RPRD 801: Risk Management Theory and Implementation

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Overview:

This course provides an overview of Risk Management (RM) models and procedures in banks and other Financial Institutions (FI's).

Until the onset of the Crisis in 2007-8, there was standard set of tools used by most FI's for Risk Management. During this period, Crouhy, Galai and Mark (2001) was widely regarded as an excellent medium tech reference on the battery of techniques that would be required by any Risk Manager. From 2001 until the Crisis this fundamental methodology remained in place, with various refinements, largely coming from statistical, econometric and quantitative methods.

As we will see, the classic RM techniques were based on the theoretical Arrow Debreu (AD) economy where FI's operated in competitive financial markets. Cash flows derived from the real AD sectors were modeled as an exogenous stochastic process to be priced by AD arbitrage and diversification methods (see the monograph by Milne (2003)) for a concise exposition of the integrated theory of the real economy and financial markets). Familiar financial asset pricing models and derivative models are all predicated upon that structure and it was imported into much of the RM modeling. Parameterization of these models relied on econometric techniques, especially cross section stochastic factor and time series modeling. There was an assumption that financial markets were replacing FI's and that the traditional Commercial Banking structure was being eroded. Although there were elements of truth in that assertion, the Crisis demonstrated that the markets versus institutions view was a flawed paradigm. (See Milne (2008, 2009).

Pre-Crisis was a period of low volatility in the growth of US GDP. Bernanke (2004) and others referred to this period as the "Great Moderation". With hindsight it should be called the "Great Complacency". Macroeconomic and Monetary policy were described by leading Macroeconomists as having removed any reoccurrence of the business cycle. There were dissenting voices who had deep knowledge of credit, banking and financial markets, but they were largely ignored. (See the relevant topics in RPRD 802.)

The Crisis destroyed that complacency. Some of the RM theoretical structures and their applied modeling failed spectacularly, whereas other areas performed reasonably well. Since that time, there has been a surge in research to explore where the problems occurred.

There were many RM failures that have become apparent. To fully understand the criticisms, the student must understand the CMG (2001) technical modeling, some refinements to that technical literature added pre-Crisis, and the evolution of markets and institutions that occurred up to the Crisis. This classic material will be covered in Section B of the course. Because there is so much material, I have added books or surveys that explore particular topics in far greater depth. I have tried to cite material that will be technically accessible to this class.

Section C of the course will explore major elements the post Crisis material. Subsequent Financial, Banking and Economics research, trying to explain the Crisis, has drawn upon specialized areas that had been largely ignored by mainstream Asset Pricing and RM. The integration of this material into RM theory and practice is beginning to emerge. As the student will realize there are many puzzles and research issues to be considered, some of which cannot be addressed within the limits a semester course. We will concentrate on three areas: (i) Illiquid Asset Markets and FI's (some of this material is covered in RPRD 802.); (ii) Systemic Risk Modeling and Applications; and (iii) Strategic Industry Risks (SIRS) embedded in the real and financial economies.

The student should realize that in this course we do not have time to develop a number of important topics. We hope to address some of them in the topics course RPRD 804.

I will assume that the student will have read Pedersen (2015). It is a good introduction to hedge-fund trading strategies when there are liquidity problems.

Assessment: There are three components:

1. **30% for an assignment. A Monte Carlo simulation of pension fund returns with leverage.**
2. **30% class presentation/lecture in the second half of the term on one topic on the reading list.**
3. **40% Final Examination.**

Textbooks:

Crouhy, Galai, Mark, ***Risk Management,*** McGraw-Hill, 2001. (Crouhy (2001))

Dowd (2005) ***Measuring Market Risk,*** (Second Edition) Wiley.

Note: Crouhy (2001) is an encyclopedic reference for pre-crisis, medium tech quant methods, but is now dated.
Dowd (2005) is an excellent survey of market risk models and their properties.
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Sections of other books that will be used for specific topics:

A. Saunders and L. Allen, ***Credit Risk Measurement In and Out of the Financial Crisis,*** third edition, Wiley, 2010. (Used in conjunction with Crouhy (2001) it updates standard credit modeling techniques and their failures.)

G. Beneplane and J-C. Rochet, ***Risk Management in Turbulent Times*** OUP 2011. It is idiosyncratic on RM but it has shrewd insights on various topics including the statistical weaknesses of various VaR techniques. It draws on the banking and financial stability literatures – topics that are almost completely absent in the standard risk management literature.

