APPLIED BUSINESS MATHEMATICS

Dual Degree Bachelor in Business Administration and Bachelor of Laws BBALLB [2504110] SEP-2025 ABMn-NBNL.1.M.A

Area Operations and Business Analytics

Number of sessions: 25

Academic year: 25-26

Degree course: FIRST

Number of credits: 6.0

Semester: 1º

Category: BASIC

Language: English

Professor: **SAMUEL GONZALEZ MANCEBO**

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Education:

- Ph.D. in Chemistry. University of Salamanca. Spain.
- Master in Environmental Education. Instituto de Investigaciones Ecológicas, Málaga, Spain.
- Bachelor in Chemistry. University of Salamanca. Spain.

Academic experience:

- Professor of Mathematics in the Bachelor of Business Administration (IE University) and dual degrees from 2015 until now.
- Professor of Chemistry and Physics in the Bachelor of Biology (IE University) from 1997 to 2012.
- Director of 10 final projects in the Bachelor of Biology.
- Associate professor at University of Salamanca (1997).

Research experience:

- Researcher in different projects at the University of Salamanca (3 months at the University of Bielefeld, Germany) and at IE University. Spain.
- Several articles in prestigious journals in his field.

Administration experience:

- Vice-rector of IE University from 2003 to 2010.

Office Hours

Office hours will be on request. Please contact at:

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SUBJECT DESCRIPTION

Mathematics is often perceived as an abstract discipline, detached from real-world challenges. However, in today's dynamic and data-driven environment, mathematical methods have become essential tools for analysing complex problems in business, economics, and public policy.

This course explores the practical applications of mathematics in decision-making and strategic problem-solving within business and management contexts. Students will develop analytical skills to assess financial models, interpret economic trends, and optimize business processes using quantitative reasoning.

In an era of rapid technological advancements—including AI-driven tools—professionals must navigate an evolving landscape shaped by financial, geopolitical, and demographic factors. The ability to think mathematically enhances problem-solving capabilities, fostering both analytical and creative thinking—skills recognized as critical in the World Economic Forum's Future of Jobs 2023 report.

By the end of this course, students will gain a strong foundation in mathematical techniques that support data-driven decision-making, empowering them to tackle real-world business challenges with confidence and precision.

LEARNING OBJECTIVES

Overall Learning Goals

By the end of this course, students will be able to:

- Understand, interpret, and apply mathematical functions (linear, non-linear, exponential, logarithmic) to model business and economic problems.
- Use calculus techniques (differentiation and integration) to analyze and solve optimization and marginal analysis problems in economics and business.
- Construct, solve, and interpret systems of equations and differential equations relevant to economic modeling.
- Apply analytical reasoning to concepts such as elasticity, equilibrium, cost analysis, and market behavior.
- Use Excel as a computational and graphical tool to visualize mathematical functions and solve real-world problems.

Skills Development

Throughout the course, students will develop the following skills:

Skill Area	Description
Analytical Thinking	Formulate and analyze mathematical models in economic and business contexts.
Problem-Solving	Solve a wide range of applied mathematical problems, including optimization.
Data Literacy	Use numerical methods to evaluate and interpret economic data.
Digital Literacy (Excel)	Apply Excel tools such as functions, graphs, and Goal Seek for problem-solving.
Graphical Communication	Accurately sketch and interpret mathematical and economic graphs.
Critical Interpretation	Interpret the outcomes of mathematical models in terms of economic meaning.
Modeling	Construct and solve mathematical models involving demand, supply, revenue, etc.

Topic-Based Learning Goals

Topic 1: Linear Functions and Applications

- Represent and graph linear equations using slope, intercepts, and point methods.
- Use Excel to plot linear functions and solve simple equations.
- Model budget constraints and interpret economic implications.
- Solve and analyze systems of two linear equations using algebraic and Excel methods.
- Identify economic variables in supply-demand models and compute equilibrium.
- Model linear consumption and saving functions and compute marginal propensities.

