STONYBROOK UNIVERSITY
CENTER FOR QUANTITATIVE FINANCE
EXECUTIVE EDUCATION COURSE

NEXT GENERATION RISK MANAGEMENT
and
PORTFOLIO CONSTRUCTION

A four-part series

LED BY
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Next Generation Risk Management and Portfolio Construction offers a comprehensive series for understanding and applying the latest class of models for multi-asset-class quantitative risk measurement and the construction of resilient portfolios. These models accurately capture and describe the dynamics of risk across markets, asset-classes and market regimes including periods of market distress, high turbulence and transition.

A body of academic literature and courses on modeling, risk management and portfolio construction in highly volatile markets has been developed in recent years. Presented through clear and insightful illustrations, this lecture series is a unique blend of the most advanced theoretical modeling achievements with commercially-implemented portfolio examples, covering all major strategies and investment styles. These courses demonstrate how the theoretical concepts are applied in the investment process and translated into practical real world real-life decisions for traditional and alternative asset management.

Through lectures, case studies and software tools, you will progress through a four-part curriculum comprising Theoretical Foundations, Practical Applications, Exercises in MATLAB and High-frequency Models. While linked theoretically, these courses are independent, and any selection from the four is possible.

Receive a onetime $1,000 discount off each additional course when registering for more than one course.

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<th>Course</th>
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<tr>
<td>Theoretical Foundations</td>
<td>September 20 &amp; 21, 2011</td>
<td>Stony Brook Manhattan 387 Park Avenue South</td>
<td>$3,000.00 (USD)</td>
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<td>Practical Applications</td>
<td>September 26 &amp; 27, 2011</td>
<td>Stony Brook Manhattan 387 Park Avenue South</td>
<td>$3,000.00 (USD)</td>
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<td>Model Implementation (MATLAB based)</td>
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<td>Portfolio Selection with Transaction Costs</td>
<td>February 22 &amp; 23, 2012</td>
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To register for this program please visit
http://www.ams.sunysb.edu/QF/executivehome.shtml

CONTACT INFORMATION: 631-632-8370
NEXT GENERATION RISK MANAGEMENT

Theoretical Foundations

The theoretical foundations section is separated into 4 parts – (1) introduction, (2) fat-tailed models alternatives and building blocks, (3) risk measures, risk estimation and portfolio optimization and (4) derivatives pricing. We start by reviewing quantitative modeling of financial markets and the classical approaches to risk management and portfolio construction.

A discussion of the limitations of classical time series and risk models for forecasting financial markets and an assessment of various risk exposures in view of the empirical evidence of fat-tails, extreme returns dependence and dynamic correlations and skewness follows. We examine the building blocks of models to describe the market phenomena and the corresponding estimation techniques including stable Paretoan models, EVT, copula functions, and ARCH-type models. Various alternatives, their estimation methods and how these apply to the reality of the markets are presented.

The third part is the theory of risk measures (standard deviation, VaR, etc.), estimation and its employment for portfolio construction and risk budgeting. We will consider optimization techniques for normal and volatile markets. The theoretical background of coherent downside risk measures (i.e. AVaR) is covered. The concepts of reverse optimization and tail-risk budgeting are explained.

Finally, the course lays the ground for options pricing and hedging in the presence of fat-tails. It presents the theory of stable models.

September 20, 2011

10:00am - 12:00pm Introduction – background review
- Discrete Probability Distributions
- Continuous Probability Distributions
- Statistical Moments and Quantiles
- Joint Probability Distributions

12:00pm - 1:00pm Lunch

1:00pm - 3:00pm Fat-tailed models building blocks
- Univariate fat-tailed models
- Copula functions
- Estimation Methodologies

3:00pm - 6:00pm Stochastic processes
- Stochastic processes in discrete time and time series
- ARMA models
- ARMA Processes with Exogenous Variables
- GARCH models
- Introduction to Stochastic processes in continuous time
- Brownian motion and the Poisson process
- Cox Processes
- Compound Poisson Processes
- Transforms of Brownian Motion
- Fractional Brownian Motion
- Lévy process

September 21, 2011

10:00am - 1:00pm Risk measures, risk management and optimization
- Review of classical risk measures and estimation techniques (parametric and historical VaR, tracking error)
- Coherent risk measures
- Mean-variance optimization extensions in the presence of fat-tails – elliptical distributions, dispersion measures, mean-dispersion optimization
- ETL (AVaR) optimization
- Alternative performance measures (Farinelli-Tibiletti ratio, Sortino-Satchell ratio, Rachev ratio, and others)
- Introduction to Option Pricing: the Binomial Model and Black-Scholes Option Pricing Model
- Extension of the Black-Scholes Model and Alternative Approaches
- Local Volatility Models
- Stochastic Volatility Models
- Models with Jumps
- Models with Heavy-Tailed Returns and Tempered Stable Option pricing

1:00pm - 2:00pm Lunch

2:00pm - 4:00pm Option pricing
- Introduction to Option Pricing: the Binomial Model and Black-Scholes Option Pricing Model
- Extension of the Black-Scholes Model and Alternative Approaches
- Local Volatility Models
- Stochastic Volatility Models
- Models with Jumps
- Models with Heavy-Tailed Returns and Tempered Stable Option pricing
This session provides a working knowledge for aggregating multi-asset class portfolio risk and for portfolio construction for different strategies and asset classes. The seminar starts with a construction of a practical alternative to Gaussian risk factor distributions based on the Stable Distribution Framework extending it to Generalized Subordinated models. We discuss the following three components of the proposed model:

- **Univariate factor modeling:** Unlike normal distributions, stable ones capture the fat tails and asymmetries of real-world risk factor distributions.
- **Multivariate extensions:** Two alternatives of the multivariate model based on implicit and explicit copula functions are proposed as a generalization of overly restrictive linear correlation models to account for the dependencies between risk factors during extreme events. The main representatives of the copula functions are covered and illustrated in detail.
- **The third key building block presented as part of the proposed new generation model is the multivariate ARCH-type processes with stable innovations which accounts for joint volatility clustering.**

The variety of empirical examples demonstrate how the application of the three techniques results in a more accurate modeling of extreme risk event probabilities, and consequently delivers more accurate risk measures for both trading/live investment decision-making and risk management. Each component of the model is examined to show why it is essential for practical applications and what the consequences of dropping a particular model feature could be in terms of missed information on risk-return characteristics of the portfolio. For this, an extensive review of possible alternative fat-tailed models is presented that covers EVT, Cornish-fisher expansion, mixture models and others, as well as a variety of approaches for modeling the dependence structure between assets.

Participants will gain a functional understanding on:

1. How to translate and implement the theoretical body of knowledge of each class of fat-tailed models from part one into a practical high-dimensional framework.
2. Modeling of a single asset and multivariate models.
3. Alternative fat-tailed models: the good models, the not-so-good ones and how to discern and evaluate these. A check list for verifying fat-tailed model soundness.
4. How to apply fat-tailed models:
   a. In everyday risk management and portfolio building;
   b. During periods of intensifying market turbulence.
5. Risk budgeting and portfolio optimization in volatile markets.
   We explore which facets of the models to use for which purposes, such as short-horizon vs. long-horizon modeling. We explain how to deal with different asset classes and data frequencies? A special topic on incorporating alternative investments is included.

Six real-life case-studies shall be presented to show how fat-tailed models improve strategic asset allocation, boost risk management and introduce extreme loss prevention toolset. We will utilize the enhanced capabilities to evaluate hedging strategies and the performance of internal and external managers in a live setting.
September 26, 2011

10:00am - 12:00pm Key empirical phenomena and building blocks for multi-asset class portfolio risk fat-tailed framework Part 1

- Review and contrast the alternatives for the univariate models – coverage of the empirical phenomena, fitting challenges, dimensionality considerations
  1. EVT-based models
  2. Cornish-Fisher expansions
  3. Mixture models
  4. Sub-Gaussian subordinated models
  5. Examples

12:00pm - 1:00pm Lunch

1:00pm - 3:00pm Key empirical phenomena and building blocks for multi-asset class portfolio risk fat-tailed framework Part 2

- Review and contrast the alternatives for the multivariate models – coverage of the empirical phenomena, fitting challenges, dimensionality considerations
  1. Copula functions – Gaussian, Clayton, Archimedean copulas, T copula, asymmetric extended subordinated copula
  2. Embedded dependence in a subordinated model
  3. Examples

- Dimensionality reduction and factor modeling
  1. Statistic and time-series factor models
  2. Robust models and factor models for fat-tailed distributions

- Creating a fat-tailed model check-box list – how to differentiate good from not so good fat-tailed models

3:00pm - 4:00pm Risk budgeting based on fat-tailed models

September 27, 2011

10:00am - 12:00pm Modeling alternative investments

- Fitting models on short and unequal history
- Different data frequencies
- Non-linear models for hedge-funds returns

12:00pm - 1:00pm Lunch

1:00pm - 5:00pm The fat-tailed models in action

- Risk monitoring, tail-risk budgeting and extreme losses prevention, evaluation of hedging strategies, internal and external managers evaluation - 6 real-life case-studies covering equity long-only & long-short, fixed income and credit and alternative investments to be presented and discussed

3:00pm - 4:00pm Long-term fat-tailed models and strategic asset allocation
This course will provide risk assessment, budgeting and optimization of large scale financial portfolios in different market regimes.

The section will include a MATLAB implementation of the following topics:
1. Single asset returns modeling and forecasting – historical, normal and stable,
2. Volatility clustering estimation
3. Multivariate models
4. Measures of risk – Standard deviation, Value-at-Risk (VaR), Expected Tail Loss (ETL)
5. Portfolio Optimization and Risk Budgeting

As a result of these exercises the participants will be familiar with a MATLAB implementation of some of the latest quantitative methods for risk estimation, portfolio construction and risk budgeting.

A personal copy (for non-commercial use) of the software will be distributed.

October 5, 2011

10:00am - 12:00pm Single asset returns modeling and forecasting
  • Historical scenarios
  • Normal distribution – parameters estimation and scenarios generation
  • Stable distribution – parameters estimation and scenarios generation

12:00pm - 1:00pm Lunch

1:00pm - 3:00pm Volatility clustering estimation
  • GARCH(1,1) parameters estimation
  • Future paths generation

3:00pm - 4:00pm Multivariate models
  • Multivariate normal distribution fit and scenarios generation

October 6, 2011

9:00am – 11:00am Multivariate models continued
  • Subordinated stable distribution fit and scenarios generation
  • Time series factor model fit and scenarios generation
  • Fat-tailed model with volatility clustering – fit and scenarios generation

11:00am - 1:00pm Measures of risk – Standard deviation, Value-at-Risk (VaR), Expected Tail Loss (ETL)
  • Parametric estimation of portfolio risk
  • Fat-tailed Monte Carlo estimation of portfolio risk
  • Out-of-sample backtesting of portfolio risk

1:00pm - 2:00pm Lunch

2:00pm - 5:00pm Portfolio optimization and risk budgeting
  • Minimum portfolio risk problem – standard deviation vs ETL
  • Maximum portfolio reward-risk ratio problem – Sharpe vs STARR
  • Marginal contribution to risk estimation – standard deviation vs ETL
  • Implied return – Sharpe vs STARR
PORTFOLIO CONSTRUCTION
Portfolio Selection with Transaction Costs

Given the cost of trading and the size of trades, when does it make sense to trade and how much should you trade? How does trading impact the underlying characteristics of the portfolio such as risk, return, and covariance? This course is aimed at the asset manager or trader who wishes to answer these important questions.

Participants will learn how to:

• Mathematically model transaction costs, including slippage, taxes and induced costs
• Incorporate transaction costs into the Markowitz framework to create optimal portfolios
• Gain an understanding of the impact of variable trading costs and trade size on rebalancing decisions
• Interpret the “no trade region”
• Structure matrices in high dimensions for efficient computation
• Analyze portfolio performance graphically
• Expose hidden expected returns from differential portfolio selection performance

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<tr>
<td><strong>10:00am - 1:00pm</strong> Modeling transaction costs</td>
<td><strong>10:00am - 12:00pm</strong> Incorporating transaction costs into the Markowitz framework to create optimal portfolios (continued)</td>
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<tr>
<td>• Slippage and other cost components</td>
<td>• Hedging by Distortion of Expected Returns or Covariance</td>
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<td>• Introduction of transaction costs to the mean-variance optimization</td>
<td>• Special Case: Box Constrained Quadratic Program</td>
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<td>• Deterministic and nondeterministic costs-ultimate dominance of cost uncertainty</td>
<td>• Special Alternative Methods</td>
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<td>• Deterministic superproportional costs-optimality and no-trade regions</td>
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<td>• No-trade regions and information</td>
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<td><strong>1:00pm - 2:00pm Lunch</strong></td>
<td><strong>12:00pm - 1:00pm Lunch</strong></td>
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<tr>
<td><strong>2:00pm - 5:00pm</strong> Incorporating transaction costs into the Markowitz framework to create optimal portfolios</td>
<td><strong>1:00pm - 3:00pm</strong> Computational aspects</td>
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<td>• Constrained optimization and optimality</td>
<td>• Exploiting Easy and 'Code Free' Parallelism</td>
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<td>• Interior point approach to convex optimization</td>
<td>• Benchmarking for accuracy and speed</td>
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<td>• Structured Linear Algebra - interaction of Constraints and Hessian</td>
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<td><strong>3:00pm - 6:00pm</strong> Interpretation of results</td>
<td>• Simulation of portfolios against controlled data</td>
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<td>• Observe impact of variable trading costs and trade size on rebalancing decisions</td>
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<td>• Analyze portfolio performance graphically</td>
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<td>• Expose hidden expected returns from differential portfolio selection performance</td>
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WHAT YOU WILL LEARN

- The theoretical body of knowledge of various classes of fat-tailed models and how to discern and evaluate them.
- Understand the benefits of applying fat-tailed models:
  1. In everyday risk management and portfolio building.
  2. During periods of intensifying market turbulence.
  3. Portfolio construction approaches via risk budgeting and optimization based on fat-tailed models.
  4. Which facets of the models to use for which purposes: how to apply fat-tailed models on short-horizon versus long-horizon modeling, multi-asset-class portfolios and diverse data frequencies.

LEVEL OF MATHEMATICS

This course presents a quantitative approach to risk management and portfolio selection. A certain level of mathematical knowledge is beneficial including basic understanding of probability, calculus and some familiarity with mathematical manipulations. Exposure to mathematical statistics is recommended.

WHO SHOULD ATTEND

- Portfolio Managers, Risk Managers, Quantitative Analysts, Treasurers, Asset Managers, Consultants & Advisors, CFOs and CIOs:
  - Banks
  - Hedge Funds
  - Pension Funds
  - Endowments & Foundations
  - Funds of Funds
  - Family Offices
  - Corporate Treasurries
  - Insurance Companies

Organizers of Executive Education

- Stony Brook Department of Applied Mathematics and Statistics offers MS and PhD training in quantitative finance and is home to the University’s Center for Quantitative Finance. The department prepares practitioners who apply mathematical and computational methods to develop and exploit financial opportunities for return enhancement and risk control. The department, one of the country’s leading applied mathematics departments, offers a range of related coursework in applied statistics, operations research, and computational science.
- FinAnalytica is a leading provider of real world portfolio and risk management solutions for risk and portfolio managers. FinAnalytica’s Cognity suite of analytics incorporates a transparent framework for modeling fat-tailed returns. FinAnalytica clients include global fund of funds, hedge funds and asset managers.

FACULTY

Dr. Svetlozar (Zari) Rachev is Frey Family Foundation Chair-Professor in Department of Applied Mathematics & Statistics, Stony Brook University. He is one of the world foremost authorities in the application of heavy-tailed distributions in finance, author of 14 books and over 300 published articles on finance, econometrics, probability, statistics and actuarial science. He holds a Ph.D. from Lomonosove University (Moscow) and Doctor of Science Degree from Steklov Mathematical Institute (Moscow).

Dr. Boryana Racheva-Iotova is President of FinAnalytica. She leads FinAnalytica’s Research & Development team and product development of the Cognity platform that offers risk and portfolio construction analytics for funds of funds, hedge funds and asset managers. She was co-founder and CEO of the Bravo Risk Management Group - the originator of the Cognity product suite, which was later acquired by FinAnalytica. Her many articles have appeared in premier scientific journals and a forthcoming book will appear in Wiley-Finance. She has nearly 10 years of experience in building risk management solutions and utilizing the latest analytical advancements to meet the needs of financial industry practitioners.

Dr. Ivan Mitov is Head of Quantitative Research at FinAnalytica. He has been working for FinAnalytica for the past eight years studying and implementing heavy tailed distributions in the field of financial risk management and risk budgeting. Currently he is leading a team of ten quantitative analysts responsible for the research and implementation of the company’s quantitative models. Ivan Mitov holds a Ph.D. in Probability and Statistics from Sofia University considering heavy-tailed models and an application to the approximation of extreme operational losses. He also holds a M.S. degree in Mathematical Modeling in Economics and Finance from Sofia University and a B.S. degree in Applied Mathematics from Sofia University.

Dr. Mullhaupt is a Research Professor at the Center for Quantitative Finance at Stony Brook University. His original research interests involved partial differential equations and linear algebra. Prior to joining the faculty at Stony Brook he worked for over 20 years on Wall Street designing mathematically based trading systems, first at Morgan Stanley, then at Renaissance Technologies, and most recently at SAC Capital Management, where he recently retired from his position as Director of Research for the SAC Meridian Fund. He received his PhD from New York University.