2016

2016 FRM LEARNING OBJECTIVES

PART I

FOUNDATIONS OF RISK MANAGEMENT—PART I EXAM WEIGHT 20% (FRM)

The broad areas of knowledge covered in readings related to Foundations of Risk Management include the following:

- Basic risk types, measurement and management tools
- Creating value with risk management
- The role of risk management in corporate governance
- Enterprise Risk Management (ERM)
- Financial disasters and risk management failures
- The Capital Asset Pricing Model (CAPM)
- Risk-adjusted performance measurement
- Multi-factor models
- Information risk and data quality management
- Ethics and the GARP Code of Conduct

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

Michel Crouhy, Dan Galai, and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York: McGraw-Hill, 2014).

Chapter 1. Risk Management: A Helicopter View (Including Appendix 1.1) [FRM-1]

After completing this reading you should be able to:

- Explain the concept of risk and compare risk management with risk taking.
- Describe the risk management process and identify problems and challenges which can arise in the risk management process.
- Evaluate and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative assessment, and enterprise risk management.
- Distinguish between expected loss and unexpected loss, and provide examples of each.
- Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management.
- Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.

Chapter 2. Corporate Risk Management: A Primer [FRM-2]

After completing this reading you should be able to:

- Evaluate some advantages and disadvantages of hedging risk exposures.
- Explain considerations and procedures in determining a firm's risk appetite and its business objectives.
- Explain how a company can determine whether to hedge specific risk factors, including the role of the board of directors and the process of mapping risks.
- Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency and interest rate risk.
- Assess the impact of risk management instruments.

Chapter 4. Corporate Governance and Risk Management [FRM–3]

After completing this reading you should be able to:

- Compare and contrast best practices in corporate governance with those of risk management.
- Assess the role and responsibilities of the board of directors in risk governance.
- Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
- Distinguish the different mechanisms for transmitting risk governance throughout an organization.
- Illustrate the interdependence of functional units within a firm as it relates to risk management.
- Assess the role and responsibilities of a firm's audit committee.

James Lam, *Enterprise Risk Management: From Incentives to Controls, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2014).

Chapter 4. What is ERM? [FRM–4]

After completing this reading you should be able to:

- Describe enterprise risk management (ERM) and compare and contrast differing definitions of ERM.
- Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative.
- Describe the role and responsibilities of a chief risk officer (CRO) and assess how the CRO should interact with other senior management.
- Distinguish between components of an ERM program.

"Governance, Risk Management and Risk-Taking in Banks," René Stulz, Finance Working Paper 427/2014 (June 2014). [FRM—5]

- Assess methods which banks can use to determine their optimal level of risk exposure, and explain how the optimal level of risk can differ across banks.
- Describe implications for a bank if it takes too little or too much risk compared to its optimal level.
- Explain ways in which risk management can add or destroy value for a bank.
- Describe structural challenges and limitations to effective risk management, including the use of VaR in setting limits.
- Assess the potential impact of a bank's governance, incentive structure and risk culture on its risk profile and its performance.

Steve Allen, *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk, 2nd Edition* (New York: John Wiley & Sons, 2013).

Chapter 4. Financial Disasters [FRM–6]

After completing this reading you should be able to:

- Analyze the key factors that led to and derive the lessons learned from the following risk management case studies:
    - Chase Manhattan and their involvement with Drysdale Securities
    - Kidder Peabody
    - Barings
    - Allied Irish Bank
    - Union Bank of Switzerland (UBS)
    - Société Générale
    - Long Term Capital Management (LTCM)
    - Metallgesellschaft
    - Bankers Trust
    - JPMorgan, Citigroup, and Enron

John Hull, *Risk Management and Financial Institutions, 4th Edition* (Hoboken, NJ: John Wiley & Sons, 2015).

Chapter 6. The Credit Crisis of 2007 [FRM–7]

After completing this reading you should be able to:

- Analyze various factors that contributed to the Credit Crisis of 2007 and examine the relationships between these factors.
- Describe the mechanics of asset-backed securities (ABS) and ABS collateralized debt obligations (ABS CDOs) and explain their role in the 2007 credit crisis.

- Explain the roles of incentives and regulatory arbitrage in the outcome of the crisis.
- Apply the key lessons learned by risk managers to the scenarios provided.

