty.ie.edu

Ana Maria holds a Ph.D. in Mathematical Engineering from Carlos III University of Madrid. She taught different topics of Mathematics at Carlos III University and University of Navarra. Her actual research interest is on fintech and the application of mathematical modelling into finance, in particular in risk management and valuation of complex financial instruments, as an important cause of contagion during the recent global financial crisis.

Academic Qualifications

Ph.D. in Mathematical Engineering, Carlos III University, 2016.Master in Biosensors for Environmental Monitoring, Perpignan University and Bucharest University, 2003.B.Sc. in Chemistry, Bucharest University, 2001.

Academic Experience

Professor, IE Business School, 2016-present. Professor, Carlos III University, Ph.D. Programme in Mathematical Engineering, 2016-2017. Professor, University of Navarra, 2010-2012. Teaching Assistant, Carlos III University, 2004-2009. Research Assistant, BIOMEM, Centre de Phytopharmacie, 2002-2003.

Fields of Interest

Computational methods in finance. Applied and computational mathematics. Numerical modelling algorithms.

Office Hours

Office hours will be on request. Please contact at:

1 Edited by Documentation 15th May 2024

SUBJECT DESCRIPTION

Mathematics has often been perceived as a realm of abstract axioms and theorems, seemingly disconnected from real-world problems. However, this perspective has evolved significantly over the past few decades, particularly in the context of applied mathematics within social sciences. Rather than viewing Mathematics as a standalone subject, we now recognize it as a powerful collection of tools essential for rigorous analysis across diverse domains such as the economy, business, society, and public policies.

We are living in an extraordinary time of technological advances, such as Al generative tools. Simultaneous to this significant upheaval, there is an arrangement of financial, geopolitical, and demographic drivers of progress, each interacting in multiple directions and intensifying one another. This challenging scenario opens new opportunities for those professionals capable of managing and analyzing such complex situations.

The World Economic Forum's report on the "Future of Jobs 2023" states that the analytical and creative thinking skills remain the most important skills for workers. Interestingly, Mathematical thinking shares fundamental principles with analytical thinking, making them complementary in problem-solving and understanding societal challenges. Students enrolled in this course will acquire valuable mathematical tools to analyze economic and management problems effectively.

LEARNING OBJECTIVES

- The objective of this course is to provide the student with part of the quantitative tools required to analyze economic, social, or political problems. Regarding its contents, this first course comprises some elementary topics of Calculus of one-real variables. In brief, the topics covered will include functions of one variable and derivatives.

- To address economic problems by means of abstract models.

- To solve the above formal models.
- To use the basic tools which are needed in the modern analysis of economic problems.
- Plot the straight line when given the value of slope and intercept.

- Write down the equation of the straight line when given (i) the value of slope and intercept (ii) any two points on the line (iii) the slope of the line and a point on the line.

- Plot a straight line when given its equation.
- Plot linear demand, supply, cost and revenue functions.
- Verbally describe linear demand, supply, cost and revenue functions.

- Translate linear functions horizontally and vertically and write down the equation of the translated function.

- Calculate the price elasticity of demand and supply for linear demand and supply functions.

- Plot any linear function in Excel. Use Excel to find the slope and y-intercept given 2 points on the line.

- Use Excel to illustrate the rules for vertical and horizontal translations.

- Solve two equations in two unknowns and illustrate the solution graphically.
- Distinguish between unique solutions, no solutions and infinitely many solutions.
- Calculate the equilibrium price and quantity in the goods market and illustrate the solution graphically.
- Use Excel to find the point of intersection of two straight lines. Goal seek function.
- Calculate and illustrate graphically break-even, profit and loss.

- Recognize the general form of the equation representing a non-linear function as well as the main characteristics of the graph representing the function.

- Manipulate non-linear functions algebraically, particularly in economic applications such as demand, supply, revenue, cost and profit.

- Use exponentials and logs in a range of applications, such as production and consumption.
- Plot quadratic, cubic and other functions using Excel.
- Calculate the derivatives of a range of functions.
- Calculate marginal and average functions.
- Determine the maximum and minimum values.
- Determine maximum and minimum values of revenue, profit, cost, and other economic functions.
- Determine points of inflection and use these to describe curvature.
- Use points of inflection in applications such as the point of diminishing returns.

- Determine the point elasticity of demand and relationships between price elasticity of demand and marginal revenue, total revenue and price changes.

