UNIVERSIDAD DE MURCIA

FACULTY OF MATHEMATICS

Modelling and quantification of risks

Syllabus

Course code:	6366
Number of ECTS credits:	3
Semester:	1st (September-January)
Recommended components:	Real functions of a single variable I (1568), Real functions of a single variable II (1573), Functions of several real variables I (1578), Functions of several real variables II (1579), Probability theory (1590), Advanced probability and stochastic processes (1595).
Language of instruction:	Spanish (students are allowed to ask questions and write homeworks and exams in English)

Course description

In this course the student will study how to model and quantify risks in the context of actuarial theory and finances. It starts with the individual and collective risk models, and the student will be provided with statistical tools to get simulations of such models. Later the student will study the two main risk measures known as the value at risk (VAR) and tail value at risk (TVaR). To finish the student will study some probabilistic tools for the comparison of risks.

Learning outcomes and competences

After completion of this course you will:

1. understand the individual and collective risks models.
2. know how to obtain simulations of the individual and collective risk models using the notion of copula.
3. know statistical tools to fit a multivariate distribution to a vector of random risks.
4. know the VaR and TVaR risk measures, their properties and how to provide non parametric estimations of these measures.
5. know how to compare two portfolios of risks in terms of the VaR and TVaR risk measures.

Course contents

I. THEORY

1. Probabilistic models in risk theory
   Individual and collective risk models. Properties. Panjer's recursion.
2. Risk measures
   Quantile and stop-loss functions. value at risk (VaR). Tail value at risk (TVaR). Properties. Risk measures and elliptical distributions. Coherent measures.
3. Comparison of risks
   Stochastic comparisons in terms of the VaR and TVaR measures. Properties, characterizations, sufficient conditions and relationships. Comparison of portfolios.

II. COMPUTER PRACTISES

1. Fitting a univariate distribution to a random risk
   Fitting a univariate distributions, like normal, lognormal, generalized t-Student, gamma and Pareto, to real data sets using the package `fitdsitrplus` *with* `R`*.*
2. Fitting a copula to random vector of risks
   Fitting a copula to real data sets using the package `copula` *with* `R`*.*
3. Simulation of a portfolio
   Simulation of a portfolio, to provide non parametric estimations of the distribution function of the return of a portfolio, from real data sets using `R`*.*
4. Estimation of risk measures
   Non parametric estimation of VaR and TVaR risk measures using `R`*, from real data sets.*
5. Comparison of risk measures
   Non parametric validation of the comparison of risks in terms of VaR and TVaR risk measures using `R`*, from real data sets.*

References

Main texts

1. Belzunce, F., Martínez-Riquelme, C. & Mulero, J. *An introduction to stochastic orders*; Elsevier-Academic Press, 2015.
2. Denuit, M., Dhaene, J., Goovaerts, M. & Kaas, R. *Actuarial theory for dependent risks*, Wiley, 2005.
3. Kaas, R., Goovaerts, M., Dhaene, J. & Denuit, M. *Modern actuarial risk theory*, Springer, 2008.
4. McNeil, A.J., Frey, R. & Embrechts, P. *Quantitative risk management*, Princeton, 2015.
5. Nelsen, R.E. *An introduction to copulas*; Springer, 2006.
6. Shaked, M. & Shanthikumar, J.G. *Stochastic orders*, Springer, 2007.