René Stulz, *"Risk Management Failures: What Are They and When Do They Happen?"* Fisher College of Business Working Paper Series, October 2008. [FRM–8]

After completing this reading you should be able to:

- Explain how a large financial loss may not necessarily be evidence of a risk management failure.
- Analyze and identify instances of risk management failure.
- Explain how risk management failures can arise in the following areas: measurement of known risk exposures, identification of risk exposures, communication of risks, and monitoring of risks.
- Evaluate the role of risk metrics and analyze the shortcomings of existing risk metrics.

Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann, *Modern Portfolio Theory and Investment Analysis, 9th Edition* (Hoboken, NJ: John Wiley & Sons, 2014).

Chapter 13. The Standard Capital Asset Pricing Model [FRM–9]

After completing this reading you should be able to:

- Understand the derivation and components of the CAPM.
- Describe the assumptions underlying the CAPM.
- Interpret the capital market line.
- Apply the CAPM in calculating the expected return on an asset.
- Interpret beta and calculate the beta of a single asset or portfolio.

Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, England: John Wiley & Sons, 2003).

Chapter 4. Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators (Section 4.2 only) [FRM–10]

After completing this reading you should be able to:

- Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.
- Compute and interpret tracking error, the information ratio, and the Sortino ratio.

Zvi Bodie, Alex Kane, and Alan J. Marcus,
Investments, 10th Edition
(New York: McGraw-Hill, 2013).

Chapter 10. Arbitrage Pricing Theory and Multifactor Models of Risk and Return [FRM–11]

After completing this reading you should be able to:

- Describe the inputs, including factor betas, to a multi factor model.
- Calculate the expected return of an asset using a single-factor and a multi-factor model.
- Describe properties of well-diversified portfolios and explain the impact of diversification on the residual risk of a portfolio.
- Explain how to construct a portfolio to hedge exposure to multiple factors.
- Describe and apply the Fama-French three factor model in estimating asset returns.

Anthony Tarantino and Deborah Cernauskas,
Risk Management in Finance: Six Sigma and Other Next Generation Techniques
(Hoboken, NJ: John Wiley & Sons, 2009).

Chapter 3. Information Risk and Data Quality Management [FRM–12]

After completing this reading you should be able to:

- Identify the most common issues that result in data errors.
- Explain how a firm can set expectations for its data quality and describe some key dimensions of data quality used in this process.
- Describe the operational data governance process, including the use of scorecards in managing information risk.

"Principles for Effective Data Aggregation and Risk Reporting,"
(Basel Committee on Banking Supervision Publication, January 2013). [FRM–13]

After completing this reading you should be able to:

- Explain the potential benefits of having effective risk data aggregation and reporting.
- Describe key governance principles related to risk data aggregation and risk reporting practices.
- Identify the data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices.
- Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another.
- Describe characteristics of effective risk reporting practices.

GARP Code of Conduct.* [FRM–14]

After completing this reading you should be able to:

- Describe the responsibility of each GARP member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information and adherence to generally accepted practices in risk management.
- Describe the potential consequences of violating the GARP Code of Conduct.

QUANTITATIVE ANALYSIS—PART I EXAM WEIGHT 20% (QA)

The broad areas of knowledge covered in readings related to Quantitative Analysis include the following:

- Discrete and continuous probability distributions
- Estimating the parameters of distributions
- Population and sample statistics
- Bayesian analysis
- Statistical inference and hypothesis testing
- Correlations and copulas
- Estimating correlation and volatility using EWMA and GARCH models
- Volatility term structures
- Linear regression with single and multiple regressors
- Time series analysis
- Simulation methods

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

Michael Miller, *Mathematics and Statistics for Financial Risk Management, 2nd Edition*
(Hoboken, NJ: John Wiley & Sons, 2013).

Chapter 2. Probabilities [QA–1]

After completing this reading you should be able to:

- Describe and distinguish between continuous and discrete random variables.
- Define and distinguish between the probability density function, the cumulative distribution function, and the inverse cumulative distribution function.
- Calculate the probability of an event given a discrete probability function.
- Distinguish between independent and mutually exclusive events.
- Define joint probability, describe a probability matrix, and calculate joint probabilities using probability matrices.
- Define and calculate a conditional probability, and distinguish between conditional and unconditional probabilities.

