Course description

This course introduces risk management principles, with an emphasis on their practical implementation and application. It presents standard market, liquidity and credit risk measurement techniques, as well as their drawbacks and limitations. The course will convey much of the quantitative and technical material by working through calculation examples using market data and simple models. The example also introduce many sources of financial and statistical data, enabling students to better grasp the realities behind abstract financial concepts.

Students will understand risk management techniques from the viewpoint of practitioners, such as banks and other intermediaries. Many of these techniques have been adopted into financial regulatory standards. Especially since the crisis, regulatory standards have exerted great influence over firms’ risk management practices. The course will help understand this interaction, and the role of risk management in regulatory compliance.

Lecture materials will be available on CourseWorks.

Prerequisites

The course assumes basic familiarity with probability and statistics, instruments of the financial markets, and asset pricing models, and is appropriate for graduate students, as
well as advanced undergraduates who meet these requirements. Students should also be comfortable with programming numerical examples using software of their choice.

**Schedule, location and office hours**

Tuesdays and Thursdays 2:40–3:55 p.m., Sep. 5–Dec. 7, 2017

My office hours are Tuesdays and Thursdays 2:00–2:30, and by appointment, at the IEOR offices in Mudd. If you’d like to meet, please send me an e-mail ahead of time so that I can be sure to be available.

**Assignments and grades**

There will be four problem sets, giving students the opportunity to practice the quantitative techniques and concepts presented, and a midterm and final exams. Grades will be based primarily on the assignments and exams, but some weight may also be placed on class discussion.

Problem sets will be posted and answers should be submitted electronically on CourseWorks.

**Textbooks and resources**

Assignments and exams will be based primarily on material presented in class. The main textbook is


There’s a short bibliographical essay at the end of each chapter of the textbook, and I’ve listed more recent publications and other additional readings for most of the lectures here.

Students are encouraged to become familiar with economic and financial data. The captions of the graphs in the lecture slides contain detailed information on data sources.

Among the rich resources on the Internet are:

**Bank for International Settlements** invests reserves on behalf of some central banks and hosts regulator groups and research conferences. A large number of key regulatory documents are posted on its website: [http://www.bis.org/](http://www.bis.org/)
Central banks such as the Bank of England and the European Central Bank publish research on risk management and other topics. Some have recently begun to publish separate journals devoted to financial stability issues. A good starting point is the BIS links collection: http://www.bis.org/cbanks.htm.


International Monetary Fund has a crucial role in the international financial system, particularly as a lender to poor countries. Its research includes the Global Financial Stability Report: http://www.imf.org/external/pubs/ft/GFSR/index.htm.

Session 1  Overview of financial risks

- Financial intermediation
- Overview of market risk
- Overview of credit, counterparty and liquidity risk
- Overview of operational, model, reputational and compliance risk

Readings

Malz 2011, chap. 1, sec. 2.

Session 2  Risk, return distributions and portfolios

- Defining returns: arithmetic and logarithmic
- Total, nominal and real returns
- Univariate and multivariate return distributions
- Portfolios and diversification
- Investor choice: the tradeoff between risk and return

Readings

Malz 2011, chap. 2, sec. 2 and 4.
Session 3  Asset prices over time

- The standard model of asset price dynamics: random walks and geometric Brownian motion
- Useful rules-of-thumb from the standard model
- Time variation in return behavior across assets

Readings

Malz 2011, chap. 2, sec. 2–3.

Session 4  Volatility estimation and forecasting

- Estimating volatility via GARCH
- Estimating volatility via EWMA

Readings

Malz 2011, chap. 3, sec. 2.

Session 5  Basic approaches to measuring market risk

- Risk, expectations and market prices: the Capital Asset Pricing Model
- Scenario analysis and stress testing

Session 6  Value-at-Risk

- Definition and motivation of Value-at-Risk
- Computing Value-at-Risk: parametric, Monte Carlo, and historical simulation approaches
- Value-at-Risk for short positions

Readings

Malz 2011, chap. 3.
Session 7  Assessing the accuracy of Value-at-Risk

- Limitations of Value-at-Risk
- Coherent risk measures
- Backtesting Value-at-Risk estimates
- Variability of Value-at-Risk estimates

Readings

Malz 2011, chap. 2, sec. 2–3.

