UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Risk Measures

2425-2-F1601M061-F1601M069M

Learning area

Learning objectives

The course aims to give the main tools for the risk measurement and management and to deepen the knowledge of the statistical tools learned during the basic courses of statistical inference and probability in order to improve the student's ability in analyzing financial time series.

Some numerical applications will be provided so that the theoretical insights can actually lead to an increase of the student's practical ability.

Contents

Value at Risk, Conditional Value at Risk, risk measures and optimization.

Detailed program

Preliminaries. Review on probability theory, quantiles, first and second order stochastic dominance and portfolio theory, and statistical inference.

Risk measures and portfolios of derivatives. Definition of a risk measure. Definition of Value at Risk (VaR) and outline of the Basel Committee rules. Examples of computation of VaR for discrete and continuous distributions. Properties of VaR. Computation of VaR for portfolios of stocks under the assumption of normality of the yields of

the stocks. Delta and Delta-Gamma approximations of the computation of the VaR of derivatives portfolios (under the assumption of normality of the yield of the underlyings). Outline of the estimation of the Variance-Covariance matrix. Historical simulations and Monte Carlo Method for the computation of VaR. Backtesting. Drawbacks and applications of VaR.

CVaR and optimization. Axiomatic definition of a coherent risk measure. Conditional Value at Risk (CVaR): definition, examples and coherence. Application of CVaR to portfolio optimization. Acceptance set of a risk measure and representation of risk measures via acceptance sets.
Coherent (and convex) risk measures and relation with utility theory.

Overview of dynamic risk measures, capital allocation problems and systemic risk measures.

Numerical examples and complements.

Prerequisites

Basic notions of mathematical analysis, probability theory, statistical inference, and informatics.

Teaching methods

The lessons will be held mainly in presence with traditional lectures and exercises. A small percentage (anyway, smaller than 30%) could be taken online (in streaming) in case of necessity.

The course consists in:

- 28 hours of lectures;
- 12 hours of exercises.

Around 80% of the course will be done in erogative mode, the remaining 20% in interactive mode.

Assessment methods

The exam is composed by a written part (composed by open questions and exercises) and an optional oral part. The final score takes into account the parts above.

The exam can be replaced - if agrred by the student - by the development and discussion of an assignment to be done and discussed necessarily by January 2025.

Textbooks and Reading Materials

Artzner, Delbaen, Eber and Heath (1999): “Coherent measures of risk”, Mathematical Finance.

Danielsson, J. (2011). Financial risk forecasting: the theory and practice of forecasting market risk with

implementation in R and Matlab. John Wiley & Sons.

Duffie, Pan (1997): “An Overview of Value at Risk”.

Follmer, Schied (2004): Stochastic Finance. An introduction in Discrete Time. De Gruyter. http://search.ebscohost.com.proxy.unimib.it/login.aspx?direct=true&db=nlebk&AN=388088&site=ehost-live&scope=site

Hull (2000):“Options, futures and other derivatives”; Prentice Hall.

Jorion (2000): “Value at Risk”, Mc Graw Hill.

Meucci (2005): “Risk and asset allocation”, Springer Finance.

Rosazza Gianin, Sgarra (2023): Mathematical Finance: Theory Review and Exercises. Springer

Wilmott (2003):“Introduzione alla Finanza Quantitativa”, Egea.

Sustainable Development Goals

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