Chapter 3. Basic Statistics [QA-2]

After completing this reading you should be able to:

- Interpret and apply the mean, standard deviation, and variance of a random variable.
- Calculate the mean, standard deviation, and variance of a discrete random variable
- Interpret and calculate the expected value of a discrete random variable.
- Calculate and interpret the covariance and correlation between two random variables.
- Calculate the mean and variance of sums of variables.
- Describe the four central moments of a statistical variable or distribution: mean, variance, skewness and kurtosis.
- Interpret the skewness and kurtosis of a statistical distribution, and interpret the concepts of coskewness and cokurtosis.
- Describe and interpret the best linear unbiased estimator.

Chapter 4. Distributions [QA–3]

After completing this reading you should be able to:

- Distinguish the key properties among the following distributions: uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution, normal distribution, lognormal distribution, Chi-squared distribution, Student's t, and F-distributions, and identify common occurrences of each distribution.
- Describe the central limit theorem and the implications it has when combining i.i.d. random variables.
- Describe independent and identically distributed (i.i.d) random variables and the implications of the i.i.d. assumption when combining random variables.
- Describe a mixture distribution and explain the creation and characteristics of mixture distributions.

Chapter 6. Bayesian Analysis (pp. 113-124 only) [QA-4]

After completing this reading you should be able to:

- Describe Bayes' theorem and apply this theorem in the calculation of conditional probabilities.
- Compare the Bayesian approach to the frequentist approach.
- Apply Bayes' theorem to scenarios with more than two possible outcomes and calculate posterior probabilities.

Chapter 7. Hypothesis Testing and Confidence Intervals [QA–5]

After completing this reading you should be able to:

- Calculate and interpret the sample mean and sample variance.
- Construct and interpret a confidence interval.
- Construct an appropriate null and alternative hypothesis, and calculate an appropriate test statistic.
- Differentiate between a one-tailed and a two-tailed test and identify when to use each test.
- Interpret the results of hypothesis tests with a specific level of confidence.
- Demonstrate the process of backtesting VaR by calculating the number of exceedances.

John Hull, *Risk Management and Financial Institutions, 4th Edition* (Hoboken, NJ: John Wiley & Sons, 2015).

Chapter 11. Correlations and Copulas [QA-6]

After completing this reading you should be able to:

- Define correlation and covariance, differentiate between correlation and dependence.
- Calculate covariance using the EWMA and GARCH (1,1) models.
- Apply the consistency condition to covariance.
- Describe the procedure of generating samples from a bivariate normal distribution.
- Describe properties of correlations between normally distributed variables when using a one-factor model.
- Define copula, describe the key properties of copulas and copula correlation.
- Explain tail dependence.
- Describe the Gaussian copula, Student t-copula, multivariate copula and one factor copula.

James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston: Pearson, 2008).

Chapter 4. Linear Regression with One Regressor [QA-7]

After completing this reading you should be able to:

- Explain how regression analysis in econometrics measures the relationship between dependent and independent variables.
- Interpret a population regression function, regression coefficients, parameters, slope, intercept, and the error term.
- Interpret a sample regression function, regression coefficients, parameters, slope, intercept, and the error term.
- Describe the key properties of a linear regression.
- Define an ordinary least squares (OLS) regression and calculate the intercept and slope of the regression.
- Describe the method and three key assumptions of OLS for estimation of parameters.
- Summarize the benefits of using OLS estimators.
- Describe the properties of OLS estimators and their sampling distributions, and explain the properties of consistent estimators in general.

- Interpret the explained sum of squares, the total sum of squares, the residual sum of squares, the standard error of the regression, and the regression R2.
- Interpret the results of an OLS regression.

Chapter 5. Regression with a Single Regressor [QA–8]

After completing this reading you should be able to:

- Calculate, and interpret confidence intervals for regression coefficients.
- Interpret the p-value.
- Interpret hypothesis tests about regression coefficients.
- Evaluate the implications of homoskedasticity and heteroskedasticity.
- Determine the conditions under which the OLS is the best linear conditionally unbiased estimator.
- Explain the Gauss-Markov Theorem and its limitations, and alternatives to the OLS.
- Apply and interpret the t-statistic when the sample size is small.

Chapter 6. Linear Regression with Multiple Regressors [QA–9]

After completing this reading you should be able to:

- Define and interpret omitted variable bias, and describe the methods for addressing this bias.
- Distinguish between single and multiple regression.
- Interpret the slope coefficient in a multiple regression.
- Describe homoskedasticity and heterosckedasticity in a multiple regression.
- Describe the OLS estimator in a multiple regression.
- Calculate and interpret measures of fit in multiple regression.
- Explain the assumptions of the multiple linear regression model.
- Explain the concept of imperfect and perfect multicollinearity and their implications.

