Syllabus for FRE 6731

Market Risk Management and Regulations

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Contents of the Course

Market Risk Management and Regulations

I. INTRODUCTION

Objective of the course is to introduce students to methodology of quantification of market risk and its major applications to the risk management and reporting, the market risk economic capital, and regulatory requirements for the risk measurement and reporting including CCAR, Basel 2.5 and 3, and FRTB.

In the process of the course the students will develop a complete Excel-based risk management system based FinCAD software. The system will encompass all major methodologies of the risk quantification and will produce regulatory required measures of the risk.

The syllabus consists of three sections: Lectures, Final Assignment, and Literature

II. LECTURES

Lecture 1

Exposure-based market risk measurement

- Risk: General Features and Terminology
- Focus on Market Risk
- Commonly Used Sensitivity Measures: Examples
- Risk Measures for Fixed Income Instruments
- Options Sensitivity Factors
- Accuracy of the Greeks Approximation

Home assignment

- Install FinCAD
- Derive an expression that relates Duration of a bond to its PV01
- Calculate all Greeks for European stock call option contract
- Determine limits of applicability of Delta- and Delta/Gamma approximations (I.e. accuracy of the approximations)
- Determine effective Delta/Gamma for large moves in the stock price

Lecture 2

Application of Greeks for Measurement and Management of Market Risk

- The Greeks-based measurement and monitoring of market risk
    - Risk limits, Scenario analysis
- Management of market risk. Static hedging
- Delta hedging
    - Hedging equity risk of stock option with stocks
- Cross-hedging. Hedge ratio
    - Hedging 30yr bond with 10yr bond
- Market risk for portfolio of fixed income instruments. Portfolio Greeks
- Advantages and limitations of the exposure-based risk measurement

Home assignment

- Download Data spreadsheet
- Plot and analyze time series of market factors
- Calculate STD of "portfolio" of three time series (IBM, HPC, and DELL) using Var/Covar matrix and non-parametric methods

Lecture 3

Forecasting probability distributions of market factors changes

- Properties of market factors changes distributions
- Forecasting distributions of market factors changes
- Three major parameters of VAR calculations
- Historical data quality requirements
- Optimization of the look-back interval by backtesting of the distributions

Home assignment

- Perform Back-Testing analysis to determine which look-back interval is better: 100, 50, or 25 days for time series of 5 yr Treasuries at Confidence Level of 97.8% by using both STD and NP methodology

Lecture 4

VAR, Expected Shortfall calculation

- Producing distributions of market value changes – approaches (Delta, Delta/Gamma, Full Valuation)
- Aggregation of market risk for portfolios of financial instruments VAR and ES calculation using parametric and non-parametric methods
- Three approaches to VAR: Variance/Covariance, Monte Carlo, and historical simulations. Comparison of their methodologies

Home assignment

- Calculate VAR, ES for a IBM put option using both the Sensitivities and the Full Valuation methodologies

Position: Long 100 IBM Put options with:

- *Strike = 102*
- *Vol = 20%*
- *Interest rate = 5%*
- *Holding cost = 5%*
- *Expiration date = 1 month from today*

Use Data2 file for historical prices and volatilities of the IBM stock

Lecture 5

VaR Applications: ES, Economic Capital. BIS Regulatory Capital Initiatives: Basel 1, 2, 2.5, FRTB

- VAR Applications
  - Using VAR for risk management

  - Market risk capital and VAR
- Expected Shortfall

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- Economic Risk Capital
- Basel on Regulatory Risk Capital
- Calculation of Regulatory Capital in Basel 1, 2, and 2.5 Frameworks
- Basel 3
- FRTB
- Economic vs Regulatory Risk Capital

Home assignment

- Calculate VAR for a portfolio of 4 instruments using FinCAD and Data02 historical data file (example):
  - *Long 300 IBM stocks*
  - *Long 600 IBM Put options*
    - *Strike = 102*
    - *Vol = 20%*
    - *Interest rate = 5%*
    - *Holding cost = 5%*
    - *Expiration date = 1 month from today*
  - *Short 100 ounces of Gold*
  - *Treasury Bond*
    - *$10,000 notional amount*
    - *Coupon = 5%*
    - *Maturity date = 10 yrs. from today*
- Calculate Marginal and Incremental VAR for the GOLD position

