Degree:	2nd	**Field of Study:**	Master in Actuarial Sciences				
Code:	MR-CA	**Course name:**	Risk Models	**Credits ECTS:**	6		
Scientific field:	Statistics and Actuarial Science	**Department:**	Mathematics				
Curricular year:	1st	**Semester:**	1st: X / 2nd:	**Type:**	Obligatory: X / Elective:		
Responsible lecturer:	João Manuel de Sousa Andrade e Silva						

Contact hours:

Lectures	Praticals	Lectures/Praticals	Total	Total workload
		45.5	45.5	168

Aims and scope

The student is expected:

- To use statistical methods to define and estimate models adequate to model claims behavior or other relevant aspects of the actuarial work.
- To understand the assumptions implicit in each statistical technique.
- To recognize which assumptions and statistical techniques are appropriate to solve a given problem.

Summary

- Review of Basic statistical concepts
- Non-parametric estimation
- Frequentist estimation
- Bayesian estimation
- Model Selection
- Simulation and Bootstrap

Main bibliography

- Klugman, S.A., Panjer, H.H. and Willmot, G.E. (2012), *Loss Models – From data to decisions*, 4th Edition, John Wiley & Sons, Inc., New-Jersey.
- Hesterberg, T., Monaghan, S., Moore, D.S., Clipson, A., Epstein, R. (2003), *Bootstrap Methods and Permutation Tests* (http://bcs.whfreeman.com/pbs/cat_160/PBS18.pdf), companion chapter 18 to The practice of Business Statistics by David S. Moore, MCCabe, Duckworth and Sclove.
- Casella, G. and Berger, R. (2002), *Statistical Inference* (Second Edition). Duxbury Press.
- Efron, B. and Tibshirami, R.J. (1993), *An Introduction to the Bootstrap*, Chapman & Hall, New-York.
- Ross, S.M. (2002) *Simulation*, 3rd Edition, Academic Press.
- Seila, A., Ceric,V. and Tadikamalla,P. (2003), *Applied Simulation Modeling,* Duxbury Applied Series.
- Sharma, S. (1996) *Applied Multivariate Techniques,*John Wiley & Sons Inc., New-York.
- Wasserman, L. (2004), *All of Statistics: A Concise Course in Statistical Inference*, New York, Springer.

Teaching and assessment methodologies

The curricular unit will be taught by mean of theoretical-practical lectures using slides to underline the main points and using a computer to solve some examples. Student's autonomous work is a main point of teaching methodologies. Students must also solve a set of exercises. The final grade, on the scale of 0 to 20, is assigned on the basis of a written exam (75%) and an exam using the computer (25%) based on EXCEL and R.

COURSE CONTENT

1. Review of basic statistical concepts

- 1.1. Introduction – Population versus sample
- 1.2. Summarizing information
  - 1.2.1. Location, variability and other characteristics of a data collection
  - 1.2.2. Measures of relationship between variables
  - 1.2.3. Basics of Principal Components Analysis (PCA)
- 1.3. Sampling and sampling distribution
- 1.4. Point estimation with emphasis on measures of quality
- 1.5. Interval estimation
- 1.6. Tests of hypothesis

2. Non-parametric estimation

- 2.1. The empirical distribution for complete individual data
- 2.2. The empirical distribution for grouped data
- 2.3. Kernel density models

3. **Frequentist estimation**

- 3.1. Methods of moments and percentile matching
- 3.2. Maximum likelihood estimation (individual, grouped, censored and truncated data)
- 3.3. Variance and interval estimation
- 3.4. Non-normal confidence intervals

4. **Bayesian estimation**

- 4.1. Introduction
- 4.2. Definitions and Bayes' theorem
- 4.3. Inference and prediction
- 4.4. Conjugate prior distributions

5. Model selection

- 5.1. Introduction
- 5.2. Representation of the data and model
- 5.3. Graphical comparison of the density and distribution functions
- 5.4. Hypothesis tests
- 5.5. Selecting a model

6. Simulation

- 6.1. Basics of simulation
- 6.2. Examples of simulation in actuarial modeling and finance

7. An introduction to the bootstrap

- 7.1. Introduction to bootstrapping
- 7.2. Bootstrap distributions and standards errors
- 7.3. Bootstrap confidence intervals
- 7.4. Significance testing using permutation tests