Chapter 7. Hypothesis Tests and Confidence Intervals in Multiple Regression [QA–10]

After completing this reading you should be able to:

- Construct, apply, and interpret hypothesis tests and confidence intervals for a single coefficient in a multiple regression.
- Construct, apply, and interpret joint hypothesis tests and confidence intervals for multiple coefficients in a multiple regression.
- Interpret the F-statistic.
- Interpret tests of a single restriction involving multiple coefficients.
- Interpret confidence sets for multiple coefficients.
- Identify examples of omitted variable bias in multiple regressions.

- Interpret the R2 and adjusted-R2 in a multiple regression.

Francis X. Diebold, *Elements of Forecasting, 4th Edition* (Mason, Ohio: Cengage Learning, 2006).

Chapter 5. Modeling and Forecasting Trend (Section 5.4 only—Selecting Forecasting Models Using the Akaike and Schwarz Criteria) [QA-11]

After completing this reading you should be able to:

- Define mean squared error (MSE) and explain the implications of MSE in model selection.
- Explain how to reduce the bias associated with MSE and similar measures.
- Compare and evaluate model selection criteria, including s2, the Akaike information criterion (AIC), and the Schwarz information criterion (SIC).
- Explain the necessary conditions for a model selection criterion to demonstrate consistency.

Chapter 7. Characterizing Cycles [QA-12]

After completing this reading you should be able to:

- Define covariance stationary, autocovariance function, autocorrelation function, partial autocorrelation function and autoregression.
- Describe the requirements for a series to be covariance stationary.
- Explain the implications of working with models that are not covariance stationary.
- Define white noise, describe independent white noise and normal (Gaussian) white noise.
- Explain the characteristics of the dynamic structure of white noise.
- Explain how a lag operator works.
- Describe Wold's theorem.
- Define a general linear process.
- Relate rational distributed lags to Wold's theorem.
- Calculate the sample mean and sample autocorrelation, and describe the Box-Pierce Q-statistic and the Ljung-Box Q-statistic.
- Describe sample partial autocorrelation.

Chapter 8. Modeling Cycles: MA, AR, and ARMA Models [QA-13]

After completing this reading you should be able to:

- Describe the properties of the first-order moving average (MA(1)) process, and distinguish between autoregressive representation and moving average representation.
- Describe the properties of a general finite-order process of order q (MA(q)) process.

- Describe the properties of the first-order autoregressive (AR(1)) process, and define and explain the Yule-Walker equation.
- Describe the properties of a general pth order autoregressive (AR(p)) process.
- Define and describe the properties of the autoregressive moving average (ARMA) process.
- Describe the application of AR and ARMA processes.

John Hull, *Options, Futures, and Other Derivatives, 9th Edition* (New York: Pearson, 2014).

Chapter 23. Estimating Volatilities and Correlations for Risk Management [QA-14]

After completing this reading you should be able to:

- Explain how various weighting schemes can be used in estimating volatility.
- Apply the exponentially weighted moving average (EWMA) model to estimate volatility.
- Describe the generalized autoregressive conditional heteroskedasticity (GARCH (p,q)) model for estimating volatility and its properties:
  - Calculate volatility using the GARCH (1,1) model
  - Explain mean reversion and how it is captured in the GARCH (1,1) model
- Explain the weights in the EWMA and GARCH (1,1) models.
- Explain how GARCH models perform in volatility forecasting.
- Describe the volatility term structure and the impact of volatility changes.
- Describe how correlations and covariances are calculated, and explain the consistency condition for covariances.

Chris Brooks, *Introductory Econometrics for Finance, 3rd Edition* (Cambridge, UK: Cambridge University Press, 2014).

Chapter 13. Simulation Methods [QA-15]

After completing this reading you should be able to:

- Describe the basic steps to conduct a Monte Carlo simulation.
- Describe ways to reduce Monte Carlo sampling error.
- Explain how to use antithetic variate technique to reduce Monte Carlo sampling error.
- Explain how to use control variates to reduce Monte Carlo sampling error and when it is effective.
- Describe the benefits of reusing sets of random number draws across Monte Carlo experiments and how to reuse them.
- Describe the bootstrapping method and its advantage over Monte Carlo simulation.
- Describe the pseudo-random number generation method and how a good simulation design alleviates the effects the choice of the seed has on the properties of the generated series.
- Describe situations where the bootstrapping method is ineffective.
- Describe disadvantages of the simulation approach to financial problem solving.

