COURSE DATA

Data Subject	
Code	36508
Name	Dynamic Modelling for Business Management
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1332 - Degree in Business Intelligence and Analytics	Faculty of Economics	3	Second term

Subject-matter

Degree	Subject-matter	Character
1332 - Degree in Business Intelligence and Analytics	8 - Matemáticas Avanzadas	Obligatory

Coordination

Name	Department
RUIZ FEMENIA, PEDRO DAVID	257 - Business Mathematics

SUMMARY

Dynamic Modelling for Business Management is a compulsory semester course taught in the third year, second semester of the Degree in Business Intelligence and Analytics and consists of a total of 6 credits.

This course studies the mathematical tools that are essential to analyze the behavior, over time, of any economic situation. Specific methods will be shown to analyze the stability of solutions in continuous and discrete time. In addition, systems of equations will be used to analyze several dynamical systems occurring simultaneously. An introduction to dynamic systems described by stochastic processes, involving random variables, will also be given.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is recommended to have passed the courses Mathematical Models for Management, and Probability, Uncertainty, and Inference.

OUTCOMES

1332 - Degree in Business Intelligence and Analytics

- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Acquire basic training that can be used to learn new methods and technologies and to adapt to new situations in academic and professional areas.
- Be able to solve problems and to communicate and spread knowledge, skills and abilities, taking account of the ethical, egalitarian and professional responsibility of the activity of business intelligence and analytics.
- Be able to produce models, calculations and reports, and to plan tasks in the specific field of business intelligence and analytics.
- Be able to access and manage information in different formats for subsequent analysis in order to obtain knowledge through data.
- Be able to make autonomous decisions in digital environments characterised by the abundance and dynamism of data.
- Know and know how to properly use the appropriate quantitative and qualitative methods to reason analytically, evaluate results and predict economic and financial magnitudes.

- Be able to apply analytical and mathematical methods for the analysis of economic and business problems.
- Demonstrate skills for analysis and synthesis.
- Be able to analyse and search for information from diverse sources.
- Be able to learn autonomously.
- Be able to use ICT, both in academia and in professional practice.
- Be able to define, solve and present complex problems systemically.
- Be able to work in a team demonstrating commitment to quality, ethics, equality and social responsibility.
- Express situations of uncertainty and randomness using mathematical, synthetic and graphic languages.
- Make decisions under certainty and uncertainty.
- Reach strategic diagnoses in complex and uncertain environments using appropriate methodologies.
- Know the basic concepts of logic, algorithmics, computational complexity and their application to business intelligence.

LEARNING OUTCOMES

To pass the course the student must prove that the has acquired the following skills:

- Increased ability to use logical/strategic reasoning to address real world economic situations.
- Use of advanced quantitative tools and their application in an economic context.
- Ability to select a theoretical framework for the development of the analysis.
- Being able to apply different methods and techniques of analysis using computer programs.

DESCRIPTION OF CONTENTS

1. Introduction to dynamic systems

Types of dynamic systems. Components of a dynamic system: state variables, parameters. Stock and flux diagrams. Feedback and balance loops. Delays.

2. Discrete-time dynamical systems

First-order finite difference equations (FDE). Equilibrium points. Solution of linear EDFs. Nonlinear EDFs. Nonlinear FDE. Bifurcation and chaos diagrams. Stability. Systems of FDE. Applications.

3. Continuous time models

Ordinary differential equations (ODE). Separable equations. First-order linear ODEs. ODE systems. Nonlinear ODEs. Stability analysis.

4. Stochastic processes

Basic concepts about financial markets. Stock prices as stochastic processes. Pricing options and arbitrage. Binomial model. Wiener processes. Introduction to stochastic differential equations and Itô's calculus. Geometric brownian movement. Black-Scholes model for option pricing.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Computer classroom practice	30,00	100
Development of group work	5,00	0
Development of individual work	5,00	0
Study and independent work	15,00	0
Preparation of evaluation activities	30,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The teaching methodology to fulfill the course's objectives will be based on theoretical and hands-on classes in which the teacher will promote the use of mathematical and symbolic language and rigorous and systematic reasoning, and will encourage the autonomous work of the student both independently and collaboratively.

In the theoretical lectures, the teacher will highlight the main aspects of each topic, will give typical examples and will guide the study of the students through the materials available in the Virtual Classroom and the basic bibliography. The explanations will be combined with the participation of the students through the discussion of proposed exercises and/or brief questions posed by the teacher for class discussion of the most frequent doubts. At the end of the class, the materials needed for the next class will be indicated, so that the student can prepare the next session. It is intended that the student develops his/her capacity for autonomous work (through his work prior to the lecture) and his/her ability to argue rigorously using mathematical and symbolic language.

Along with these lectures, hands-on training classes will be carried out in which the theoretical knowledge will be applied to the analysis of business problems. The student's ability to define, solve and expose complex problems in a systemic way will be encouraged through the realization of exercises

and/or planned hands-on activities. These more complex cases may be solved by using computer programs such as interpreted programming languages (R / Python) or symbolic calculation languages (Mathematica / SymboLab). The planned hands-on activities (number, characteristics and location in the course schedule) will be detailed in the first class of each group, and will be published in the Virtual Classroom (http://aulavirtual.uv.es) or on the teacher's web page.

The theoretical and practical contents taught may imply that the students have to work out tasks or tests that will be subject to continuous evaluation by the teacher during the semester.

EVALUATION

The evaluation of the subject is based on a system consisting of the following parts:

Written exam on the day that the exam of the course is officially called, in which the specific competences of the subject regarding contents and their application will be evaluated (maximum score 7 points).

Continuous evaluation of the student in which the achievement of the general competences of the degree and the participation and involvement of the student in the teaching-learning process through the performance of exercises will be evaluated (maximum score 3 points). Continuous evaluation activities are not recoverable.

To pass the subject you must pass the written exam. The final grade will be obtained from the sum of the written exam grade plus the continuous assessment note. In case of not passing the written exam, the final grade will be a maximum of 4'5. Obviously, to pass the course you must obtain a final grade greater than or equal to five (5).

REFERENCES

Basic

- Shone, R. (2002) Economic Dynamics: Phase Diagrams and their Economic Application. Cambridge University Press.
- Gandolfo, G. (2010) Economic Dynamics. Springer.
- Calvo C. e Ivorra C. (2015) An Introduction to Economic Dynamics. Ed Tirant lo Blanc. Valencia.
- Wilmott, P., Howison, S. and Dewynne, J. (1995) The Mathematics of Financial Derivatives - A Student Introduction. Cambridge University Press
- Joshi, M. (2003). The Concepts and Practice in Mathematical Finance. Cambridge University Press

- Duggan, J. (2016) System Dynamics Modeling with R. Lecture Notes in Social Networks. Springer-Verlag.

Additional

- Gardiner, C. W. (2009) Stochastic Methods: A Handbook for the Natural and Social Sciences (Springer Series in Synergetics). Springer
- Voit, J. (2005) The Statistical Mechanics of Financial Markets. Springer
- Braumann, C. (2019) Introduction to Stochastic Differential Equations with Applications to Modelling in Biology and Finance. Wiley