UNIVERSIDAD DE **MURCIA**

FACULTY OF **MATHEMATICS**

Mathematics of Financial Markets

Syllabus

Course code:	1610
Number of ECTS credits:	6
Semester:	2nd (February-June)
Prerequisites:	None
Recommended components:	Probability Theory (1590), Probability and Stochastic Processes (1595), Functional Analysis (1599)
Language of instruction:	Spanish (students are allowed to ask questions and write homeworks and exams in English)

Course description

The field Mathematics of Financial Markets has undergone a remarkable development since the papers by F. Black, M. Scholes and R. Merton in which the famous “Black-Scholes Option Princing Formula” was derived. In 1997 the Nobel prize in Economics was awarded to R. Merton and M. Scholes for this achivement (F. Black had died).

In fact, the idea of developing a “formula” for the price of an option goes back as far as 1900, when L. Bachelier wrote his thesis “Théorie de la spéculation” where he had the innovative idea of using a stochastic process as a model for the price evolution of a stock.

Financial markets represent nowadays one of the main points of application of mathematical analysis and probability theory. This course is an introduction to modern techniques of mathematical analysis and stochastic calculus that are used for valuation of financial products, portfolio optimization and measurement of financial risk.

Learning outcomes and competences

After completion of this course you will:

1. be able to understand the the concepts of non arbitrage, hedging and futures;
2. know how to use finite probability models to price stock options with the binomial model, numerically handle the trees and calculate over them;
3. understand and manage the Brownian motion concepts and Itô integral with numerical examples;
4. understand the Black-Scholes model to price derivative products;
5. be able to use computer applications with graphical and numerical resources to display the stochastic calculus and to manage practical problems in finance.

Course contents

1. Introduction to financial terminology: markets and money, buying and selling options, non-arbitrage and hedging.
2. Binomial model. Pricing call and put options.
3. Relationship between non-arbitrage and martingales. Risk neutral measures. Fundamental Theorem of Asset Pricing.
4. Introduction to Brownian motion and stochastic calculus.
5. The Black-Scholes's model. Dinamic hedging and pricing options.
6. PRACTICES. Hedging and pricing with binomial models. Stochastic calculus and Itô integral. Black-Sholes call and put pricing options.

References

1. Bobrowski, A. *Functional Analysis for Probability and Stochastic Processes.* Cambridge University Press, 2005.
2. Capinski, M. and Zastawniak, T. *Mathematics for Finance. An introduction to financial engeneering.* Second edition Springer Undergraduate Mathematics Series. Springer, 2011.
3. Cerny, A. *Mathematical Techniques in finance.* Second edition. Princeton University Press, 2009.
4. Cvitanic, J. and Zapatero, F. *Introduction to the Economics and Mathematics of Financial Markets.* The MIT Press, 2004.
5. Delbaen, F. and Schachermayer, W. *The Mathematics of Arbitrage.* Springer, 2006.
6. Dineen, S. *Probability Theory in Finance. A Mathematical Guide to the Black-Scholes Formula.* Graduate Studies in Mathematics, 2005.
7. Higham, D.J. *An Introduction to Financial Option Valuation. Mathematics, Stochastics and Computation.* Cambridge University Press, 2004.
8. Shreve, S. *Stochastic Calculus for Finance I. The Binomial Asset pricing Model.* Springer finance Textbook. Springer, 2004.