FINANCIAL MARKETS AND PRODUCTS—PART I EXAM WEIGHT 30% (FMP)

The broad areas of knowledge covered in readings related to Financial Markets and Products include the following:

- Structure and mechanics of OTC and exchange markets
- Structure, mechanics, and valuation of forwards, futures, swaps and options
- Hedging with derivatives
- Interest rates and measures of interest rate sensitivity
- Foreign exchange risk
- Corporate bonds
- Mortgage-backed securities
- Rating agencies

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

John Hull, *Options, Futures, and Other Derivatives, 9th Edition* (New York: Pearson, 2014).

Chapter 1. Introduction [FMP–1]

After completing this reading you should be able to:

- Describe the over-the-counter market, distinguish it from trading on an exchange, and evaluate its advantages and disadvantages.
- Differentiate between options, forwards, and futures contracts.
- Identify and calculate option and forward contract payoffs.
- Calculate and compare the payoffs from hedging strategies involving forward contracts and options.
- Calculate and compare the payoffs from speculative strategies involving futures and options.
- Calculate an arbitrage payoff and describe how arbitrage opportunities are temporary.
- Describe some of the risks that can arise from the use of derivatives.

Chapter 2. Mechanics of Futures Markets [FMP–2]

After completing this reading you should be able to:

- Define and describe the key features of a futures contract, including the asset, the contract price and size, delivery, and limits.
- Explain the convergence of futures and spot prices.
- Describe the rationale for margin requirements and explain how they work.
- Describe the role of a clearinghouse in futures and over-the-counter market transactions.
- Describe the role of collateralization in the over-the-counter market and compare it to the margining system.
- Identify the differences between a normal and inverted futures market.
- Describe the mechanics of the delivery process and contrast it with cash settlement.
- Evaluate the impact of different trading order types.
- Compare and contrast forward and futures contracts.

Chapter 3. Hedging Strategies Using Futures [FMP–3]

After completing this reading you should be able to:

- Define and differentiate between short and long hedges and identify their appropriate uses.
- Describe the arguments for and against hedging and the potential impact of hedging on firm profitability.
- Define the basis and explain the various sources of basis risk, and explain how basis risks arise when hedging with futures.
- Define cross hedging, and compute and interpret the minimum variance hedge ratio and hedge effectiveness.
- Compute the optimal number of futures contracts needed to hedge an exposure, and explain and calculate the "tailing the hedge" adjustment.
- Explain how to use stock index futures contracts to change a stock portfolio's beta.
- Explain the term "rolling the hedge forward" and describe some of the risks that arise from this strategy.

Chapter 4. Interest Rates [FMP–4]

After completing this reading you should be able to:

- Describe Treasury rates, LIBOR, and repo rates, and explain what is meant by the "risk-free" rate.
- Calculate the value of an investment using different compounding frequencies.
- Convert interest rates based on different compounding frequencies.
- Calculate the theoretical price of a bond using spot rates.
- Derive forward interest rates from a set of spot rates.
- Derive the value of the cash flows from a forward rate agreement (FRA).
- Calculate the duration, modified duration and dollar duration of a bond.

- Evaluate the limitations of duration and explain how convexity addresses some of them.
- Calculate the change in a bond's price given its duration, its convexity, and a change in interest rates.
- Compare and contrast the major theories of the term structure of interest rates.

Chapter 5. Determination of Forward and Futures Prices [FMP–5]

After completing this reading you should be able to:

- Differentiate between investment and consumption assets.
- Define short-selling and calculate the net profit of a short sale of a dividend-paying stock.
- Describe the differences between forward and futures contracts and explain the relationship between forward and spot prices.
- Calculate the forward price given the underlying asset's spot price, and describe an arbitrage argument between spot and forward prices.
- Explain the relationship between forward and futures prices.
- Calculate a forward foreign exchange rate using the interest rate parity relationship.
- Define income, storage costs, and convenience yield.
- Calculate the futures price on commodities incorporating income/storage costs and/or convenience yields.
- Calculate, using the cost-of-carry model, forward prices where the underlying asset either does or does not have interim cash flows.
- Describe the various delivery options available in the futures markets and how they can influence futures prices.
- Explain the relationship between current futures prices and expected future spot prices, including the impact of systematic and nonsystematic risk.
- Define and interpret contango and backwardation, and explain how they relate to the cost-of-carry model.