Topic 2: Non-Linear Functions and Applications

- Solve and graph quadratic equations using factorization and standard formulas.
- Apply quadratic and cubic functions to economic scenarios such as cost, revenue, and profit.
- Analyze equilibrium, break-even points, and revenue maximization using non-linear models.
- Use hyperbolic, exponential, and logarithmic functions in modeling growth, decay, and production.
- Apply rules of indices and logarithms to simplify and solve algebraic expressions.
- Utilize Excel to visualize complex functions and support economic interpretation.

Topic 3: Differentiation and Applications
- Understand the concept of the derivative and apply rules of differentiation (sum, product, quotient, chain).
- Calculate and interpret first and second derivatives in business contexts.
- Derive marginal functions (cost, revenue, productivity, consumption).
- Analyze elasticity of supply and demand using derivatives.
- Use differentiation to optimize economic functions (profit, cost, revenue).
- Understand and apply the conditions for price discrimination and marginal analysis.
- Differentiate exponential and logarithmic functions and apply them in economic models.

Topic 4: Integration and Applications
- Understand the principles of indefinite and definite integration.
- Calculate areas under curves and apply to economic surplus (consumer and producer).
- Solve differential equations to derive total functions from marginal functions.
- Analyze stability and dynamics in economic systems using first-order differential equations.
- Apply integration techniques to model cost, revenue, consumption, and savings.

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	6.7 %	10.0 hours
Discussions	5.3 %	8.0 hours
Exercises in class, Asynchronous sessions, Field Work	32.0 %	48.0 hours
Group work	10.0 %	15.0 hours
Individual studying	46.0 %	69.0 hours
TOTAL	100.0 %	150.0 hours

AI POLICY

Restricted use of GenAI

In today's world, generative artificial intelligence (GenAI) is changing how we work, study and, ingeneral, how we get things done. However, in the context of this course, the use of GenAI is notpermitted, 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 beconsidered academic misconduct, and the student might fail the respective assignment or the course.

PROGRAM

SESSION 1 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Course presentation.

Topic 1. Linear functions

Bibliography: Chapters 1 and 2

- The straight line. Graphs of linear equations.
- Excel: Excel as a calculator. Slope and Intercept functions. Graph of linear functions.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 1. Section 1.3. (See Bibliography)

Learning goals:

- Sketch a line by finding the coordinates of two points of the line.
- Sketch a line by using its slope and intercept.
- Use EXCEL to plot linear functions.

SESSION 2 (LIVE IN-PERSON)

- Budget constraints.
- Translations of linear functions.
- Systems of linear equations: solutions of simultaneous linear equations.
- Excel: Goal Seek function.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 1. Section 1.4 (except exercises of systems of 3 linear equations) (See Bibliography)
Book Chapters: Teresa Bradley. (2013). Essential Mathematics for Economics and Business. 4th. Wiley. Sections 2.5 and 2.7. (See Bibliography)(Optional)

Learning goals:

- Apply the straight line to budget constraints.
- Translate linear equations.
- Detect when a system of equations doesn't have a solution.
- Detect when a system of equations has infinitely many solutions.
- Apply Goal Seek function to find the solution of a system of linear equations.

SESSION 3 (LIVE IN-PERSON)

- Applications of linear functions: Supply and demand analysis. Market equilibrium. Taxes and subsidies.
- Excel for these applications.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 1. Section 1.5 and 1.6. (See Bibliography)

Learning goals:

- Use the functions' notation.

- Identify endogenous and exogenous variables in an economic model.
- Identify and sketch linear demand and supply functions.
- Determine the market equilibrium (i.e., price and quantity).
- Use Excel to represent market equilibrium conditions.

SESSION 4 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

First part:

- Applications of linear functions: Consumption and savings functions. Excel for these applications.
- Case study 1.

Second part:

Topic 2. Non-linear functions

- Quadratic and cubic functions.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 1. Section 1.7 (first part); Bibliography: Chapter 2. Section 2.1 (second part). (See Bibliography)

Learning goals:

- Identify and plot with Excel linear consumption functions.
- Identify and plot with Excel linear savings functions.
- Solve a quadratic equation using “the formula”
- Solve a quadratic equation given its factorisation.
- Sketch the graph of a quadratic function using table of values.
- Sketch the graph of a quadratic function by finding the coordinates of the intercepts.
- Use Excel to plot quadratic and cubic functions.

