

Course information	
ECTS	3
Degree	Master in Finance / Máster Universitario en Finanzas por la Universidad Pontificia de Comillas
Professor	Guillermo Corredor
Name	Fixed Income Derivatives
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Objectives

The course aims to provide the tools in statistics, mathematics, and numerical methods that students will need to understand the mathematical underpinnings of derivative valuation models, in the context of fixed income derivatives. The course begins with a thorough review of derivative pricing and stochastic processes, as these tools are paramount to understanding and applying interest rate models to pricing fixed income derivatives. After introducing the foundations of interest rate derivatives, the main frameworks of valuation are discussed and analyzed to provide a general overview of the available modeling approaches.

After completing the course, the student will be able to conduct a valuation procedure of a complex interest rate product using a continuous-time stochastic model for interest rates, communicating the main findings of the analysis.

General Competencies

CG.1 Project-based learning: Ability to develop and execute in its different phases collective financial projects based on real situations, proposing real solutions and making efficient all interactions with the team, clients and any other participant.

RA1. Ability to engage in the development of experimental collective projects based on the real world, managing and aligning customer needs with available resources, optimally distributing the work, communicating and projecting its different phases, proposing real solutions and making efficient all interactions with the team, customers and other stakeholders.

CG.3 Teamwork: Apply techniques and methodologies that promote teamwork and mutual collaboration in talent management projects to be carried out with companies and organizations.

RA1. Be committed and cooperate in the roles defined for the achievement of the goals related to the tasks, activities, projects and responsibilities defined and assigned.

CG.10 Technical Capacity: Capacity of analysis, synthesis and projection, applied to situations, problems and models in the financial field.

RA1. Able to deal with the analytical study of cases and scenarios, as well as to carry out synthesis of information and data.



Specific Competencies

CE04. Master the different techniques of valuation and modeling of derivative assets and contextualize them within the advanced management of real investment portfolios.

RA1. Understands the role of derivative products both in arbitrage situations and in the total or partial hedging of financial risks or speculative investment in the different organized and non-organized financial markets in which they are traded, understanding the role played by both leverage and credit risk in the transaction of these products.

RA2. Able to define, build and program valuation models for interest rate, equity, currency or commodity derivatives using financial mathematics and probabilistic calculus.

RA3. Analysis of fixed income derivatives for total or partial hedging of interest rate risks.

Contents

1. Derivative pricing and Stochastic Differential Equations

- 1.1. Single period discrete time model. Contingent claims
- 1.2. Multiperiod discrete time model. Martingales
- 1.3. Stochastic differential equations. Monte Carlo simulation
- 1.4. Change of probability measure

2. Foundations of interest rate derivatives

- 2.1. Definition of rates: spot and forward
- 2.2. Zero-coupon bonds and money market account
- 2.3. Forward Rate Agreement (FRA)
- 2.4. Interest Rate Swap (IRS)
- 2.5. Cap and Floor
- 2.6. Swaption
- 2.7. Structured products
- 2.8. Market quotes, bootstrapping, and interpolation of term structure of interest rates

3. Interest rate models

- 3.1. Modeling the Simple Forward Rate
 - 3.1.1. Bachelier
 - 3.1.2. Black
 - 3.1.3. Hagan (SABR)
- 3.2. Modeling the Instantaneous Short Rate
 - 3.2.1. Merton
 - 3.2.2. Vasicek
- 3.3. Modeling the Instantaneous Forward Rate
 - 3.3.1. Heath Jarrow Morton framework

Teaching methodology

The lectures will focus on the exposition of the main theoretical results that will then be applied to practical exercises. Most topics will be taught using a hands-on approach, developing simulation experiments using Jupyter Notebooks. Students are expected to take their own class notes and review thoroughly the concepts and exercises discussed during the lessons. The active participation of students is an essential piece of the learning process.



EVALUATION AND GRADING CRITERIA

Evaluation items / Graded activities	Weight (%)
Individual final assessment (Final Exam)	50%
Group final assessment (Case study)	30%
Class participation	20%

Grading criteria

1. All students must comply with 100% attendance on the days established for this course. Any absence must be justified.
2. The final grade corresponds to the weighted sum of the graded activities. Students must successfully pass each evaluation item.
3. Individual and group work must be submitted on time and in the form specified by the professor.
4. A final grade lower than 5 implies the need to take an extraordinary exam. The final grade for this exam may not exceed the median of the passing grades in the ordinary evaluation period.

The student enrolled in the second-year course must complete the individual and group tasks established by the course professor. The same evaluation criteria described in the Evaluation and Grading Criteria section will be maintained.

In circumstances not covered by this Teaching Guide, the Advantere School of Management Regulation and the General Regulation of Comillas will apply

Bibliography

- Brooks, R.E. and Chance, D.M. (2024). *Foundations of the Pricing of Financial Derivatives: Theory and Analysis*. Wiley.
- Brigo, D., and Mercurio, F. (2006). *Interest rate models: Theory and practice*. Springer Finance.
- Shreve, S.E. (2004). *Stochastic Calculus for Finance II: Continuous-Time Models*. Springer.