Shin ***Risk and Liquidity*** (2010) OUP. A thoughtful and penetrating analysis of financial stability issues that complements Beneplane and Rochet. This is used as a text in RPRD 802.

Jarrow and Turnbull, **Derivative Securities,** second edition, 2000. (Classic derivative pricing medium tech text that plays up the AD pricing foundations in discrete and continuous time. Out of print.)

Meissner, ***Credit Derivatives: Applications, Pricing and Risk Management,*** Blackwell, 2005. Chapter 5 provides a good medium tech description of major credit models up to the Crisis.)

Constantinides, Harris and Stulz (eds.) ***Handbook of the Economics of Finance*** Vols. 2A and 2B, North-Holland (2013)

Gregory (2015) ***Counterparty Credit Risk,*** (Third Edition) Wiley. An excellent summary of counterparty credit risk that is accessible to students in this course.

Pedersen (2015) ***Efficiently Inefficient: How Smart Money Invests and Market Prices Are Determined,*** Princeton University Press. Student will be assumed to have read this introductory book. It provides background on trading strategies and how they are altered to accommodate illiquidity. Serious recent research is cited, and some of these papers are studied in the course.

Topics:

Section A: Introduction to RM:

1. **Overview of RM Pre Crisis:**
   CGM (2001) Ch.1-4

Section B: Modeling Market Risk and its Problems:

For a full discussion see Dowd (2005).

B.1 Basic VaR Techniques:

1. **Measuring Market Risk: The VaR Approach:**

CGM (2001) Ch.5
Dowd Chs.1-3

2. **Non-Parametric Approaches:**
   Dowd Ch.4

3. **Forecasting Volatilities:**
   Dowd Ch.5

4. **Measuring Market Risk: Derivatives and Interest Rate Risks:**
   CGM (2001) Ch.6.
   Dowd Ch.10

5. **Dangers Using VaR Methods:**
   A. Statistical Problems with VaR:
   BR (2011) Ch.5
   Dowd Ch.6
   Dowd, *Math Gone Mad: Regulatory Risk Modeling by the Federal Reserve,* Cato Institute, 2014. Pp.1-22.
   Hull, *Risk Management* (3rd Ed) 2012 Ch. 11.

6. **VaR as Economic Amplifier in Levered Banking System:**
   Shin (2011) Chs.2&3.

B.2 Interest Rate Risk Modeling:

1. Overview of Basic Factor Interest Rate Modeling:

J&T (2000) Chs.13,14,15,16.

Duffee "Bond Pricing and the Macroeconomy" Ch.13 in CHS (eds) 2013.

B.3 Asset and Liability Management:

Shin (2011) Ch.5

B.4 Credit Analysis and Modeling:

1. Classic Credit Analysis: Cash Flows and Holding to Maturity:
Crean, (2012) Notes to Lectures 3, 6, 7.
This traditional analysis is crucial for understanding bank lending to major corporations. Statistical Models provide a useful first pass, but traditional analysis is necessary to understand the sources of credit risks arising from the firm, industry and corporate financial structure.

2.Integrating Classic Credit Analysis, I.O. and Asset Pricing:
Crean and Milne,"The Foundations of Systemic Risk" Working Paper 2016.
Crean and Milne, "The Anatomy of Systemic Risk" Working Paper 2016.

3. Credit Rating and Credit Migration Approaches:
CGM (2001) Chs. 7 & 8.

4. The Contingent Claim Approach to Measuring Credit Risk:
CGM (2001) Ch.9.
S&A (2010) Ch.4, 5
A.Milne, "Distance to Default and the Financial Crisis", *Journal of Financial Stability*, 12, 2014, pp.26-36.

5. Other Approaches:
CGM (2001) Chs.10, 11.
S&A (2010) Ch. 6.

B.5 Hedging and Pricing Credit Risk

1. Credit Derivatives Modeling:
J&T Ch.18.
S&A (2010) Chs.5, 12
Meissner Ch.5 (A detailed discussion of discrete tree applications, with model summaries for the thoughtful practitioner.)

2. Estimation of Loss Given Default:
S&A Chs. 7.
Altman, "Default Recovery Rates and LGD in Credit Risk Modeling and Practice" in Lipton and Rennie, *The Oxford Handbook of Credit Derivatives*, OUP 2011, (An excellent recent critique of the structural and reduced form credit models. Read in conjunction with Crean-Milne, the limitations of the models are obvious.)

3.Counterparty Credit Risk:
A.Basics:
J&T Ch.18.

