

Course on Financial Risks
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Much of the finance is concerned with measuring and managing financial risks. The return of an investment is its revenue as a fraction of the initial investment. For more assets, future returns cannot be known exactly and therefore are random variables. The risk measures uncertainty in the future from an investment. Because risk depends upon the probability distribution of a return, probability and statistics are fundamental tools for finance.

The objective of this course is to discuss how to measure the risks associated to assets which compose, for instance, a portfolio. We will present different approaches and in each case we illustrate them through several data sets.

Lesson 1: The probability distributions in finance: the interest of the Generalized Hyperbolic class of distributions.

The first lesson illustrates the poverty of the classical distributions (Gaussian, GED or Student distributions) used in finance to model assets and we introduce a general class of distributions which is more flexible taking into account the four first moments which characterize a price, permitting to take into account the features of the financial assets.

Lesson 2: Classical measures of dependence between assets composing a portfolio.

This lesson recalls the method used to measure the dependence between assets inside a portfolio and the risk measures associated to them (conditional correlation, concordance, transfert function and Kendall tau).

Lesson 3: Introduction to the copula concept and Value-at-Risk measure

We introduce the notion of copula which permits to work with n assets and to know their distribution function outside the assumptions of independence and Gaussianity. The risk measure known as Value-at-Risk is introduced.

Lesson 4: Properties and estimation of the copulas.

We specify in details the concept of copulas, introduce several classes of copulas and develop an estimation theory to use these copulas in practice. Illustrations are given.

Lesson 5: Notion of coherent measures

We discuss the choice of the Value-at-risk measure by the regulators and show the limit of this notion, proposing alternative measures;

Some references:

- Artzner P., F. Delbaen, J. Eber, D. Heath (1997), "Thinking Coherently", Risk, 10, 68-71.
- Caillault C., Guégan D. (2009) Forecasting VaR and Expected shortfall using dynamical Systems : a risk Management, Frontiers in Finance, 6 (1), 26 – 50.

- Dias A. and P. Embrechts (2004), "Dynamic Copula Models for Multivariate High-Frequency Data in Finance", In: Risk Measures for the 21st Century, ed. by Giorgio Szegoe, Wiley Finance Series, Chapter 16, 321-335.
- Guégan D. (2009) VaR computation in a non-stationary setting, ed. G. N. Gregoriou, C. Hoppe, C.S. Wehn, Handbook on "Model Risk: measuring, managing and mitigating model risk, lessons from financial crisis", Chapter 19, J. Wiley, 431 - 454.
- Guégan D., Zhang J. (2009) Change analysis of dynamic copula for measuring dependence in multivariate financial data, Quantitative Finance, Nov 2009.
- Joe N., Multivariate Models and Dependence Concepts, Chapman and Hall, London, 1997.
- Nelsen, R., An Introduction to Copulas, Springer, New York, 1999.

The exam is a project based on an article which will be given during the third course. The project will be sent for the 1st of June to Dominique Guégan. The objective of the project is to use and discuss the tools developed during the course to illustrate the article making simulations or developing the concepts with a real data set.