



# Course guide

## 200620 - QR - Risk Quantification

**Last modified:** 01/06/2023

**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

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**Coordinating lecturer:** CATALINA BOLANCÉ LOSILLA

**Others:** Primer quadrimestre:  
CATALINA BOLANCÉ LOSILLA - A  
LUIS ORTIZ GRACIA - A

### REQUIREMENTS

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

DeGroot, M.; Schervish, M. (2012) Probability and statistics. 4th ed. Pearson, 2012.  
Peña, D. Análisis de datos multivariantes. McGraw-Hill, 2002.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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.  
Translate to english
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**

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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**

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- 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**

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Type	Hours	Percentage
Hours small group	15,0	12.00
Hours large group	30,0	24.00
Self study	80,0	64.00

**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.

Translate to english

MESIO-CE3. 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.

MESIO-CE9. CE-9. Ability to implement statistical and operations research algorithms.

MESIO-CE1. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.

MESIO-CE2. 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.

CT5. 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.

CT4. 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.

CT3. 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.

CT2. 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.

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

Theory classes: 7h 30m

### 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

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### Basic:

- Jorion, P. Value at risk : the new benchmark for managing financial risk. McGraw Hill, 2007. ISBN 9780071464956.
- Coles, S. An introduction to statistical modelling of extreme values. Berlin: Springer, 2001. ISBN 1852334592.
- Resnick, S.I. Heavy-tail phenomena [on line]. New York: Springer, 2006 [Consultation: 04/07/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-0-387-45024-7>. ISBN 0387242724.
- McNeil, A.J.; Frey, R.; Embrechts, P. Quantitative risk management : concepts, techniques and tools. Princeton: Princeton University Press, 2005. ISBN 0691122555.
- Bolancé, C. ; Guillén, M. ; Gustafsson, J. ; Nielsen, J.P. Quantitative operational risk models (with examples in SAS and R). Chapman & Hall/CRC, 2012. ISBN 9781439895924.
- Adrian, T. and Brunnermeier, M.K. "CoVaR". American Economic Review [on line]. [Consultation: 04/07/2023]. Available on: <https://www-jstor-org.recursos.biblioteca.upc.edu/journal/amerconrevi>.