Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Applied Mathematics for Economics and Management (cód. 472)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT00905L	Mathematical Analysis I	Mathematics	6	Semester	162
ECN02314L	Principles of Microeconomics	Economy	6	Semester	156
INF00878L	Programming	Informatics	6	Semester	156
GES02311L	Introduction to Management	Management	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00906L	Mathematical Analysis II	Mathematics	6	Semester	162
ECN02319L	Principles of Macroeconomics	Economy	6	Semester	156
MAT10689L	Mathematics and Statistics Laboratory	Mathematics	6	Semester	156
MAT00920L	Fundaments of Operations Research	Mathematics	6	Semester	158
GES02351L	Introduction to Business Finnance	Management	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00907L	Mathematical Analysis III	Mathematics	6	Semester	162
ECN02353L	Macroeconomics I	Economy	6	Semester	156
ECN02352L	Microeconomics I	Economy	6	Semester	156
MAT10690L	Mathematics Programming	Mathematics	6	Semester	156
MAT02354L	Probability and Statistics	Mathematics	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00908L	Mathematical Analysis IV	Mathematics	6	Semester	162
GES10218L	Marketing Research	Management	6	Semester	156
MAT00912L	Complements of Probability and Statistics	Mathematics	6	Semester	162

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN02356L	Microeconomics II	Economy	6	Semester	156
ECN02358L	Econometrics I	Economy	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN02361L	Econometrics II	Economy	6	Semester	156
MAT00927L	Introduction to Stochastic Processes	Mathematics	6	Semester	156
GES02332L	Operation Management	Management	6	Semester	156
ECN10692L	* Project	Economy Management Mathematics	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00902L	Sampling	Mathematics	6	Semester	156
MAT10693L	Forecasting Models	Mathematics	6	Semester	157
MAT00919L	Multivariate Statistics	Mathematics	6	Semester	156
MAT00926L	Introduction to Quality Control and Reliability	Mathematics	6	Semester	156
MAT00932L	Discrete Mathematics	Mathematics	6	Semester	156
MAT00939L	Functional Optimization	Mathematics	6	Semester	156
ECN10694L	Complements of Econometrics	Economy	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN02357L	Macroeconomics II	Economy	6	Semester	156
ECN02344L	Financial Economics	Economy	6	Semester	156
ECN02360L	Monetary Economics	Economy	6	Semester	156
GES00009L	Real Investments	Management	6	Semester	156
GES02323L	Management Accounting I	Management	6	Semester	156
GES10695L	Financial Calculus	Management	6	Semester	156
GES00010L	Decision and Negotiation Analysis	Management	6	Semester	156

Group of Free Options

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN10692L	Project	Economy Management Mathematics	6	Semester	156
MAT00937L	Computational Methods	Mathematics	6	Semester	160

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT00902L	Sampling	Mathematics	6	Semester	156
MAT10693L	Forecasting Models	Mathematics	6	Semester	157
MAT00919L	Multivariate Statistics	Mathematics	6	Semester	156
MAT00926L	Introduction to Quality Control and Reliability	Mathematics	6	Semester	156
MAT00932L	Discrete Mathematics	Mathematics	6	Semester	156
MAT00939L	Functional Optimization	Mathematics	6	Semester	156
ECN10694L	Complements of Econometrics	Economy	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
ECN02357L	Macroeconomics II	Economy	6	Semester	156
ECN02344L	Financial Economics	Economy	6	Semester	156
ECN02360L	Monetary Economics	Economy	6	Semester	156
GES00009L	Real Investments	Management	6	Semester	156
GES02323L	Management Accounting I	Management	6	Semester	156
GES10695L	Financial Calculus	Management	6	Semester	156
GES00010L	Decision and Negotiation Analysis	Management	6	Semester	156

Group of Free Options

Conditions for obtaining the Degree:

*** TRANSLATE ME: Matemática Aplicada à Economia e à Gestão

Para obtenção do grau de licenciado em Matemática Aplicada à Economia e à Gestão é necessário obter aprovação a 150 ECTS em unidades curriculares obrigatórias e 30 ECTS em unidades curriculares optativas

distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC Obrigatórias num total de 30 ECTS

