UNIVERSIDADE DA CORUÑA

Teaching Guide			
Identifying Data			2021/22
Subject (*)	Mathematical modeling in finance	Code	614855211
Study programme	Mestrado Universitario en Matemática Industrial (2013)		

Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	6

Language	Spanish		
Teaching method	Face-to-face		
Prerequisites			
Department	Matemáticas		
Coordinador	Vazquez Cendon, Carlos	E-mail	carlos.vazquez.cendon@udc.es
Lecturers	Calvo Garrido, María Del Carmen Vazquez Cendon, Carlos	E-mail	carmen.calvo.garrido@udc.es carlos.vazquez.cendon@udc.es
Web	m2i.es/docs/modulos/EModelizacion/MBasica/6.%20Modelos%20matematicos%20en%20finanzas.pdf		
General description	It is intended that the student knows the most used mathematical models and methods for the valuation of the most common financial derivative products.		
Contingency plan	1. Modifications to the contents: there are no modifications 2. Methodologies *Teaching methodologies that are maintained: all mehodologies are maintained *Teaching methodologies that are modified: all mehodologies are maintained 3. Mechanisms for personalized attention to students: Consultation of doubts by email, videoconference system of the master, TEAMS or skype. Available to the student, setting an appointment between the student and the teacher if necessary. 4. Modifications in the evaluation: - Individual solution of selected problems posed in classroom which represents 40% of the grade. - Oral defense through videoconference system of the individually solved selected problems, with questions from the teacher, which represents 15% of the grade. - Set of exercises to be solved in limited time. The development of this written exam will be followed through the master videoconference system in real time. Answers will be sent by e-mail to the teacher. It represents 35% of the grade. - Oral defense through videoconference system of the previous written exam, with questions from the teacher. It represents 10% of the grade. *Evaluation observations:The criteria for the 2nd assessment opportunity are the same as in the 1st assessment opportunity 5. Modifications to the bibliography or webgraphy: There are no modifications.		

Study programme competences	
Code	Study programme competences
A1	Alcanzar un conocimiento básico en un área de Ingeniería/Ciencias Aplicadas, como punto de partida para un adecuado modelado matemático, tanto en contextos bien establecidos como en entornos nuevos o poco conocidos dentro de contextos más amplios y multidisciplinares.
A2	Modelar ingredientes específicos y realizar las simplificaciones adecuadas en el modelo que faciliten su tratamiento numérico, manteniendo el grado de precisión, de acuerdo con requisitos previamente establecidos.

A3	Determinar si un modelo de un proceso está bien planteado matemáticamente y bien formulado desde el punto de vista físico.
A4	Ser capaz de seleccionar un conjunto de técnicas numéricas, lenguajes y herramientas informáticas, adecuadas para resolver un modelo matemático.
A5	Ser capaz de validar e interpretar los resultados obtenidos, comparando con visualizaciones, medidas experimentales y/o requisitos funcionales del correspondiente sistema físico/de ingeniería.
A6	Ser capaz de extraer, empleando diferentes técnicas analíticas, información tanto cualitativa como cuantitativa de los modelos.
A7	Saber modelar elementos y sistemas complejos o en campos poco establecidos, que conduzcan a problemas bien planteados/formulados.
A8	Saber adaptar, modificar e implementar herramientas de software de simulación numérica.
B1	Saber aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios, incluyendo la capacidad de integrarse en equipos multidisciplinares de I+D+i en el entorno empresarial.
B2	Poseer conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación, sabiendo traducir necesidades industriales en términos de proyectos de I+D+i en el campo de la Matemática Industrial
B3	Ser capaz de integrar conocimientos para enfrentarse a la formulación de juicios a partir de información que, aun siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos.
B4	Saber comunicar las conclusiones, junto con los conocimientos y razones últimas que las sustentan, a públicos especializados y no especializados de un modo claro y sin ambigüedades.
B5	Poseer las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo, y poder emprender con éxito estudios de doctorado.

