



TECHNICAL SHEET OF THE SUBJECT

| Data of the subject | |
|---------------------|---|
| Subject name | Financial Mathematics |
| Subject code | E000011442 |
| Main program | Bachelor's Degree in Business Administration and Management (E-2) |
| Involved programs | Grado en Administración y Dirección de Empresas (E-2) [First year] Grado en Administración y Dirección de Empresas con Mención en Internacional (E-4) [First year] Grado en Administración y Dirección de Empresas y Grado en Relaciones Internacionales [First year] Grado en Administración y Dirección de Empresas (E-2) - Bilingüe en inglés [First year] Grado en Administración y Dirección de Empresas y Grado en Análisis de Negocios/Business Analytics [First year] Grado en Ingeniería en Tecnologías Industriales y Grado en Administración y Dirección de Empresas [Third year] |
| Level | Reglada Grado Europeo |
| Quarter | Semestral |
| Credits | 6,0 ECTS |
| Type | Compulsory |
| Department | Departamento de Métodos Cuantitativos |
| Coordinator | Susana Carabias López |

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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

The subject is designed to provide students with the knowledge and the resources that are needed to analyze and compare financial operations that are held in an environment characterized by certainty, as well as the foundations to solve problems associated with many kinds of financial transactions.

Prerequisites

Mathematics at high school level.

Competencies - Objectives

Competences

GENERALES

| | | |
|------------|--|--|
| CG1 | CG1 Adquirir una base de conocimientos sólida y relevante sobre la disciplina científica y empresarial | |
| | RA1 | Identifica, define y explora las problemáticas concretas del área de estudio de manera lógica y coherente dentro de un marco analítico adecuado. |
| CG3 | Capacidad para la resolución de problemas y toma de decisiones empresariales seleccionando y aplicando adecuadamente las técnicas pertinentes de análisis de datos | |
| | | Aplica los conceptos matemáticos y técnicas cuantitativas y cualitativas de análisis de datos necesarios |



| | | |
|--------------------|------------|---|
| | RA2 | para la resolución de problemas empresariales y apoyar el diagnóstico y toma de decisiones en la empresa. |
| CG5 | | Desarrollar habilidades interpersonales que refuercen el aprendizaje de un trabajo autónomo, bien organizado y planificado y que esté orientado a la acción y a la calidad. |
| | RA1 | Desarrolla habilidades académicas, interpersonales e instrumentales necesarias para la investigación independiente, relacionando los conocimientos adquiridos con las distintas aplicaciones profesionales o prácticas reales |
| ESPECÍFICAS | | |
| CE08 | | Conocimiento de técnicas matemáticas que permiten modelizar y resolver problemas en el ámbito económico-empresarial |
| | RA1 | Aplica la abstracción la simplificación para modelar en términos matemáticos el problema al que se enfrenta |
| CE09 | | Comprensión y correcta aplicación de los modelos matemáticos dinámicos y de valoración financiera |
| | RA1 | Conoce y sabe aplicar los conceptos de ley financiera y equivalencia financiera |
| | RA2 | Es capaz de interpretar la información instituciones de operaciones financieras e identificar su estructura |

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

BLOCK 1: FUNDAMENTAL ELEMENTS OF FINANCIAL MATHEMATICS

Topic 1: FINANCIAL CAPITALS AND FINANCIAL OPERATIONS

1.1 Financial capital: definition and unit of measure

1.2 Financial operations: definition

1.3 Financial operations: classification

Topic 2: FINANCIAL LAWS

2.1 Financial law as a criteria to project financial capitals

2.2 Commonly used laws of accumulation

2.3 Commonly used laws of discount

Topic 3: FINANCIAL EQUILIBRIUM



- 3.1 The equation of financial equivalence
- 3.2 The financial equilibrium of a financial operation
- 3.3 Income and effective rates. The rules of the Spanish Central Bank: TAE
- 3.4 Outstanding balance. Definition and calculation methods

BLOCK 2: FINANCIAL OPERATIONS IN THE LONG RUN

Topic 4: VALUATION OF ANNUITIES

- 4.1 Annuities: definition and classification
- 4.2 The value of constant annuities
- 4.3 The value of variable annuities
- 4.4 Application to financial decisions. NPV and IRR