Session 8  Market risk measurement in practice

- Value-at-Risk for nonlinear positions: delta-gamma and full revaluation
- Delta-normal Value-at-Risk
- Value-at-Risk for portfolios
- Value-at-Risk for options and fixed income

Readings

Malz 2011, chap.s 4 and 5.

Session 9  Credit and counterparty risk

- Financial distress: default, ratings migration, insolvency and bankruptcy
- Treatment of insolvency for financial firms
- Counterparty risk
- Forms of debt, capital structure and collateral

Readings

Malz 2011, chap. 6, sec. 1–6.

Session 10  Default analytics

- Key metrics of credit risk
- Merton default model
- Hazard rates and default analytics
- Credit spreads and credit spread risk

Readings

Malz 2011, chap. 7.

Session 11  Leverage and leverage risk

- Defining and measuring leverage for the financial industry
- Leverage risk and the attractions of leverage
- Concept of economic capital

Readings

Malz 2011, chap. 12.


Session 12  Forms of leverage

- Carry trades and embedded leverage
- Collateralized security loans and leverage

Readings

Malz 2011, chap. 12.
Session 13  Midterm exam

Session 14  Liquidity and liquidity risk

- Funding liquidity risk and risk management by financial firms
- Financial distress: solvency and liquidity
- Market liquidity risk and risk management
- Sources of liquidity risk: credit, maturity and liquidity transformation
- Commercial banking and liquidity

Readings

Malz 2011, chap. 12.


Session 15  Credit portfolios

- Overview of credit portfolio risk
- Behavior of credit portfolios: credit diversification and default correlation

Readings

Malz 2011, chap. 8, sec. 1–2, 4.

Session 16  Portfolio credit risk models

- Copula models
- Default correlation in the single-factor model
- Credit Value-at-Risk in the single-factor model

Readings

Malz 2011, chap. 8, sec. 3.
Session 17  Securitization

- Basics of structured credit and securitization
- Tranching and the waterfall
- Tranches as options
- Tranche leverage and risk

Readings

Malz 2011, chap. 9, sec. 1–2.

Session 18  Structured credit risk

- Impact of default rates and default correlation on structured credit risk
- Tranche credit VaR

Readings

Malz 2011, chap. 6, sec. 3.

Session 19  Extreme events in asset markets and market risk measurement

- Limitations of the standard model of asset price dynamics
- Behavior of asset prices in normal and in stress periods
- Alternative models of asset price behavior

Readings

Malz 2011, chap. 10, chap. 3, sec. 5.

Session 20  Incorporating extreme events into risk measurement

- Alternatives to Value-at-Risk: expected shortfall
- Extreme Value Theory
Session 21   Financial crises

- Banking, currency, and sovereign and external debt crises
- Typical features of financial crises
- Illiquidity and insolvency during crises
- Bubbles, market crashes and financial crises

Readings


Session 22   Overview of regulatory policy

- Organization of regulation: governments, central banks, and international coordination
- Regulation and supervision of individual financial firms
- Pitfalls of regulation

Readings

Malz 2011, chap. 15.


Session 23   Regulatory capital standards

- Evolution of capital standards: Value-at-Risk, internal models and pre-crisis risk management practice
- Imposition of higher capital standards: Basel 2.5, III and beyond
- Regulatory stress testing and its impact on firm practice
Readings

Malz 2011, chap. 15, sec. 2.

Session 24  Liquidity regulation

- Addressing liquidity and run risk
- Basel III liquidity standards
- Money market mutual fund reform

Session 25  Financial stability regulation

- Regulatory stress testing and its impact on firm practice
- Rationale and tools of macroprudential policy
- Private-risk taking and public guarantees: deposit insurance, Too-Big-to-Fail and the Volcker Rule
- Anticipating financial stress and financial warning indicators
- Addressing counterparty risk: capital standards and derivatives clearing mandates

Readings

Malz 2011, chap. 6, sec. 1–6.

Session 26  Financial market impact of the crisis and policy response

- Policy impact on market and funding liquidity risk since the crisis
- Policy impact on market and credit risk management instruments: evolution of derivatives markets
- Policy impact on risk-taking: reaching for yield
- Limits to arbitrage in pricing risk: negative swap spreads and other anomalies

Final exam

The final exam will be administered during finals week.