2º Semestre:

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre:

5 UC Obrigatórias num total de 30 ECTS

4º Semestre:

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

3 UC Obrigatórias num total de 18 ECTS

UC Optativas ou livre num total de 12 ECTS

6º Semestre

2 UC Obrigatórias num total de 12 ECTS

UC Optativas ou livre num total de 18 ECTS ***

Program Contents

Back
Linear Algebra and Geometry I (MAT00900L)
Systems of linear equations.
Matrices.
Determinants.
Vector spaces.
Linear applications.
Eigenvalues and eigenvectors.
Geometry of plane and space.
Quadratic forms.

Back
Mathematical Analysis I (MAT00905L)

Principles of Microeconomics (ECN02314L)

1. Introduction
1.1 Economics as a science
1.2 The economic problem: scarcity and choice
1.3 Society's technological possibilities
1.4 Review of mathematical tools and graphical analysis
1.5 The economic circuit

2. Model of Supply and Demand - Introduction
2.1 Market
2.2 Demand curve
2.3 Supply curve
2.4 Joint analysis of supply and demand
2.5 Government intervention in the market
2.6 Consumer surplus and producer surplus

3. Consumer behaviour
3.1 Utility and preferences
3.2 Static equilibrium of the consumer
3.3 Changes in income and prices: impact on consumer choices

4 Firm's production and organization
4.1 Basic concepts
4.2 Production
4.3 Costs
4.4 Firm's decision: optimal combination of factors

5. Markets
5.1 Perfect Competition
5.2 Monopoly

Programming (INF00878L)
- Introduction to programming: algorithms, variables, data types, arithmetic operators, logical values and operators, relational operators.
- Control structures: selection, repetition, decision making.
- Data structures: lists, tuples, dictionaries, sets.
- Working with text: string manipulation, text parsing.
- Functions and modularity.
- Using and creating modules.
- Methods (and classes).
- Looping structures.
- Working with files (I/O).
- Plots.
- Scientific computing libraries.

Note: The order may vary.

Introduction to Management (GES02311L)

Mathematical Analysis II (MAT00906L)

Principles of Macroeconomics (ECN02319L)

Mathematics and Statistics Laboratory (MAT10689L)
The programming in interactive system of symbolic and numerical calculation, and manipulation and visualization of data (mathematical packages SymPy, NumPy, Matplotlib and SciPy in Python, among others).
Introduction to the numerical methods of solving the nonlinear equations, data interpolation, numerical integration and differentiation, graphical visualization of the functions of one and two variables and optimization.
Introduction to Excel and R software. Elaboration of small functions in R.
Review of the basic concepts of statistics: population, sample and type of variables.
Univariate descriptive statistics: grouping of data, frequency table, graphical representation and summary statistics (location, dispersion, asymmetry, kurtosis and concentration). Empirical distribution function.
Bivariate descriptive statistics: graphical representation and contingency table.

Fundaments of Operations Research (MAT00920L)

Introduction to Business Finnance (GES02351L)
1. Introduction
2. The Role of Financial Markets
3. Financial Diagnostic
4. Fundamental Concepts of Financial Management
5. Analysis of Investment Projects
6. Study of Financing Mix (Funding Sources)

Mathematical Analysis III (MAT00907L)