Learning outcomes

Learning outcomes	Study programme competences		
Knowledge of the management of the most popular financial products, specially options and bonds	AC1 AC2 AC5 AC6 AC7	BJ1 BC3 BR1	
Knowledge and application of the usual techniques of stochastic calculus to solve the pricing problems	AC2 AC6 AC7	BJ1 BR1	
Knowledge of the dynamic hedging methodology to pose Black-Scholes mathematical models	AC2 AC3 AC7	BJ1 BC1 BR1	
For a given financial derivative, ability to pose the most suitable Black-Scholes pricing model	AC1 AC2 AC4 AC7	BC1 BC2 BC3 BR1	
Knowledge of the most suitable numerical methods to solve the Balck-Scholes models for the different financial products, either with one or two stochastic factors.	AC4 AC5 AC8	BC1 BC2 BC3 BR1	
Knowledge about models of financial risk and the associated computations	AC1 AC2 AC5 AC6 AC7	BJ1 BC1 BC2 BC3 BR1	

Contents

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Topic	Sub-topic
1. Financial markets and financial derivatives	
2. Discounted value of riskless financial products	
3. Pricing models for risky assets	
4. Dynamic hedging methodologies and Black Scholes models	
5. Black-Scholes models for options and bonds with one stochastic factor	
6. Black-Scholes models for options and bonds with two stochastic factors	

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Problem solving	A2 A3 A4 A5 A6 A7 B5 B3 B1	0	60	60
Problem solving	A2 A3 A4 A5 A6 A7 B5 B3 B1	0	36	36
Objective test	A2 A3 A6 A7 B5	4	0	4
Guest lecture / keynote speech	A1 A2 A3 A4 A5 A6 A7 A8 B2 B5 B3 B1 B4	42	0	42
Personalized attention		8	0	8
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Problem solving	A set of problems is delivered to the student, some of them shorter to understand and practice concepts and technique, others are more complex.
Problem solving	- In the .pdf documents exhibited during lectures the are some easy exercises to review and apply the explained concepts - Moreover, some bibliographic references are indicated that contain exercises related to the developed subject
Objective test	Several problems are posed to be solved by the student who can use the slides containing the explanations in the lectures
Guest lecture / keynote speech	- Previously to lecture sessions, a .pdf document with the slides to use in the lecture is delivered to students - Table PC and videoconference facilities will be used so that lectures can be followed by the students from the different campus - Paricipation of students with quetions and comments will be encouraged. Questions will be solved and comments will be illustrated by means of Windows Journal computer application

Personalized attention	
Methodologies	Description
Problem solving	Those problems solved by each student making part of the qualifications will be assessed

Assessment			
Methodologies	Competencies	Description	**Qualification**
Objective test	A2 A3 A6 A7 B5	A written exam of practical applications of the lectured contents will take place in a fixed date. In case of failing, a recovery exam will take place in a later fixed date	60
Problem solving	A2 A3 A4 A5 A6 A7 B5 B3 B1	A set of exercises proposed to be solved outside classroom timetable will be evaluated	40

Assessment comments

Sources of information	
Basic	- I. Achdou, O. Pironneau (2005). Computational methods for options pricing. SIAM - J.C.Hull (2000). Options, Futures and Other Derivatives. Prentice-Hall Inc., (New Jersey) - T.Mikosch (1998). Elementary Stochastic Calculus with Finance in View. World Scientific, (Singapur) - C.W. Oosterlee, L.Grzelak (2020). Mathematical modeling and computation in finance. World Scientific (london) - A. Pascucci (2011). PDE and martingale methods in option pricing. Bocconi University Press, Springer - R.Seydel (2007). Tools for Computational Finance. Universiteitext, Springer-Verlag - C. Vázquez (2010). An introduction to Black-Scholes modeling and numerical methods in derivatives pricing. MAT Serie A - P.Wilmott, S.Howison, J.Dewynne (1996). The mathematics of Financial Derivatives, A Student Introduction. Cambridge University Press - P.Wilmott, S.Howison, J.Dewynne (1996). Option Pricing: Mathematical Models and Computation. Oxford Financial Press - P.G.Zhang (1998). Exotic Options, A guide to second generation option. World Scientific (Singapur)
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Stochastic numerical methods/614855226
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Professional software in finance/614855218
Other comments