USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA
DEPARTAMENTO DE ESTATÍSTICA E INVESTIGACIÓN OPERATIVA

"THESE DE DOCTORAT" REPORT.UNIVERSITE CLAUDE BERNARD. LYON 1

THESE: **"Modélisation de la dépendance et mesures de risque multidimensionnelles"**, by **Elena Di Bernardino**

The professor **Dr Wenceslao González Manteiga,** of the Department of the Statistics and Operation Research, in the University of Santiago de Compostela in Spain, nominated as a rapporteur of the comisión of the University Claude Bernard , Lyon 1, France, to evaluate the work of **Elena Di Bernardino**, **informs** about:

1. General aspects:

In this work different results for modeling the risk for two dimensional variables are considered. The thesis contains 4 chapters with some additional material on copulas, simulations and conclusions with perspectives for future work. At the end of every chapter a big list of references can be found.

The first chapter is devoted to describe the orientation of the thesis . Some important results related with the distributions of extremes are reviewed with special emphasis in copulas functions and generalizations to the concepts of VAR for the multidimensional case.

The second chapter is really already one finished paper. Using the concepts introduced in the previous chapter, some theory is developed to estimate the distribution of a vector of bivariate extremes, specially for the estimation of the bivariate tail using copula functions with the idea of modeling the behaviour of two extreme events in a bivariate random vector. Rates of convergence for the introduced non parametric estimators are obtained and the chapter is completed with simulations and real data. At the end of the chapter, in the acknowledgements, thanks are given to two referees. One proof that the chapter is going in a good way to be a published paper.

The third chapter is also other finished paper oriented to extend the concept of the value at risk or related functionals for the case of a bidimensional vector. Again the introduced concepts are illustrated with several examples.

The chapter four , for me the nicest one in the work, is devoted to estimate level sets associated to the estimation of the distributions in the tail and the general value at risk functions. So, the recent results on set estimation are revised and the new estimators are ilustrated in real data and simulations. Rates for convergence are given for the set estimators using the Hausdorff distance and the distance based on the Lebesgue measure of the symmetric difference of sets.

The thesis ends with complementary material and some perspectives for future work.

2. Importance of the topic.

The topic studied in this work is of big importance from different aspects, theoretical and practice. With respect of the theoretical field, nice probabilistic results are obtained related with the rate of convergence of the estimators of functions and sets. With respect to the practical aspects, all the concepts show their relevance in fields as for example the Actuarial Sciences.

3. Methodology:

The mathematical methodology is clear with the use of different mathematical arguments and the proofs are very rigorous. All the results in the work are very well presented.

4. References:

The references given in the different chapters are very accurate with the topic of the work. In general these references cover the more recent and interesting aspects of the topic studied in the literature in the last years.

5. Conclusions:

This work represents a good scientific advance in the study of estimation of the distribution of extremes for the bidimensional case. The real data illustrations are of big importance for the Actuarial Science and the numerical aspect of the work is very well documented in simulations. The thesis contains three chapters that really are finished papers. One of them, the chapter four is already published in the journal ESAIM: Probability and Statistics. The other two, soon will be published also in international reputed journals. **My vision about the work obtained is very positive.**

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