Topic 5: PRIVATE LOANS

- 5.1 Concept and general overview
- 5.2 Classical amortization methods
- 5.3 Mortgage loans

BLOCK 3: INTRODUCTION TO MARKET VALUATION

Topic 6: OPERATIONS WITHIN "FIXED INCOME" MARKETS

- 6.1 Public promissory notes (Treasury Bills)
- 6.2 Government bonds
- 6.3 The market value of a loan
- 6.4 The term structure of interest rates (TTIR)

TEACHING METHODOLOGY

General methodological aspects of the subject

In-class Methodology: Activities

Master class: The teacher will explain the subject's basic concepts as well as the relationships between them, with emphasis on the fact that the same principles can be applied to study a wide range of financial operations. The material explained in each class will be based on the material taught in the previous ones; for this reason, to obtain the best results it is key to deeply assimilate previously learnt concepts.



In addition, the student is recommended to bring to each class the corresponding material.

Practical class: In each session we will discuss the exercises that the student worked out at home and we will present new problems to be solved in class. Quizzes will be administered as independent activities. The work may be submitted upon teacher's request at the end of a class. Students are expected to actively participate in the practical sessions with an adequate knowledge of the material, which will contribute to the student's overall score on the subject

Midterm exams: depending of the topic, midterm exams will have different formats and be more or less comprehensive; they will be designed to assess the student's understanding of the subject

Non-Presential Methodology: Activities

Preparation for the master class: At the end of each class, students are supposed to self-assess what they have learned and supplement it with the provided material. Students not achieving an optimum performance in the master class will be expected to talk to their teacher in order to identify the sources of their problem.

Preparation for the practical class: Before each practical class, students are expected to solve the exercises previously pointed out by the instructor .

Preparation and analysis of midterm exams: At the end of each topic, the student is expected to review all the concepts that they have learned and understand the relationships that exist between them and with the concepts learned in previous topics. When the student receives a graded test they should critically analyze their mistakes and talk to the professor in case the score does not correspond with their expectations.

Assignment I: once having made a group of three, the students are expected to select an actual loan and analyze it. They are expected to submit two reports, one at the beginning of the course and another at the end, by so reflecting their understanding progress.

Assignment II (non-mandatory): The students are expected to compare the presentation of a key concept of financial mathematics done in the basic bibliography with another source of their choice. Then, they are expected to produce a report based on this comparison.

Assignment III and IV (non-mandatory): The students are expected to apply the concepts of annuities to financial valuation problems, using the spreadsheet Excel.

SUMMARY STUDENT WORKING HOURS

| CLASSROOM HOURS | | |
|--|---|---|
| Lecciones de carácter expositivo | Ejercicios y resolución de casos y de problemas | |
| 36.00 | 24.00 | |
| NON-PRESENTIAL HOURS | | |
| Estudio individual y/o en grupo y lectura organizada | Ejercicios y resolución de casos y de problemas | Trabajos monográficos y de investigación, individuales o colectivos |
| 50.00 | 35.00 | 10.00 |
| ECTS CREDITS: 6,0 (155,00 hours) | | |

EVALUATION AND CRITERIA

| Evaluation activities | Evaluation criteria | Weight |
|-----------------------|---|--------|
| | <ul style="list-style-type: none"> To understands concepts | |



| | | |
|---|---|------|
| Tests for all groups in each specialty | <ul style="list-style-type: none">To properly apply these concepts to solve the problems that relate to financial operations | 75 % |
| Continuous evaluation exams | <ul style="list-style-type: none">To understands conceptsTo properly apply these concepts to solve the problems that relate to financial operations | 10 % |
| Assignments | <ul style="list-style-type: none">To identify quality informationTo identify the relevant information for a given problemTo correctly interpret the information provided by a financial institutionTo correctly apply the concepts related to specific loansTo learn how to quote and reference properlyTo develop concepts and conclusions by using a language that is consistent with what is requiredTo properly use the spreadsheet Excel to apply theoretical concepts | 10 % |
| Active involvement/Class participation | <ul style="list-style-type: none">To correctly perform the required workTo actively participate in class activity | 5 % |

Ratings

Evaluation rules are described in the following paragraphs. Each activity includes in parenthesis their weight in the student's overall course scores. These weights are applicable to students who enrolled for the first time (i.e. first call, en su primera convocatoria).

