

Summer School "Modern Models in Market Analysis"

25-30 June 2012

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3 lectures

Abstract

The importance of risk measures in the analysis and management of financial assets is well recognized, but new ideas have been developed which further expand the tools that are available. Risk can be modeled also through measures of deviation and regret. Statistical estimation in terms of factor models can be tuned to risk preferences in order to achieve better performance when applied to portfolio optimization. Value-at-risk (VaR) can be supplemented or even replaced by conditional value-at-risk (CVaR) and its mixtures. The CVaR risk measure also is called Expected Shortfall and mixtures of VaRs or CVaRs with different confidence levels are called Spectral Risk Measures. We will discuss advantages and disadvantages of these and other risk measures.

All this can now be placed in a unified framework called the fundamental quadrangle of risk. These lectures will explain this framework on an introductory level, providing many examples of importance in finance and related statistics. In addition to its broad potential in market analysis, the subject opens the way to new research in effective modeling and computation.

Reference:

Rockafellar R.T. and S. Uryasev. The Fundamental Risk Quadrangle in Risk Management, Optimization, and Statistical Estimation. Research Report 2011-5, ISE Dept., University of Florida, May 2012.

Submitted for publication to the Journal of Operations Research:

<http://www.ise.ufl.edu/uryasev/files/2012/05/quadrangle-WP.pdf>

Prof. Stan Uryasev, University of Florida and American Optimal Decisions, USA

2 lectures

Abstract

Risk management involves various risk measures: Variance, Value-at-Risk, Conditional Value-at-Risk, Drawdown, Omega, and others. This part of the course is focused on comparative analysis of risk measures in portfolio optimization setting. We will discuss statistical stability of estimates of risk

measures and inputs needed for portfolio optimization. We will present and explore portfolio optimization techniques with various tail risk measures. We will consider both long and short positions in the portfolio optimization settings.

Various case studies in Financial Engineering area with problem statements, data, and solutions are posted at this website: http://www.ise.ufl.edu/uryasev/research/testproblems/financial_engineering

KEY OBJECTIVES AND LEARNING OUTCOMES

- Observe pros and cons of various risk measures
- Learn efficient optimization settings and approaches with tail risk measures
- Portfolio optimization statements with various risk measures and constraints
- In-sample vs out-of-sample portfolio optimization runs
- Understand when portfolio optimization approaches can (and cannot) be used
- Learn about interface of optimization and statistics (e.g., statistics problems with constraints)
- Hand on experience in financial optimization case studies

OUTLINE

1. Pros and cons of tail risk measures

- Variance/(Standard Deviation) vs VaR, CVaR, and Maximum Loss
- VaR vs CVaR
- Dynamic versus static risk measures
- Drawdown (conditional drawdown-at risk) measure

2. Portfolio optimization: recent developments

- Mean-Variance optimization
- CVaR functions and constraints
- VaR functions and constraints
- Max-loss constraints
- Drawdown functions and constraints

- Omega functions
- Probability functions

3. Hedging: a special type of portfolio optimization problem

- Cash-matching problems for Fixed Income securities
- Pricing based on hedging considerations
- Credit risk hedging with Cardinality Constraints (on number of hedging instruments)

4. Case studies

- Portfolio optimization of a Fund of Funds composed of Hedge Funds: comparison of Variance, Mean Absolute Deviation, CVaR and Drawdown risk management
- VaR vs CVaR optimization of a portfolio of active managers
- Portfolio optimization to assure compliance with BASEL II requirements including regulatory (VaR) constraints and economic capital (CVaR) constraints
- Portfolio optimization with drawdown constraints for dynamic strategies in futures
- Calibrating default probabilities with Maximum Entropy approach and structuring CDOs