Chapter 6. Interest Rate Futures [FMP–6]

After completing this reading you should be able to:

- Identify the most commonly used day count conventions, describe the markets that each one is typically used in, and apply each to an interest calculation.
- Calculate the conversion of a discount rate to a price for a US Treasury bill.
- Differentiate between the clean and dirty price for a US Treasury bond; calculate the accrued interest and dirty price on a US Treasury bond.
- Explain and calculate a US Treasury bond futures contract conversion factor.
- Calculate the cost of delivering a bond into a Treasury bond futures contract.
- Describe the impact of the level and shape of the yield curve on the cheapest-to-deliver Treasury bond decision.

- Calculate the theoretical futures price for a Treasury bond futures contract.

- Calculate the final contract price on a Eurodollar futures contract.

- Describe and compute the Eurodollar futures contract convexity adjustment.

- Explain how Eurodollar futures can be used to extend the LIBOR zero curve.

- Calculate the duration-based hedge ratio and create a duration-based hedging strategy using interest rate futures.

- Explain the limitations of using a duration-based hedging strategy.

Chapter 7. Swaps [FMP–7]

After completing this reading you should be able to:

- Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows.

- Explain how a plain vanilla interest rate swap can be used to transform an asset or a liability and calculate the resulting cash flows.

- Explain the role of financial intermediaries in the swaps market.

- Describe the role of the confirmation in a swap transaction.

- Describe the comparative advantage argument for the existence of interest rate swaps and evaluate some of the criticisms of this argument.

- Explain how the discount rates in a plain vanilla interest rate swap are computed.

- Calculate the value of a plain vanilla interest rate swap based on two simultaneous bond positions.

- Calculate the value of a plain vanilla interest rate swap from a sequence of forward rate agreements (FRAs).

- Explain the mechanics of a currency swap and compute its cash flows.

- Explain how a currency swap can be used to transform an asset or liability and calculate the resulting cash flows.

- Calculate the value of a currency swap based on two simultaneous bond positions.

- Calculate the value of a currency swap based on a sequence of FRAs.

- Describe the credit risk exposure in a swap position.

- Identify and describe other types of swaps, including commodity, volatility and exotic swaps.

Chapter 10. Mechanics of Options Markets [FMP–8]

After completing this reading you should be able to:

- Describe the types, position variations, and typical underlying assets of options.

- Explain the specification of exchange-traded stock option contracts, including that of nonstandard products.

- Describe how trading, commissions, margin requirements, and exercise typically work for exchange-traded options.

Chapter 11. Properties of Stock Options [FMP–9]

After completing this reading you should be able to:

- Identify the six factors that affect an option's price and describe how these six factors affect the price for both European and American options.

- Identify and compute upper and lower bounds for option prices on non-dividend and dividend paying stocks.

- Explain put-call parity and apply it to the valuation of European and American stock options.

- Explain the early exercise features of American call and put options.

Chapter 12. Trading Strategies Involving Options [FMP–10]

After completing this reading you should be able to:

- Explain the motivation to initiate a covered call or a protective put strategy.

- Describe the use and calculate the payoffs of various spread strategies.

- Describe the use and explain the payoff functions of combination strategies.

Chapter 26. Exotic Options [FMP–11]

After completing this reading you should be able to:

- Define and contrast exotic derivatives and plain vanilla derivatives.

- Describe some of the factors that drive the development of exotic products.

- Explain how any derivative can be converted into a zero-cost product.

- Describe how standard American options can be transformed into nonstandard American options.

- Identify and describe the characteristics and pay-off structure of the following exotic options: gap, forward start, compound, chooser, barrier, binary, lookback, shout, Asian, exchange, rainbow, and basket options.

- Describe and contrast volatility and variance swaps.

- Explain the basic premise of static option replication and how it can be applied to hedging exotic options.

Robert McDonald,
Derivatives Markets, 3rd Edition
(Boston: Pearson, 2012).

