200620 - QR - Risk Quantification

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona
Academic year: 2018
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Spanish

Teaching staff

Coordinator: CATALINA BOLANCÉ LOSILLA
Others: Primer quadrimestre:
          CATALINA BOLANCÉ LOSILLA - 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,
200620 - QR - Risk Quantification

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>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>24.00%</th>
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<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<td>0.00%</td>
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<tr>
<td>Hours small group:</td>
<td>15h</td>
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<td>12.00%</td>
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<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>80h</td>
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<td>64.00%</td>
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### Content

#### 1. Introduction

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>1.1 Basics concepts of Risk Management</td>
</tr>
<tr>
<td>1.2 Definition of risk</td>
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<tr>
<td>1.3 Types of Risk</td>
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<tr>
<td>1.4 Notation</td>
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<tr>
<td>1.5 Some examples</td>
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**Learning time:** 7h 30m  
**Theory classes:** 7h 30m  

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#### 2. Multivariate models for risk management

<table>
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<th>Description:</th>
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<tbody>
<tr>
<td>2.1 Random Vectors and Their Distribution</td>
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<tr>
<td>2.2 Multivariate Normal Distribution</td>
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<tr>
<td>2.3 Spherical and Elliptical Distributions and Risk Quantification</td>
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**Learning time:** 10h 30m  
**Theory classes:** 10h 30m  

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#### 3. Measures of dependence and copulas

<table>
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<th>Description:</th>
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<tbody>
<tr>
<td>3.1 Definitions</td>
</tr>
<tr>
<td>3.2 Examples of copulas</td>
</tr>
<tr>
<td>3.3 Applications</td>
</tr>
</tbody>
</table>

**Learning time:** 10h  
**Theory classes:** 10h  

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#### 4. Risk Measures

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<th>Description:</th>
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<tbody>
<tr>
<td>4.1 Coherent risk measures</td>
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<tr>
<td>4.2 Value at Risk</td>
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<tr>
<td>4.3 Risk measures based on the distortion of the survival function</td>
</tr>
<tr>
<td>4.4 Aggregated risk measures</td>
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</tbody>
</table>

**Learning time:** 8h  
**Theory classes:** 8h
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

**Learning time:** 9h
- Theory classes: 9h

**Qualification system**

Continuous assessment: We propose to use risk quantification techniques reviewed throughout the course to analyse the risk of a portfolio of shares that each student will have to design (50%). A session will be devoted entirely to solve exercises individually (50%).

A Single Assessment: The single assessment consists of a written examination which will have five or six exercises. Some of these exercises consist of interpreting the results of a quantitative risk measurement situation.

**Bibliography**

**Basic:**