- Integrate standard functions and evaluate definite integrals of standard functions.

- Determine the net area enclosed between a curve and the lines x = a and x = b.
- Calculate the consumer and producer surplus and illustrate these graphically.

- Integrate marginal functions to obtain the corresponding total function.

- An inquisitive attitude when developing logical reasoning, being able to tell apart a proof from an example.

- An entrepreneurial and imaginative attitude towards the examples studied.
- A critical attitude towards formal 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.

The course classes will be based on a combination of theoretical explanations and practical exercises. Students should attempt to solve the exercises that will be given to them as homework. Student participation is considered very important to acquire the skills needed to pose and solve exercises.

All the material will be covered in class, so students should be present and active during the lectures.

Students are encouraged to work in groups when solving homework problems. However, it is highly recommended that each student tries, at the same time, to solve problems by himself.

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	8.0 %	12.0 hours
Discussions	5.0 %	7.5 hours
Exercises in class, Asynchronous sessions, Field Work	32.0 %	48.0 hours
Group work	10.0 %	15.0 hours
Individual studying	45.0 %	67.5 hours
TOTAL	100.0 %	150.0 hours

PROGRAM

SESSION 1 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Topic 1. Linear Models and Business Applications.

Session 1. Course presentation. The Straight Line. Excel as a calculator and Excel for linear functions (Adding the calculator in Excel. Graphs and the Excel functions: SLOPE and INTERCEPT).

Readings: T. Bradley: 2.1, 2.4, and 2.8 Worked examples: 2.2, 2.11-2.13. Progress exercises: 2.5. EXCEL Exercises Chapter 2: 1-4.

Book Chapters: Essential Mathematics for Economics and Business; chapters 2.1, 2.4, and 2.8 (See

Bibliography)

SESSION 2 (LIVE IN-PERSON)

Business applications: Demand, Supply, Cost and Revenue, and break-even points. Excel for linear functions (point of intersection-goal seek function).

Readings: T. Bradley: 2.3.

Worked examples: 2.6, 2.7, 2.8, 2.9, 2.10a, and 2.10b. Progress exercises: 2.3 and 2.4. EXCEL Exercises Chapter 2. 5-11.

Book Chapters: Essential Mathematics for Economics and Business; chapter 2.3 (See Bibliography)

SESSION 3 (LIVE IN-PERSON)

Elasticity of Demand and Supply. Arc Elasticity.

Readings: T. Bradley: 2.6.

Worked examples: 2.19. Progress exercises: 2.7. EXCEL Exercises Chapter 2.12.

Book Chapters: Essential Mathematics for Economics and Business; chapter 2.6 (See Bibliography)

SESSION 4 (LIVE IN-PERSON)

Translations of linear functions. Budget constraints.

Readings: T. Bradley: 2.5 and 2.7.

Worked examples: 2.14, 2.15, 2.16, 2.22, 2.23, and 2.24. Progress exercises: 2.6, 2.8, and 2.9.). EXCEL Exercises Chapter 2. 13 and 14.

Book Chapters: Essential Mathematics for Economics and Business; chapters 2.5 and 2.7 (See Bibliography)

SESSION 5 (LIVE IN-PERSON)

Market Equilibrium. Excel for linear functions (equilibrium point-goal seek function). Taxes and subsidies.

Readings: T. Bradley: 3.1., 3.2.1., 3.2.3, 3.2.4, and 3.5.

Worked examples: 3.1-3.8, 3.11, 3.12 and 3.13. Progress exercises: 3.1., 3.2., and 3.3. EXCEL Exercises Chapter 3: 1-6.

Book Chapters: Essential Mathematics for Economics and Business; chapters 3.1, 3.2.1, 3.2.3, 3.2.4, and 3.5 (See Bibliography)

SESSION 6 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Topic 2. Non-linear functions and business applications.

Session 6. Quadratic Functions. Graphs and equations of translated quadratics. Non-linear Demand and Supply Functions. Excel for non-linear functions.

Readings: T. Bradley: 4.1. and 4.5.

Worked examples: 4.1, 4.2, 4.3, 4.5, and 4.7. Progress exercises: 4.2. EXCEL Exercises Chapter 4: 1-6.

Book Chapters: Essential Mathematics for Economics and Business; chapters 4.1. and 4.5 (See

Bibliography)

SESSION 7 (LIVE IN-PERSON)

Non-linear Total Revenue and Total Profit Functions. Break-even points. Cubic functions and General Polynomials.

Readings: T. Bradley: 4.1.

Worked examples: 4.8, 4.9, 4.10a, 4.10b, and 4.11. Progress exercises: 4.3 and 4.4. Exercises Chapter 4: 7-10.

Book Chapters: Essential Mathematics for Economics and Business; chapter 4.1 (See Bibliography)

SESSION 8 (LIVE IN-PERSON)

?? Exponential Functions and Logarithmic Functions. Applications: limited and unlimited growth.??

Readings: T. Bradley: 4.2, 4.3.

Worked examples: 4.13-4.18, and 4.21, and 4.22. Progress exercises: 4.5, 4.6, 4.7, 4.8, 4.10, and 4.11. EXCEL Exercises Chapter 4: 11-15.

SESSION 9 (LIVE IN-PERSON)

Hyperbolic (Rational) Functions.?

Readings: T. Bradley: 4.4

Worked examples: 4.23, and 4.24. Progress exercises: 4.12 and 4.13. EXCEL Exercises Chapter 4: 16-17.

SESSION 10 (ASYNCHRONOUS)

?Asynchronous activities/exercises on Blackboard.?

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 11 (LIVE IN-PERSON)

Review session.?

Review the topics studied in previous sessions.?

SESSION 12 (LIVE IN-PERSON)

Midterm Exam 1.

Materials: Excel and a formula sheet (provided by the professor) are permitted. Physical calculators, Windows calculators, Apple calculators, mobile phones, etc. are forbidden.

SESSION 13 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Topic 3. Differentiation and Applications.

Session 13. Slope of a Curve and Differentiation. Differentiation Rules. Further Differentiation.

Readings: T. Bradley: 6.1 and 6.6.

Worked examples: 6.1, 6.2, 6.3, 6.4, 6.33, 6.34, 6.35, and 6.36. Progress exercises: 6.1, 6.12, 6.13, 6.14, and 6.15. EXCEL Exercises Chapter 6: 1, 2, and 3.

Book Chapters: Essential Mathematics for Economics and Business; chapters 6.1 and 6.6 (See Bibliography)

SESSION 14 (LIVE IN-PERSON)

Business Applications of Differentiation: Marginal Functions and Average Functions.

Readings: T. Bradley: 6.2.1 and 6.2.2.

Worked examples: 6.6, 6.8, 6.10. Progress exercises: 6.3. EXCEL Exercises Chapter 6: 4, 5, and 6. Book Chapters: Essential Mathematics for Economics and Business; chapters 6.2.1 and 6.2.2 (See Bibliography)

SESSION 15 (LIVE IN-PERSON)

Optimization for Functions of One Variable. Readings: T. Bradley: 6.3. Worked examples: 6.16, 6.17, 6.18, and 6.19.). Progress exercises: 6.5, 6.6, 6.7, and 6.8. Book Chapters: Essential Mathematics for Economics and Business; chapter 6.3 (See Bibliography)

SESSION 16 (LIVE IN-PERSON)

Economic Applications of Maximum and Minimum Points. Price discrimination. Readings: T. Bradley: 6.4. Worked examples: 6.21, 6.22, 6.23, and 6.24. Progress exercises: 6.9. EXCEL Exercises Chapter 6: 7, 8, and 9. Book Chapters: Essential Mathematics for Economics and Business; chapter 6.4 (See Bibliography)

SESSION 17 (LIVE IN-PERSON)

Curvature and Other Applications.

Readings: T. Bradley: 6.5.

Worked examples: 6.27, 6.28, 6.31, 6.32, 6.37, and 6.38.). Progress exercises: 6.10, 6.11, and 6.16. EXCEL Exercises Chapter 6: 10.

Book Chapters: Essential Mathematics for Economics and Business; chapter 6.5 (See Bibliography)

SESSION 18 (LIVE IN-PERSON)

Elasticity and the Derivative.

Readings: T. Bradley: 6.7. Worked examples: 6.39, 6.40, and 6.41. Progress exercises: 6.17. Book Chapters: Essential Mathematics for Economics and Business; chapter 6.7 (See Bibliography)

SESSION 19 (ASYNCHRONOUS)

?Exercises on Blackboard.

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 20 (LIVE IN-PERSON)

?Review Session.?

??Review the topics studied in previous sessions.??

SESSION 21 (LIVE IN-PERSON)

Midterm Exam 2.

