FIN 285a : Computer Simulations and Risk Assessment, Fall 2012

Instructor

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TA

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Times:

- Class Times: Mon/Wed 9:30-10:50

Course Description

Measuring and managing financial risk has been a critical task for institutions, regulators, and investors. Over the last half century, as markets have become more complex, this task has become more important. Modern technology has changed the playing field in risk measurement. Computers allow for measurement of risk across the enterprise at near up to the minute frequencies, which has led to demands for processing and interpreting this information. Computational tools have provided a key component in this mission. Analyses based on monte-carlo, or computer simulation methods allow us to produce future scenarios from which we can judge the overall risks we are currently exposed to. This course will introduce the computational tools and show how they can be used in various forms of financial risk assessment. We will look at classic statistical methods such as bootstrapping, and also other modern methods such as extreme value theory and copulas. We will apply these in different financial settings involving both market and credit risk. Finally, we will look at these computational tools from the perspective of the recent crisis and global financial policy going forward.

Learning Goals

1. Ability to apply computational statistical methods such as bootstrapping, and monte-carlo to questions of risk measurement in financial settings.
2. Understand how to implement small programs in the matlab programming language for use in financial analysis.
3. Assess the confidence of various risk measures given available data sets.
4. Learn how to quantify the impact of tail risk in many situations.
5. This course can be a rough preparation (with some more reading) for taking the financial risk manager (FRM) exam from the Global Association of Risk Professionals (GARP).

Prerequisites

FIN 201, or a basic knowledge of finance is essential. Fin 270 (Options and derivatives) would also be useful, but it is not required. Finally, a basic working knowledge of statistics is important too. You need to know concepts such as means, variances and distributions. A standard undergraduate course in mathematical statistics would cover this, or the IBS module 210f. Although computer skills will be taught in the course, some enthusiasm for programming will be useful. The course also assumes basic calculus equivalent to about 1 semester of calculus at the undergraduate level.

This course is designed for 2nd year IBS masters students (MA, MSF, MBAi). PhD students may also find some of the content useful as well.

Required Readings:

1. Danielsson, *Financial Risk Forecasting*, Wiley, 2011.
2. Marthinsen, *Risk Takers*, Second Edition, Addison-Wesley.
3. Griffiths, Matlab Lecture Notes.

Recommended Readings

1. Hull, *Risk Management and Financial Institutions*, Third edition, Wiley 2012.
2. Malz, *Financial Risk Management:Models, History, and Institutions*, Wiley, 2012.
3. Good, *Resampling Methods*, Third Edition, Birkhauser, 2006.
4. Hanselman and Littlefield, *Mastering Matlab 7*, Prentice Hall.

Required Software

Matlab programming language. Matlab is available on all the IBS computers. Also, our license will enable you to load one copy of matlab (and key toolboxes) on your own computer. Info will be emailed to you on this.

Grading

Grades will be based on problem sets (20%), a midterm exam (30%), a group project (20%), and a final exam (30%). The group project is due on the last day of class, Wednesday, December 12th. The Midterm will be Monday, November 5th, in class, 9:30-10:50AM. The final exam (block IB2) will be Friday, December 21, 9:15AM-12:15PM.

Communications

You are responsible for all announcements and materials in class. Also, much of the information in class will be sent over Latte and the class website.

Rules specific to Fin285

1. Exams

    1. Your own work.
    2. Closed book (no notes).
    3. No laptops, no cell phones, no pda's.
2. Problem sets
    1. Hand in your own work.
    2. Can talk and assist each other.
    3. Use all resources.
3. Group projects
    1. Own work for the group.
    2. Hand in one writeup per group.
4. Laptops: Please bring to class if you want to.

Academic Honesty

You are expected to be familiar with and to follow the University's policies on academic integrity (see http://www.brandeis.edu/studentlife/sdc/ai/). Instances of alleged dishonesty will be forwarded to the Office of Campus Life for possible referral to the Student Judicial System. Potential sanctions include failure in the course and suspension from the University.

Disability Statement

If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.

Course Outline

1. Introduction
2. Tools
    1. The Matlab computer language
       Danielson, appendix C
    2. Statistical tools and the financial bootstrap toolbox:
        1. Probability basics
        2. Sampling, monte-carlo, and bootstrapping
        3. Hypothesis tests
        4. Time series
           Danielson, appendix A
3. Financial data review
    1. Financial data reminder/review
       Danielson, 1.1-1.2
    2. Stylized facts of financial data
       Danielson, 1.3-1.7
4. VaR analytics
   Danielson, 4.1-4.4
    1. Basics and interpretations
    2. VaR issues
    3. Expected shortfall

Danielson, 4.5

5. Estimating VaR
   Danielson, 5.1-5.3, 7.1,7.3.1
   1. Parametric methods
   2. Historical VaR
   3. Computational methods and precision
   4. Method comparisons
      Finger, How historical simulation made me lazy, Research Monthly, Riskmetrics, April 2006.
   5. Time aggregation and longer horizons
      Danielson, 4.6, 5.4
      LeBaron, Searching for lost decades in U.S. and Global Equities, 2012.
   6. Extreme value theory
      Danielson, 9
   7. Capital requirements and VaR
6. Volatility forecasting
   1. Modeling volatility
      Danielson, 2.1-2.3, 2.7-2.8
   2. Using volatility forecasts
      Danielson, 5.5
      1. Basic empirical conditional volatility
      2. Implied volatility and VIX
      3. High/low range information and realized volatility
      4. Time series models, and volatility forecasting
7. Correlations and portfolios
   1. Correlations and portfolios
      Danielson, 7.4
   2. Copulas
      Danielson, 1.8
   3. Choosing a copula
   4. Dynamic copulas
   5. Risk/on risk/off
8. Fixed income and simple options
   Danielson, 7.2-7.3, light skim 6
   1. Bond and option pricing with simulation
   2. Options and partial risk hedges
9. Applications and examples
   1. Exotic options and path dependence
   2. Funding liquidity risk: Pairs trading
10. Default risk
    1. Measuring default risk
    2. Structured products
    3. Case: The Gaussian Copula and residential mortgages
       Hull and White, The risk of tranches created from residential mortgages, *Financial Analysts Journal,* 66, No. 5, 2010.
       Salmon, F., Recipe for disaster: The formula that killed Wall Street. *Wired Magazine* (February 23), 2009.
11. Backtesting/stress testing

Danielson, 8
Chistopersen, Backtesting.

12. More risks
    1. Operational risk
       Case: Barings Bank: Marthinsen, 7
    2. Liquidity risk
       Background: Hedge Funds
       Case: LTCM : Marthinsen, 8
       Case: Amaranth, Marthinsen, 9
       Case: JP Morgan, 2012.
    3. Adjusting VaR for systemic risk: CoVaR
       Adrian and Brunnermeier, CoVaR, Princeton University, 2009.
13. Risk and regulation: Summary, dangers, and crisis perspectives
    1. Danielson, 10
    2. Danielson et al., Endogenous risk, London School of Economics, 2011.
    3. Hull, The credit crunch of 2007: What went wrong? Why? What lessons can be learned?, University of Toronto, 2009.