Course guide
200620 - QR - Risk Quantification

Unit in charge: School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona.
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Optional subject).
Academic year: 2023	ECTS Credits: 5.0	Languages: Spanish

LECTURER
Coordinating lecturer: CATALINA BOLANCÉ LOSILLA
Others: Primer quadrimestre:
CATALINA BOLANCÉ LOSILLA - A
LUIS ORTIZ GRACIA - A

REQUIREMENTS
Basic notions of statistical inference (as in DeGroot and Schervish, 2012) and multivariate analysis (principal components; see, for instance, Peña, 2002).


DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
5. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
6. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
7. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
8. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
9. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
10. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
11. CE-9. Ability to implement statistical and operations research algorithms.
Transversal:
1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

2. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

3. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

4. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY
The course consists of weekly theoretical and practical sessions in which the student has to participate in the proposed activities. Practical cases are resolved in the computer and also the student must write a report of the results with a maximum of five pages where he/she shows his/her ability to master course contents.

LEARNING OBJECTIVES OF THE SUBJECT
- Understanding and knowing how to use statistical methodology for risk management in banks, insurance companies and similar institutions.
- Training researchers in quantitative risk techniques most recent, also to show the research topics in this area.
- Using the program R in the application of statistical techniques for quantification of risks.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>12.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>64.00</td>
</tr>
</tbody>
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Total learning time: 125 h
CONTENTS

1. Introduction

Description:
1.1 Basic concepts in risk management
1.2 Modeling value and value change
1.3 Types of risk
1.4 Some examples
1.5 Coherent risk measures

Related competencies:
MESIO-CE7. CE-7. Ability to understand statistical and operations research papers of an advanced level. Know the research procedures for both the production of new knowledge and its transmission.
MESIO-CE6. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
MESIO-CE5. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.

2. Risk quantification methods

Description:
2.1 Variance-Covariance
2.2 Historical Simulation
2.3 Monte Carlo
2.4 Examples

Full-or-part-time: 6h
Theory classes: 3h
Laboratory classes: 3h
### 3. Multivariate models for risk management e english

**Description:**
- 3.1 Multivariate Normal Distribution
- 3.2 Factor analysis in risk quantification
- 3.3 Spherical and Elliptical Distributions and Risk Quantification

**Full-or-part-time:** 10h  
Theory classes: 5h  
Laboratory classes: 5h

### 4. Measures of dependence and copulas

**Description:**
- 4.1 Definitions
- 4.2 Examples of copulas
- 4.3 Applications

**Full-or-part-time:** 8h  
Theory classes: 4h  
Laboratory classes: 4h

### 5. Extreme Value Theory

**Description:**
- 5.1 Generalized extreme value distributions
- 5.2 Pareto distribution and related
- 5.3 Hill method
- 5.4 Non-parametric estimation
- 5.5 Transformed kernel estimation

**Full-or-part-time:** 6h  
Theory classes: 3h  
Laboratory classes: 3h

### 6. Credit risk measurement

**Description:**
- 6.1 Instruments with credit risk
- 6.2 Structural models: the Merton model
- 6.3 Factor models for capital
- 6.4 Concentration risk

**Full-or-part-time:** 7h 30m  
Laboratory classes: 7h 30m

**GRADING SYSTEM**

- **Continuous assessment:** Students are asked to make a report of results applying the risk quantification techniques studied throughout the course to a portfolio of actions that will be designed by each student individually (40% of the grade). Two whole class sessions will be devoted to solving exercises individually (60% of the grade).
- **Single assessment:** The single assessment will consist of a written exam that will have five or six exercises. Some of these exercises will consist of interpreting the quantitative results of a given situation.
BIBLIOGRAPHY

Basic: