16:958:534 Advanced Statistics for Risk Management Practice

1. This course will fill a gap in the creation of a formal Risk Management track within the FSRM program. It will enable students to select to specialize in financial risk management by taking, within the ten course curriculum, the sequence 16:598:590 - Foundations of Financial Statistics and Risk Management in their first semester, 16:598:534 – Advanced Statistics for Risk Management Practice in their second semester and 16:598:536 – Advanced Risk Evaluation and Management in their final semester. This new addition bridges a current gap between the 16:958:590 which establishes quantitative foundational concepts common to financial engineering and financial risk management and 16:958:536 which focuses primarily on case studies, research and projects using redacted financial firm and commercial vendor risk management data and case studies. It bridges this gap by covering the analytics involved in risk management practice areas including market, liquidity, credit, operational risk management and risk models. Risk management is an employment growth area in quantitative finance and students who complete this track will be directly employable in entry level quantitative and analytical risk management positions in banking, insurance and asset management institutions e.g. developing and validating models supporting regulatory required stress tests, regulatory and economic capital calculations, counterparty credit risk exposure and default risk assessments, pricing of interest rate sensitive risks and instruments, setting trading desk risk limits for equity, fixed income and commodity traded portfolios, underwriting retail and commercial loans, assessing risk of securitized and structured finance products and many other areas.

2. There are some courses, e.g. 26:390:571 Investments in the Rutgers Business School, that overlap in part with this course. However, the overlapping footprint with any particular course offered in another program is small. It would not be possible to replicate the coverage of this course without taking several other courses. Even if this were possible for an FSRM student to accommodate all of these in the FSRM program schedule and meet the required course obligation, which it is not, the replication would not be able to reproduce the tight logical and content integration of the three course risk management track sequence in this program or achieve the outcome of a robustly analytically trained risk management work-ready graduate.

3. Provides an extensive coverage of traditional, evolving and state-of-art statistical methods that are used in practice in specific “standard areas” of risk management practice including market risk, liquidity risk, credit risk, counterparty credit risk, collateral management, asset liability management, operational risk; enterprise risk management frameworks,; stress testing and scenario analysis and capital adequacy calculations as applied in financial institutions to meet regulatory mandated obligations; financial institution regulations (including Basel, Frank Dodd, Anti-Money Laundering, Know-Your-Customer).

4. Topics to be covered in the course:

1) Market Risk Measurement and Management

- VaR and other risk measures
    - Parametric and non-parametric methods of estimation
      (historical simulation, parametric, non-parametric (bootstrapping, age-weighting, volatility weighting, filtered historical simulation et al)
    - VaR mapping
      (Capturing general and specific risks, fixed income portfolio mapping; mapping forwards, FRAs, Swaps, options)
    - Backtesting VaR
    - Expected shortfall (ES) and other coherent risk measures
    - Extreme value theory (EVT)
      (EVT, POT, GP approaches)
- Modeling dependence: correlations and copulas
- Regression hedging, Principal Components Analysis applied to a hedging portfolio
- Term structure models of interest rates
  (including shape of term structure, drift and volatility short rate models)
- Discount rate selection
  (OIS discounting, funding costs, bootstrapping OIS and Swap-Rage zero curves)
- Managing Interest Rate Risks
- Volatility: smiles and term structures
  (including Shape of volatility smile versus shape of implied underlying asset price distribution and option prices, impact of asset price jumps on volatility smiles)

2) Credit Risk Measurement and Management

Credit analysis

• Default risk: Quantitative methodologies

- Merton model, credit scoring models, linear discriminant analysis, parametric discrimination, K nearest neighbor, SVMs, factors important to choosing a model
- Credit risk and credit derivatives (contingent claims, valuation of risky bonds, CDS, total return swaps – accounting for credit risk exposure)
- Credit and Counterparty Risk

        - default events, PD, EAD, LGD, EL, credit VaR, counterparty credit risk and mitigation
        - Spread risk and default intensity
    - Portfolio credit risk
    - Structured credit risk
    - Netting, compression, resets, termination
    - Collateral and Collateral Management
    - Credit Exposure

- Expected and unexpected loss
- Credit VaR
- Counterparty risk
- Credit derivatives
- Structured finance and securitization

3) Operational Risk

- Enterprise Risk Management (ERM)
- Modeling operational loss distributions
- Liquidity risk (including repurchase agreements and funding risks)
- Model risk
- Risk appetite frameworks
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital allocation
- Stress testing banks
- Evaluating the performance of risk management systems
- Failure mechanics of dealer banks
- Regulation and the Basel Accords

4) Other Topics

- Model Risk
- Liquidity Risk and Leverage

- REPOS and Financing
- RAROC and Economic Capital

5) The Buy-side: risk and investment management
    - Portfolio constructions
    - Portfolio risk and portfolio VaR (marginal, component, incremental)
    - Risk budgeting in portfolio management
    - Performance evaluation

Note: Readings will be taken from textbooks (including Kevin Dowd, “Measuring Market Risk”; Philippe Jorion, “Value at Risk”; Gunter Meissner, “Correlation Risk Modeling”; Bruce Tuckman, “Fixed Income Securities”, John Hull, “Options, Futures and Other Derivatives”; Jonathan Golin and Philippe Delhaise, “The Bank Credit Analyst Handbook”; Arnaud de Servigny and Oliver Renault, “Measuring and Managing Credit Risk”; Rene Stutz, “Risk Management and Derivatives”; Allan Matz, “Financial Risk Management – Models History and Institutions” and several others), Bank of International Settlements publications and research reports, Federal Reserve Guidelines and Reports, Office of Controller of the Currency reports, academic papers in journals.

Note: Grading will be based on homework, and team projects (including written reports and oral presentations). All materials covered with be enhanced with computational tools including R, Matlab and Python. All homework assignment will be on the application of the methods covered on real problems and data sets.