

IOE 591: Portfolio Risk Analysis (3 credits)

Until recently, investment banks measured their risk with techniques that more closely resembled accounting than risk analysis. Regulators (the Fed in the United States, and the BIS in Europe) encouraged these methods by basing capital requirements on accounting information.

But the market risk of a portfolio (for example, the probability distribution of returns) was not well represented by non-statistical measures. In the 1990s, investment banks went looking for better ways to describe the risks in their portfolios. In 1994, J.P. Morgan introduced RiskMetrics as a proposed method for measuring market risk. Although there were other approaches introduced, none were as open as RiskMetrics. It today represents the de facto standard for market risk analysis.

This course covers the foundations of portfolio Market Risk and Credit Risk. We model the market as a set of variables that drive prices. These variables are have a multivariate normal distribution. We derive closed form solutions for the distribution of portfolio returns in the case of linear portfolios. We then extend our domain to non-linear portfolios, and examine efficient techniques for Monte Carlo simulation of our portfolio. We examine several common measures of portfolio risk such as VaR (Value-at-Risk), marginal VaR, incremental VaR, and expected shortfall. We extend these techniques to model the credit risk of portfolios that are exposed to default risk.

Prerequisites

- 0. Math 419 (or corresponding course)
- 0. IOE316 (or corresponding course)
- 0. IOE 453/Math 423
- 0. IOE 515, or Math 526 (concurrent)

Class Schedule

MW, 3:30 - 5:30, room TBA.

Pete Benson Office Hours (1777 IOE)

Monday, 10am - 12:00pm, 1:00pm - 2:30pm

Mark Schmude Office Hours (in IOE FlexLab)

Tue, 3:30pm - 4:30pm

Thurs, 2:30pm - 3:30pm

Friday, 11am - 12:00pm

Good books

There are quite a few books out there, some aren't bad. However, by the time you've read the freely available material, the books have diminished marginal value. That said...

[The Practice of Risk Management](#). If you want to know how risk management is practiced at an investment bank, this is the book.

Grading

Component	%	Comment
Homework	25	Assigned weekly on Monday. Due beginning of class following Monday. You can work together if you wish. Graded individually.
Quizzes + Final	75	Weekly quizzes, 10 minutes long. Final is in class, April 18th.

Homework and quizzes are reviewed in class. Consequently, late homework and quizzes cannot be accepted for credit. The lowest HW score and lowest quiz score will be thrown out to accomodate absences.

Calendar/Classroom Materials

There is no textbook. Download course materials from the website:
<http://riskuniversity.org/ioe591/>

Lecture	Date	Content
1	Mon, Jan 10, 2005	<ul style="list-style-type: none"> . Development of risk measurement . portfolio risk analysis math overview . risk measures
2	Wed, Jan 12, 2005	<ul style="list-style-type: none"> . Historical simulation of equities, using 2003 market data . Historical market simulation slides . Historical portfolio simulation (one factor) slides .
3	Wed, Jan 19, 2005	<ul style="list-style-type: none"> . Normal model of returns (explanation, justification, and criticism) . Multiple Factor historical simulation partial spreadsheet implementation for handling multiple stocks . Marginal and Incremental Risk
4	Mon, Jan 24, 2005	<ul style="list-style-type: none"> . HW 1 due . Marginal and Incremental Risk continued . Intro to Monte Carlo . Read this excerpt from <i>Return to RiskMetrics</i>
5	Wed, Jan 26, 2005	<ul style="list-style-type: none"> . Quiz. . Markowitz IVaR spreadsheet . Monte Carlo single factor model . Monte Carlo single factor spreadsheet
6	Wed, Feb 2, 2005	<ul style="list-style-type: none"> . Monte Carlo simulation: two factors two factor spreadsheet . Monte Carlo simulation: multiple factors theory . There is a compact review of this material in <i>Return to RiskMetrics</i>, chapter 2
7	Mon, Feb	<ul style="list-style-type: none"> . HW 2 due (problems 17, 18, 19, 23, 27, 31).

	7, 2005	<ul style="list-style-type: none"> . Monte Carlo simulation: multiple factors practice . Monte Carlo multiple factors spreadsheet . Monte Carlo simulation: options . Black-Sholes spreadsheet . Compounding Frequency review spreadsheet . Yield Calculator review spreadsheet . Risk-free Curves slides . Risk-free Curves spreadsheet . Risk-free Bootstrapping spreadsheet
8	Wed, Feb 9, 2005	<ul style="list-style-type: none"> . Quiz (problem 36) . Closed form portfolio risk: method and criticism . Variance-covariance: Theory slides . Variance-covariance: Practice slides . Variance-covariance spreadsheet
9	Mon, Feb 14, 2005	<ul style="list-style-type: none"> . Risky bond indices slides . Risky index spreadsheet . Term Structure Estimation for US Corporate Bond Yields (Xiao) . Hazard rate processes . Risky Issuer Theory slides . Valuing Credit Default Swaps I: No counterparty default risk (Hull & White)
10	Wed, Feb 16, 2005	<ul style="list-style-type: none"> . HW 3 due (problems 37-40) . Quiz (based on problems 42-45, 50-52) . Hull & White notes and examples . Hull & White two bond spreadsheet
12	Mon, Mar 7, 2005	<ul style="list-style-type: none"> . HW 4 due . Backtesting (model validation) . Backtesting (Regulatory) . Lecture Notes . Q-measure (Crnkovic and Drachmann) . Kuiper test, Numerical Recipes in C . Backtesting beyond the Trading Book (Stahl, Wehn, Zapp)
13	Wed, Mar 9, 2005	<ul style="list-style-type: none"> . Quiz based on Hull-White . CreditGrades model . Overview of Credit risk modeling

		<ul style="list-style-type: none"> . CreditMetrics portfolio risk model (asset modeling, rating transitions) . CreditMetrics portfolio market models (single factor, multi-factor)
14	Mon, Mar 14, 2005	<ul style="list-style-type: none"> . HW 5 due. MGF approach to credit portfolio risk. . MGF notes
15	Wed, Mar 16, 2005	Synthetic CDOs, discuss CDO project.
16	Mon, Mar 21, 2005	<ul style="list-style-type: none"> . Credit instrument pricing (credit default swaps) . Subadditivity . Subadditivity on European options . Credit Default Swap Notes
17	Wed, Mar 23, 2005	Inclass project workshop.
18	Mon, Apr 4, 2005	CDS Quiz. Examples and Applications of Closed-Form CDO Pricing
19	Wed, Apr 6, 2005	CreditGrades™ slides, Better Ingredients note by Finger
20	Mon, Apr 11, 2005	Special topics: Nonlinear portfolio optimization
21	Wed, Apr 13, 2005	Special topics: Corporate risk management, or retail wealth management and long term risk models
21	Fri, Apr 15th, 2005	Makeup class
23	Mon, Apr 18, 2005	Final , final project due.