Materials: Excel and a formula sheet (provided by the professor) are permitted. Physical calculators, Windows calculators, Apple calculators, mobile phones, etc. are forbidden.

SESSION 22 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Topic 4. Integration and Applications.

Session 22. Integration as the Reverse of Differentiation. Rules for Integration (Power, exponential and logs). Integration of functions of linear functions.

Readings: T. Bradley: 8.1, 8.2, 8.3, and 8.4.

Worked examples: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, and 8.7. Progress exercises: 8.1 and 8.2.

Book Chapters: Essential Mathematics for Economics and Business; chapters 8.1, 8.2, 8.3, and 8.4 (See Bibliography)

SESSION 23 (LIVE IN-PERSON)

The Definite Integral and the Area under a Curve. Consumer and Producer Surplus.

Readings: T. Bradley: 8.5, 8.6.

Worked examples: 8.8, 8.9, 8.12, 8.13, and 8.14. Progress exercises: 8.3 and 8.4.

Book Chapters: Essential Mathematics for Economics and Business; chapters 8.5 and 8.6 (See Bibliography)

SESSION 24 (LIVE IN-PERSON)

Some Economic Applications of integration. Readings: T. Bradley: 8.7.

Worked examples: 8.15, 8.16, 8.17, 8.18, and 8.19. Progress exercises: 8.5, 8.6, and 8.7. Book Chapters: Essential Mathematics for Economics and Business; chapter 8.7 (See Bibliography)

SESSION 25 (LIVE IN-PERSON)

Final Exam.

Materials: Excel and a formula sheet (provided by the professor) are permitted. Physical calculators, Windows calculators, Apple calculators, mobile phones, etc. are forbidden.

EVALUATION CRITERIA

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:

FINAL GRADE = 0.10x(CP) + 0.20x(A) + 0.15x(E1) + 0.15x(E2) + 0.40x(FE)

(According to the table below)

CLASS PARTICIPATION (CP)

It will be worth 10% of the overall grade - students are expected to come prepared and participate actively (and voluntarily) during lectures. Your class grade will be based also on attendance, punctuality, participation, and class conduct – there may be a penalty if you create a disruption, talk excessively, or use electronic devices inappropriately.

ASYNCHRONOUS SESSIONS and others (A)

It will be worth 20% of the overall grade. Asynchronous activities will consist of several exercises/activities on Blackboard throughout the asynchronous sessions (2) and they will be worth 15%. Another 5% will be obtained from a different activity announced in advance by the professor.

INTERMEDIATE EXAMS (E):

It will be worth 30% of the overall grade. There will be 2 intermediate exams (15% each). Important. Only if you miss an exam due to force majeure, you will be offered an alternative option.

FINAL EXAM (FE):

It is worth 40% of the overall grade. You need to score at least 4.0 on the final exam to pass the overall course, even if you have already passed the course through the other course assessments. The final exam will cover the whole subject (Topics 1-4).

Excel and a formula sheet (provided by the professor) are permitted. Physical calculators, Windows calculators, Apple calculators, mobile phones, etc. are forbidden.

criteria	percentage	Learning Objectives	Comments
Final Exam	40 %		Session 25
Class Participation	10 %		Ongoing
Intermediate Tests	30 %		(E1 and E2): Sessions 12 and 21
Asynchronous sessions and others	20 %		Sessions 10 and 19 (15%), and others

RE-SIT / RE-TAKE POLICY

AI POLICY

In today's world, generative artificial intelligence (GenAI) is changing how we work, study and, in general, how we get things done. However, in the context of this course, **the use of GenAI is not permitted**, unless it is otherwise stated by the instructor. The use of GenAI tools would jeopardize the students' ability to acquire fundamental knowledge or skills of this course.

If a student is found to have used AI-generated content for any form of assessment, it will be considered academic misconduct, and the student might fail the respective assignment or the course.

BIBLIOGRAPHY

Compulsory

- Bradley, Teresa. (2013). *Essential Mathematics for Economics and Business.* 4th. John Wiley & Sons. ISBN 9781118358290 (Digital)

BEHAVIOR RULES

Please, check the University's Code of Conduct <u>here</u>. The Program Director may provide further indications.

ATTENDANCE POLICY

Please, check the University's Attendance Policy <u>here</u>. The Program Director may provide further indications.

- 1. Students have the obligation to attend at least 80% of sessions. For in person programs, they are required to attend?on Campus.
- 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 80% (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 <u>here</u>. The Program Director may provide further indications.