SESSION 5 (LIVE IN-PERSON)

- Vertical and horizontal translations of quadratic functions.
- Applications of quadratic and cubic functions: supply and demand functions. Excel for these functions.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 2. Section 2.1. (See Bibliography)

Book Chapters: Teresa Bradley. (2013). Essential Mathematics for Economics and Business. 4th. Wiley. Sections 4.1. (See Bibliography)(Optional)

Learning goals:

- Translate quadratic functions vertically and horizontally.
- Determine the equilibrium price and quantity given a pair of quadratic demand and supply functions.

SESSION 6 (LIVE IN-PERSON)

- Applications of quadratic and cubic functions: Revenue, cost and profit. Excel for these

applications.

- Hyperbolic functions and applications. Excel for these applications.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 2. Section 2.2. (See Bibliography)

Book Chapters: Teresa Bradley. (2013). Essential Mathematics for Economics and Business. 4th. Wiley. Sections 4.4. (See Bibliography)

Learning goals:

- Sketch the graphs of the total revenue, total cost, average cost and profit functions.
- Find the level of output that maximises total revenue.
- Find the level of output that maximises profit.
- Find the break-even levels of output.
- Use Excel to plot total revenue, total cost, average cost and profit functions.
- Define and graph using Excel hyperbolic functions of the form a/(bx+c)
- Define and solve applications which are modelled by hyperbolic functions.

SESSION 7 (LIVE IN-PERSON)

- Indices and logarithms. Applications of indices: production functions.
- Excel for these applications.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 2. Section 2.3. (See Bibliography)

Learning goals:

- Evaluate bn in the case when “n” is positive, negative, a whole number or fraction.
- Simplify algebraic expressions using the rules of indices.
- Evaluate logarithms in simple cases.
- Use the rules of logarithms to solve equations in which the unknown occurs as a power.

SESSION 8 (LIVE IN-PERSON)

- The Exponential and Natural logarithmic functions. Applications of exponential and natural logarithmic functions: growth and decay curves.
- Excel for these applications.

Learning goals:

- Sketch graphs of general exponential functions.
- Use the exponential function to model growth and decay.
- Use log graphs to find unknown parameters in simple models.
- Use the natural logarithm function to solve equations.
- Use Excel to graph exponential and logarithm functions.

SESSION 9 (ASYNCHRONOUS)

Asynchronous session

SESSION 10 (LIVE IN-PERSON)

- Review session (topics 1 and 2)

SESSION 11 (LIVE IN-PERSON)

Exam 1 (topics 1 and 2).

SESSION 12 (LIVE IN-PERSON)

Sustainability Topics:

- Economic Development

Topic 3. Differentiation

Bibliography: Chapter 4

- The derivative of a function. Rules for differentiation. Further rules for differentiation, the chain rule.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.1, 4.2, and 4.4. (See Bibliography)

Learning goals:

- Recognise the notation f'(x) and dy/dx for the derivative of a function.
- Understand the meaning of the derivative.
- Estimate the derivative of a function by measuring the slope of a tangent
- Differentiate power functions.
- Use the rule of a sum/difference to differentiate functions.
- Evaluate and interpret second order derivatives.
- Use the chain rule to differentiate a function of a function.
- Use the product rule and the quotient rule to differentiate functions.
- Differentiate complicated functions using a combination of rules.

SESSION 13 (LIVE IN-PERSON)

- Applications of differentiation: Revenue, cost and profit and Marginal functions. Production and Marginal product of labour. Consumption and savings and Marginal Propensity to Consume and Marginal Propensity to Save.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.3 (See Bibliography)

Learning goals:

- Calculate and interpret marginal revenue and marginal cost.
- Calculate and interpret marginal product of labour.
- Calculate and interpret marginal propensity to consume and marginal propensity to save.

SESSION 14 (LIVE IN-PERSON)

- Applications of differentiation: Elasticity

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.5 (See Bibliography)

Learning goals:

- Calculate and interpret price elasticity evaluated at a point (demand and supply).
- Calculate and interpret price elasticity average along an arc.