B.Advanced:
Gregory (2015). Chs. 4,5,9 (This book is an excellent survey of Counterparty Credit Risk.)

B.6 Other Risks:

1. Operational Risk:
CGM (2001) Ch.13
Cope, Mignola, Antonini, Ugoccioni, "Challenges in Measuring Operational Risk from Loss Data", 2009.

2. Model Risk:

A. Basics:
CGM (2001) Ch.15.
Dowd Ch.16

B .Implicit AD Modeling and its Problems:
B&P Chs.7, 8
Milne, "The Complexities of Financial Risk Management and Systemic Risks", *Bank of Canada Review,* Summer, 2009.

B.6: Stress Tests and Back-Testing:

1. Bank Stress Testing, Scenario Analysis and Back-Testing:
Dowd Chs.13,15 (Market Risk)
S&A Ch. 10 (Stress and Back-Testing Credit Risk.)

2. Macro Bank Stress Testing: Evolving Techniques:
Anand, Bedard-Page, Traclet, "Stress Testing the Canadian Banking System: A System-Wide Approach", Bank of Canada, Financial System Review, June 2014.
Bank of England, *Stress Testing the UK Banking System: Key Elements of the 2017 Stress Test,* March 2017.
Baranova, Coen, Lowe, Noss and Silvestri, *Simulating stress across the financial system: the resilience of corporate bond markets and the role of investment funds,* Bank of England, Fin Stab paper No 42, July 2017.
Anderson (ed.), *Stress Testing and Macroprudential Regulation: A Transatlantic Assessment, Chs.1, 5, 8.*

3. Critiques of Current Macro Stress Tests:
Borio,Drehmann and Tastsaronis, "Stress-Testing Macro Stress testing: Does it live up to expectations?" *Journal of Financial Stability,* 2014, 3-15.
Dowd, *Math Gone Mad: Regulatory Risk Modeling by the Federal Reserve,* Cato Institute, 2014. Pp.22-43.
Dowd, *No Stress: The Flaws in the Bank of England's Stress Testing Programme,* Adam Smith Institute. 2016. (Dowd's provocative papers should be seen as a complement to the Chapters in Anderson above.)

C.1 Market Liquidity and Funding Liquidity Risks:
Note: The student should have covered the material on Liquidity Risk and Banking in RPRD 802 so that material will be assumed in this and the following section.

1.Market Liquidity: Basic Market Structures:
Foucalt, Pagano and Roell, *Market Liquidity, Evidence and Policy,* OUP, 2013. Ch.1
(This book is a comprehensive recent survey of market microstructure liquidity modeling and empirical research covering bid-ask spreads, market depth, strategic trading strategies, etc. But nothing on derivative pricing and hedging in illiquid markets.)

Pedersen (2015) is a good introduction to hedge-fund trading strategies when there are liquidity problems.

2.Classic Market Liquidity Theory:
Dowd Ch.14
Amihud, Mendelson and Pedersen, *Liquidity and Asset Prices*, Foundations and Trends in Finance, 2005. (An accessible survey of theoretical and empirical market microstructure literature. Now somewhat dated).
Amihud and Mendelson (2015) "The Pricing of Illiquidity as a Characteristic and as Risk" (Multinational Finance Journal, 2015, vol. 19, no. 3, pp. 149–168.

3.Market and Funding Liquidity Theory After the Crisis :
Pedersen, "When Everyone runs for the Exits" *International Journal of Central Banking*, pp 177-199, 2009
Foucalt, Pagano and Roell 2013, Ch.9.
Tirole, "Illiquidity and All its Friends" *Journal of Economic Perspectives*, 49:2 2011. (A survey of basic modeling approaches to market and funding liquidity issues.)
Vayanos and Wang, "Market Liquidity: Theory and Empirical Evidence" Ch. 19 in Constantinides, Harris and Stulz (eds.) ***Handbook of the Economics of Finance*** Vols. 2A and 2B, North-Holland (2013).

C.2 Systemic Stress Tests, Fire Sales and Liquidity Events: Work in Progress:

Kapadia, Drehmann, Elliott and Sterne, "Liquidity Risk, Cash-Flow Constraints and Systemic Feedbacks", Bank of England WP. No.456, 2012.
Duarte and Eisenback, "Fire-Sale Spillovers and Systemic Risks", Federal Reserve Bank of NY Staff Report No.645. 2014

C.3 Putting It All Together:

Crean and Milne "The Anatomy of Systemic Risk" Working Paper 2017.