1. Elements of Differential Geometry in R3
1.1. General information on the space Rn
1.2. Contours and parameterized curves
1.3. Length of arc. Parameterization by arc length
1.4. Curvature and torsion. Frenet-Serret formulas
1.5. Surfaces.
1.6. Tangent plane and normal line to a surface. Orientability.
2. Introduction to Complex Analysis
2.1. General.
2.2. Complex functions and analytic functions.
2.3. Cauchy-Riemann equations.
2.4. Laplace equation. Harmonic functions.
2.5. Geometry of analytic functions. ConformalÂ transformation.
2.6. Elementary complex functions.
(I) Exponential function
(Ii) trigonometric and hyperbolic functions
(Iii) logarithm function
(Iv) Generalized complex powers functions
2.7. Complex integration
(I) Path Integral
(Ii) Elementary properties
2.8. Fundamental Theorem of Calculus.
2.9. Cauchys theorem and its evolution.
2.10. Cauchy integral formula and applications
3. Ordinary Differential Equations
3.1. Definitions and generalities.
3.2. Exact equations and integrating factors.
3.3. Basic equations of 1st order
(I) equation with separable variables
(Ii) homogeneous equation
(Iii) homographic Equation
(Iv) linear equation of 1st order
(V) Bernoulli Equation
(Vi) Ricati Equation
3.4. Linear equations of 2nd order
(I) reduction of order.
(Ii) Particular solution of the nonhomogeneous equation
(Iii) homogeneous equation with constant coefficients
4. Systems of ordinary differential equations
4.1. Introduction and notations
4.2. Linear systems
4.3. Systems with constant coefficients
4.4. Linear periodic systems
4.5. Asymptotic behavior of solutions for linear systems.
4.6. Stability of solutions
4.7. Planar autonomous systems
5. Fourier series
5.1. Periodic functions.
5.2. Trigonometric series.
5.3. Euler formulas for Fourier coefficients.
5.4. Orthogonality.
5.5. Uniform convergence
5.6. Convergence and the sum of the Fourier series.
5.7. Functions with a generic period 2L
5.8. Expansion in series of sines and cosines
5.9. Periodic extensions

5.10. Complex Fourier series.
5.11. Fourier integrals.

Macroeconomics I (ECN02353L)

Microeconomics I (ECN02352L)

Mathematics Programming (MAT10690L)

Non-linear programming. Free optimization and optimization with constraints in the form of equality and inequality. Necessary and sufficient conditions of optimality, Lagrange multipliers, KKT conditions.

Numerical methods of optimization. Free optimization of functions of one and several variables. Constrained optimization: penalty functions, interior point method.

Integer and mixed programming. Multi-objective optimization. Heuristic algorithms.

Formulation of mathematical programming models using the modeling languages (AMPL, MathProg, GAMS, LINGO, etc). Solving the models by software packages. Applications to Economics, Management, Natural Sciences and Engineering.

Probability and Statistics (MAT02354L)

Probabilities and Conditional Probabilities.

One and two-dimensional random variables (discrete and continuous).

Moments. Moment and probability generating functions.

Main probability distributions.

Point estimation (moment and maximum likelihood estimation methods and properties of estimators).

Confidence intervals for one and two populations.

Hypothesis tests for one and two populations.

Nonparametric alternatives for one and two populations.

Mathematical Analysis IV (MAT00908L)

Marketing Research (GES10218L)
I. Introduction and basic concepts of Marketing
II - Methodology for Data Collection

Decision about the type of information to collect.
Methods to collect primary data.
Measure and Scale Methods.
Construction of the instrument to sample data.
Sampling method
Work Field
III - Methodology for data analysis.
Steps of the process preparation data
Statistic techniques
Some specific methods useful in Marketing
 Clusters analysis
 Factorial analysis
 Multidimensional Scaling (MDS)
 Correspondence analysis
 Conjoint analysis
- Preferences analysis

Complements of Probability and Statistics (MAT00912L)

Microeconomics II (ECN02356L)

Econometrics I (ECN02358L)
THE SIMPLE REGRESSION LINEAR MODEL WITH CROSS-SECTIONAL DATA: Specification; Estimation; Expected Values, Variances and Properties of the Estimators.

MULTIPLE REGRESSION ANALYSIS WITH CROSS SECTIONAL DATA: Specification; Estimation; Functional Form and Transformation of Variables; Effects of Changing the Unit of Measurement; Expected Values, Variances and Properties of the Estimators; Multicolinearity; Inference; Prediction.

OTHER TOPICS OF LINEAR REGRESSION: Specification Analysis; Qualitative Regressors; Topics on Assymptotic Theory.