For students in their second or higher call (tercera convocatoria o superiores), or students with attendance waiver (dispensa de escolaridad), the course score will be the maximum between the final exam score and the score describe beforehand for students first-time enrolled (the latter will ONLY be applied to the activities that the student will decide to undertake).

Final exam (65%-75% Favorable compensation with continuous evaluation)

The purpose is to verify whether the student understands and manages the basic concepts that were explained during the classes, as well as to verify whether he/she is able to apply them to the analysis of the financial operations that were discussed during the course.

The final exam will be the same (and will be offered on the same date and time) of the remaining students of the same degree study.

Continuous evaluation exams (10%-20% Favourable compensation with final exam)

During the class time and on the dates announced in class, there will be three short midterm exams. The topics that will be covered in each midterm exam will focus on the concepts that teacher expects to be managed by the students on a normal understanding of the subject.

Midterms exams will under no circumstances be repeated and students not taking the exam gets a zero score for that midterm exam.

Subject to teacher's unquestionable opinion and provided a justifiable reason, the zero score earned in that exam might be excluded from the student's continuous evaluation score.

Assignments (10%) Students are expected to submit on, two extensive reports (the first report will be submitted again as a third revised assignment) focusing of the search and the analysis of financial information, Please see details on the documents that are available in Moodle. They can also submit three non mandatory reports which will be considered to improve assignments grade.

Active involvement / Class participation (5%): Another component of student's final evaluation will be their active involvement in classroom activities (such as asking question related to the subject, answering teacher's questions or solving exercises on the blackboard). Teacher may ask, at any time, to submit the exercises that were requested to the students in advance. This section of the evaluation is not focused on accurate figures but on the proactive, constant and regular work of the student.

WORK PLAN AND SCHEDULE

| Activities | Date of realization | Delivery date |
|---|-----------------------|----------------------|
| Assignment 1. Initial report. | week 2 | week 2 or 3 |
| Assignment 2 (non-mandatory) | Between week 2 and 5 | Between week 3 and 6 |
| Assignments 3 and 4 (non-mandatory) | Between week 9 and 12 | week 11 or 12 |
| Assignment 1. Final report. | week 12 and 13 | week 13 or 14 |

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

TEXTBOOK

Bonilla Musoles, MA, Ivars Escortell, AN & Ismael Moya CL 2006, *Matemática de las operaciones financieras: teoría y práctica*, Thomson, Madrid.

Kellison, ST 2009, *The theory of interest*. McGraw-Hill, New York

WEB SITES

Banco de España: <http://www.bde.es/>

Tesoro Público: <http://www.tesoro.es/>

Complementary Bibliography

Bonilla Musoles, MA & Ivars Escortell, MA 1994, *Matemáticas de las operaciones financieras : (teoría y práctica)*, AC, Madrid.

Broverman, S.A., 2017 *Mathematics of Investment and Credit*, ACTEX



COMILLAS

UNIVERSIDAD PONTIFICIA

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Syllabus
2022 - 2023

Francis, J. and Ruckman, C., 2018, *Interest Theory – Financial Mathematics and Deterministic Valuation*, ActuarialBrew

Gil Peláez, LO, Baquero, MJ, Gil, MA & Maestro, ML 1991, *Matemática de las operaciones financieras: problemas resueltos*, AC, Madrid.

Pablo López, AN 2000, *Manual práctico de matemática comercial y financiera*, Centro de Estudios Ramón Areces, Madrid.

Pablo López, AN 2002, *Valoración financiera*, Centro de Estudios Ramón Areces, Madrid.

Pablo López, AN de 2003, *Matemática de las operaciones financieras I*, UNED, Madrid.

Vaaler, L.J.F., Harper, S.K. & Daniel, J.W. *Mathematical Interest Theory (Third Edition)*, 2019, The Mathematical Association of America