Lecture 6

Comprehensive Measurement of Market Risk: Stress Testing.
Fed Regulatory Initiatives: CCAR, Dodd-Frank

- Comprehensive Market Risk Measurement
  - VAR and Catastrophic Market Risk. Stress Testing
  - Methods of Development Stress Scenarios
  - The Fed Applications of Stress Testing: SCAR and CCAR Programs. Regulatory Stress Testing and Scenarios
  - Two Types of Market Risk: “Business-as-Usual” and Catastrophic Risk. Their Measurement and Management
  - Scenario Analysis: The Third Component of the Comprehensive Risk Management
- Major Regulatory Initiatives in The Dodd-Frank Act
  - Systemic Risk in Dodd-Frank Act
  - Establishing Restrictions on Trading Activities: Volcker Rule

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Home assignment

- Perform Stress Test of your portfolio:
  - *Develop 3 Comprehensive Stress Scenarios*
  - *Perform Stress calculations*

- Calculate BIS Market Risk Capital for the total portfolio

Lecture 7

Market risk reporting. Organization of risk management function

- Objectives and structure of market risk function in major financial institution
- Market risk limits, their structure and use for management of market risk. Limits allocation and management
- Risk reporting
- Market risk manager – qualifications
- Conclusions: future of market risk management

III. FINAL ASSIGNMENT

Part 1: Essay

Write an essay based on the analysis of the following papers:

- Richard Hopper "It's time we buried VAR"
- David Rowe "In defense of VaR"
- Ricardo Rebonato "Seeing the wood for the trees"
- Carl Batlin and Barry Schachter "The ten challenges left to tackle"
- Nasim Taleb "The forth quadrant"
- Nasim Taleb "Against Value-at-Risk: Nassim Taleb Replies to Philippe Jorion"

Part 2: Market Risk analysis of a portfolio of securities

Calculate Market Risk for a portfolio of 4 instruments (example)

- *Short 180,000 IBM stocks*
- *Long 260,000 IBM Put Options*
  - *Strike = 193*
  - *Vol = 18.02%*
  - *Interest rate = 0.395%*
  - *Holding cost = 0.395%*
  - *Expiration date = 1 month from today*
- *Long 100,000 barrels of oil*
- *Long Treasury Bond*
  - *$500,000,000 notional amount*
  - *Coupon = 3.0%*
  - *Maturity date = 30 yrs. from today*

Use DATA2 file and FinCAD software

Perform the following calculations:

1. Risk factors analysis

- Identify all relevant market factors
- Perform complete statistical analysis of the factors including
  - Graphs
  - Descriptive statistics

  - Back-testing
- Conclusions:

  - Are the distributions normal? Should we use Var/Covar or Historical Simulations methodology?
  - What is the optimal look-back interval?

2. Sensitivity Analysis

- Calculate all the Greeks
- Perform the accuracy analysis of the Greeks approximation (in relationship with the volatility of relevant historical data)

3. VAR calculations

- Calculate Full Valuation VAR
- Reform the Greeks calculation of VAR
- Compare results of both calculations (simulated P/L time series). Provide interpretation of the results

4. Stress and Scenario Analyses

- Identify appropriate catastrophic events. Derive scenarios for both Stress and Scenario analyses.
- Perform the Stress and Scenario analysis calculations
- Interpret the results

5. Risk Reporting and Interpretation Create a simple market risk reports for the portfolio

- Risk should be measured using:
  - Greeks
  - VAR
  - Stress
- Risk should be presented on
  - a position-by-position and
  - an aggregated basis
- Provide interpretation of the results

IV. LITERATURE

1. Philippe Jorion, "Financial Risk Manager Handbook", GARP
2. John Hull, "Risk Management and Financial Institutions", Prentice Hall
3. Steven Allen, "Financial Risk Management", Wiley Finance
4. Basel II Accord – Market risk section
5. Basel 2.5 - Revisions to the Basel II market risk framework – latest public version (Updated as of 31 December 2010)
6. Basel: Guidelines for computing capital for incremental risk in the trading book - final version
7. Basel Committee proposals on the Trading book (May 3, 2012)
8. "Minimum capital requirements for market risk", BIS, 2016
9. "Revisions to the minimum capital requirements for market risk", BIS, 2018

Reading and reference materials (literature) for sessions will be provided.