HETEROSKEDASTICITY: Properties of the Estimators; Estimation in the Presence of Heteroskedasticity, Heteroskedasticity Tests.

Econometrics II (ECN02361L)
BINARY CHOICE MODELS:
Linear probability model
Maximum likelihood estimation
Logit and probit models

BASIC REGRESSION ANALYSIS WITH TIME SERIES DATA:
Types of models
Trends and seasonality
Stationary and nonstationary time series.

AUTOCORRELATION AND HETEROSKEDASTICITY IN TIME SERIES REGRESSIONS:
Autocorrelation tests
Generalized least squares
Dynamically complete models
Heteroskedasticity
ARCH models

DYNAMIC MODELS AND FORECASTING:
Infinite distributed lag model
Stationarity and unit roots tests
Spurious regression and cointegration
Forecasting

PANEL DATA MODELS:
Fixed effects model
Random effects model

INSTRUMENTAL VARIABLE REGRESSION:
Motivation: Omitted variables and measurement error
Estimation
Endogeneity test and overidentifying restrictions test

SIMULTANEOUS EQUATION MODELS:
Reduced form model and structural model
The identification problem
Two stage least squares

Introduction to Stochastic Processes (MAT00927L)
General concepts of stochastic processes
Discrete-time Markov chains (including Monte Carlos simulation)
Introduction to branching processes
Continuous-time Markov chains (including Monte Carlo simulation)
Poisson processes
Bith-and-death processes
Introduction to queueing theory

Operation Management (GES02332L)
Part 1 - Introduction to Operations Management

What is operations management?
Operations Strategy
Demand forecasting methods

Part 2 - Design, analysis and improvement of the operating system

Quality management and statistical quality control
Product/service design
Processs design and tecnhology choice

Part 3- Operations system management

Supply chain management
Independent demand stocks management
Aggregated production planning
Resources planning: MRP, CRP and ERP
Lean production systems
Production Scheduling
Theory of constraints

Project (ECN10692L)
Research and writing of a short monograph, according to the standards and practices of academic writing.
The development of the essay will be done at two levels, at the conceptual and theoretical level with the appropriate critical and analytical framework, and also with the applied level by using the mathematics tools applied to economics and management.

Sampling (MAT00902L)
1. Basic notions on sampling and estimation.
2. Main steps about planning a sampling design and selection of sampling units.
3. Methods for data collection in survey sampling.
4. Simple random sampling.
5. Estimation of totals, means, proportions and ratios.
6. Ratio and regression estimation.
7. Stratified sampling.
8. Cluster and multi-step sampling designs.
9. Unequal probability sampling.

Forecasting Models (MAT10693L)
1. Introduction to generalized linear models
2. Time Series Linear models: ARMA, ARIMA and SARIMA models
3. Dynamic regression models
4. Application to real data using statistical software.

Multivariate Statistics (MAT00919L)
Exploratory Analysis of Multivariate Data
Correspondence Analysis
Multidimensional Scaling
Decision Trees
Software: SPSS and R

Introduction to Quality Control and Reliability (MAT00926L)

Discrete Mathematics (MAT00932L)
Sets
Induction
Combinatorics and counting
Recurrence
Graphs
Euclid algorithm
Modular arithmetic

Functional Optimization (MAT00939L)
Historical introduction.
Weak and strong variations.
Proof of validity of the Euler-Lagrange equation for simple integrals with C1 lagrangian in spaces of functions in competition of class C1.
Generalizations of the Euler-Lagrange equation: simple integrals containing n-th order derivatives of the functions in competition; double integrals; piecewise C1 functions in competition (Weierstrass-Erdmann corner point conditions).
Sufficient conditions for existence of minimum for integrals with lagrangean depending only on the velocity variable: weak and strong minima.
Necessary conditions for the existence of minimum under isoperimetric conditions.
Special important examples: geodesics, brachistochrone, minimal surfaces of revolution.
Control theory. Controlability. Optimal control.
Minimal time linear autonomous problems: existence of an optimal control and extremal controls; normality and uniqueness of the optimal control.