- Decide whether supply and demand are inelastic, unit elastic or elastic.
- Determine the price elasticity for general demand and supply functions.

SESSION 15 (LIVE IN-PERSON)

- Applications of differentiation: Optimization of economic functions

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.6 (See Bibliography)

Learning goals:

- Use the first order derivative to find the stationary points of a function.
- Use the second order derivative to classify the stationary points of a function.
- Find the maximum and minimum points of an economic function.
- Use stationary points to sketch graphs of economic functions.

SESSION 16 (LIVE IN-PERSON)

- Applications of differentiation: Further of optimization of economic functions. Price discrimination.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.7 (See Bibliography)

Learning goals:

- Show that, at the point of maximum profit, marginal revenue equals marginal cost.
- Maximise profits of a firm with and without price discrimination in different markets.
- Show that, at the point of maximum average product of labour, average product of labour equals marginal product of labour.

SESSION 17 (LIVE IN-PERSON)

- The derivative of exponential and natural logarithmic functions: Applications.
- Case study 4

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 4. Section 4.8. (See Bibliography)

Learning goals:

- Differentiate the exponential function.
- Differentiate the natural logarithm function.
- The chain rule to differentiate combinations of these functions.
- Appreciate the use of the exponential functions in economic modelling.

SESSION 18 (ASYNCHRONOUS)

Asynchronous session

SESSION 19 (LIVE IN-PERSON)

Review session (Topic 3).

SESSION 20 (LIVE IN-PERSON)

Exam 2 (Topic 3).

SESSION 21 (LIVE IN-PERSON)

Topic 4. Integration

Bibliography: Chapter 6 and Chapter 9 (only section 9.2)

- Indefinite integration.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 6. Section 6.1. (See Bibliography)

Learning goals:

- Recognise the notation for indefinite integration.
- Write down the integrals of simple power and exponential functions.

SESSION 22 (LIVE IN-PERSON)

- Definite integration. Applications of definite integration: consumer and producer surplus.

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 6. Section 6.2. (See Bibliography)

Learning goals:

- Recognise the notation for definite integration.
- Evaluate definite integrals in simple cases.
- Find the area between two curves.
- Calculate the consumer's surplus.
- Calculate the producer's surplus.

SESSION 23 (LIVE IN-PERSON)

- Differential equations (I).

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 6. Section 6.1. and chapter 9. Section 9.2. (See Bibliography)

Learning goals:

- Find the particular solution of a differential equation.
- Find the total cost function given any marginal cost function.
- Find the total revenue function given any marginal revenue function.
- Find the consumption and savings functions given either the marginal propensity to consume or the marginal propensity to save.

SESSION 24 (LIVE IN-PERSON)

- Differential equations (II).
- Case study 6.
- Review session

Book Chapters: Ian Jacques. (2023). Mathematics for economics and business. 10th. Pearson. Chapter 6. Section 6.1. and chapter 9. Section 9.2. (See Bibliography)

Learning goals:

- Find the complementary function of a differential equation.
- Find the particular solution to a differential equation.
- Analyse the stability of economic systems: supply and demand analysis.

SESSION 25 (LIVE IN-PERSON)

Final Exam

EVALUATION CRITERIA

Your final grade on 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)

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 ACTIVITIES 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 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).

The final grade will be the weighted average of the different grades as shown in the table below:

criteria	percentage	Learning Objectives	Comments
Final Exam	40 %		Session 25
Class Participation	10 %		Continuously
Intermediate tests	30 %		Sessions 11 and 20.
Asynchornous activities	20 %		Sessions 9 and 18 (15%). And other sessions. (5%)

RE-SIT / RE-TAKE POLICY

Your final grade on 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)

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 ACTIVITIES 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 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).

For students in the third call the evaluation system is the following:

FINAL GRADE = 0.15x(A) + 0.20x(E1) +0.20x(E2) + 0.45x(FE)

BIBLIOGRAPHY

Compulsory

- Ian Jacques. (2023). *Mathematics for economics and business.* 10th. Pearson. ISBN 9781292720142 (Digital)

Recommended

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

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.

ETHICAL POLICY

Please, check the University's Ethics Code here. The Program Director may provide further indications.