Complements of Econometrics (ECN10694L)

ESTIMATION METHODS: Maximum likelihood; Generalized method of moments; Quantile regression

MODELS FOR DISCRETE AND LIMITED DEPENDENT VARIABLES: Multiple choices; Count data; Proportions

MODELS FOR EXCESS OF ZEROS: Two-part models; Tobit; Self-selection

SAMPLING PROBLEMS: Missing data; Non-random samples; Measurement error; Outliers

ECONOMETRIC TIME SERIES MODELS; Economic long term relations; multivariate cointegration; VAR e VECM; Forecasting.

SIMULATION METHODS: Bootstrap; Monte Carlo.

Macroeconomics II (ECN02357L)

Financial Economics (ECN02344L)

The Intermediaries, Financial Markets and Products.
The Portuguese Financial System.
Interest Rate Theory: Parity and Term Structure.
Financial Investments and Risk: Default Risk and Financial Asset's Portfolio Management.
The Financial Instruments of Financial Risk's Management.

Monetary Economics (ECN02360L)

1. CURRENCY : HISTORY , DEFINITION AND MEASUREMENT{\\}newline

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1.1. The currency and financial system{\\}newline

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1.2. Evolution of forms and monetary systems{\\}newline

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1.3. Functional definition of money{\\}newline

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1.4. Statistical definition : monetary aggregates{\\}newline

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2 . The money supply{\\}newline

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2.1. The Monetary Creation{\\}newline

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2.2. The Monetary Control Creation{\\}newline

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3 . A MONEY DEMAND{\\}newline

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3.1. Classical perspective : quantitative relationship and dichotomous model{\\}newline

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3.2. Keynesian Perspective : currency ratio - interest rate{\\}newline

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3.3. Modern monetary theory and its influence on the conduct of economic policy{\\}newline

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4 . MONETARY POLICY{\\}newline

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4.1. The transmission mechanism of monetary policy{\\}newline

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4.2. The monetary policy strategy of the ECB{\\}newline

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4.3. Rules and reaction functions of monetary policy{\\}newline

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5 . The INTERNATIONAL MONETARY SYSTEM{\\}newline

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5.1. The foreign exchange market{\\}newline

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5.2. Supervision of SMI{\\}newline

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5.3. exchange rate regimes{\\}newline

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6 . THEORY OF INTEREST RATES{\\}newline

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6.1. The Fisher ratio and interest rate parities{\\}newline

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6.2. Term Structure of Interest Rates

Real Investments (GES00009L)
Module 1 - General Aspects and Framework on Investment Projects
Module 2 - Specific Aspects of Design and Analysis of Investment Projects
Module 3 - Economic, Social and Environmental Investment Projects Evaluation
Module 4 - Analysis of Investment Projects in Supernormal Profit Optics (EVA)
Module 5 – Introduction of Derivatives and Real Options Investment Evaluation

Management Accounting I (GES02323L)

Financial Calculus (GES10695L)
1. Introduction
2. Equivalence regimes and interest rates
3. Financial operations of short run
4. Ordinary annuities
5. Financial operations of medium and long run
6. Actuarial instruments and operations

Decision and Negotiation Analysis (GES00010L)
1. Introduction
2. Individual decision making under uncertainty
2.1. The elements of a decision problem
2.2. Representation of decision problems
2.3. Choice criteria without probabilities
2.4. Expected monetary value criterion
2.5. Expected utility theory
2.6. Methods for preferences extraction
2.7. Analysis of sequential decision problems
2.8. Software for decision analysis (Precision Tree)
3. Individual decision making with multiple objectives
3.1. Objectives and attributes
3.2. Efficient alternatives and tradeoffs among objectives
3.3. Utility function and selection of the best alternative
4. Decisions in the presence of strategic interdependency
4.1. Strategic and extensive form representation of a game
4.2. Static games with complete information
4.3. Dynamic games with complete information
4.4. Applications of game theory to management and economics
5. Negotiation Analysis
5.1. Characteristics of negotiation analysis
5.2. Bilateral negotiation with one issue and several issues

Computational Methods (MAT00937L)