Chapter 6. Commodity Forwards and Futures [FMP–12]

After completing this reading you should be able to:

- Apply commodity concepts such as storage costs, carry markets, lease rate, and convenience yield.
- Explain the basic equilibrium formula for pricing commodity forwards.
- Describe an arbitrage transaction in commodity forwards, and compute the potential arbitrage profit.
- Define the lease rate and explain how it determines the no-arbitrage values for commodity forwards and futures.
- Define carry markets, and illustrate the impact of storage costs and convenience yields on commodity forward prices and no-arbitrage bounds.
- Compute the forward price of a commodity with storage costs.
- Compare the lease rate with the convenience yield.
- Identify factors that impact gold, corn, electricity, natural gas, and oil forward prices.
- Compute a commodity spread.
- Explain how basis risk can occur when hedging commodity price exposure.
- Evaluate the differences between a strip hedge and a stack hedge and explain how these differences impact risk management.
- Provide examples of cross-hedging, specifically the process of hedging jet fuel with crude oil and using weather derivatives.
- Explain how to create a synthetic commodity position, and use it to explain the relationship between the forward price and the expected future spot price.

Anthony Saunders and Marcia Millon Cornett,
Financial Institutions Management: A Risk Management Approach, 8th Edition
(New York: McGraw-Hill, 2014).

Chapter 13. Foreign Exchange Risk [FMP-13]

After completing this reading you should be able to:

- Calculate a financial institution's overall foreign exchange exposure.
- Explain how a financial institution could alter its net position exposure to reduce foreign exchange risk.
- Calculate a financial institution's potential dollar gain or loss exposure to a particular currency.
- Identify and describe the different types of foreign exchange trading activities.
- Identify the sources of foreign exchange trading gains and losses.

- Calculate the potential gain or loss from a foreign currency denominated investment.
- Explain balance-sheet hedging with forwards.
- Describe how a non-arbitrage assumption in the foreign exchange markets leads to the interest rate parity theorem, and use this theorem to calculate forward foreign exchange rates.
- Explain why diversification in multicurrency asset-liability positions could reduce portfolio risk.
- Describe the relationship between nominal and real interest rates.

Jon Gregory, Central Counterparties:
Mandatory Clearing and Bilateral Margin Requirements for OTC Derivatives
(West Sussex, UK: John Wiley & Sons, 2014).

Chapter 1. Introduction [FMP-14]

After completing this reading you should be able to:

- Explain the characteristics of bilateral OTC derivatives trading and the role they may have played in the recent financial crisis.
- Identify the regulatory changes implemented after the financial crisis.
- Describe the basic characteristics of central clearing and central counterparties (CCP), identifying potential benefits as well as drawbacks.

Chapter 2. Exchanges, OTC Derivatives, DPCs and SPVs [FMP-15]

After completing this reading you should be able to:

- Describe how exchanges can be used to alleviate counterparty risk.
- Explain the developments in clearing that reduce risk.
- Compare exchange-traded and OTC markets and describe their uses.
- Identify the classes of derivatives securities and explain the risk associated with them.
- Identify risks associated with OTC markets and explain how these risks can be mitigated.

Chapter 3. Basic Principles of Central Clearing [FMP-16]

After completing this reading you should be able to:

- Provide examples of the mechanics of a central counterparty (CCP).
- Describe advantages and disadvantages of central clearing of OTC derivatives.
- Compare margin requirements in centrally cleared and bilateral markets, and explain how margin can mitigate risk.
- Compare and contrast bilateral markets to the use of novation and netting.
- Assess the impact of central clearing on the broader financial markets.

Chapter 14 (section 14.4 only). Risks Caused by CCPs: Risks Faced by CCPs [FMP-17]

After completing this reading you should be able to:

- Identify and explain the types of risks faced by CCPs.
- Identify and distinguish between the risks to clearing members as well as non-members.
- Identify and evaluate lessons learned from prior CCP failures.

Frank Fabozzi (editor), Steve Mann, and Adam Cohen, *The Handbook of Fixed Income Securities, 8th Edition* (New York: McGraw-Hill, 2012).

Chapter 12. Corporate Bonds [FMP-18]

After completing this reading you should be able to:

- Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.
- Explain a bond's maturity date and how it impacts bond retirements.
- Describe the main types of interest payment classifications.
- Describe zero-coupon bonds and explain the relationship between original-issue discount and reinvestment risk.
- Distinguish among the following security types relevant for corporate bonds: mortgage bonds, collateral trust bonds, equipment trust certificates, subordinated and convertible debenture bonds, and guaranteed bonds.
- Describe the mechanisms by which corporate bonds can be retired before maturity.
- Differentiate between credit default risk and credit spread risk.
- Describe event risk and explain what may cause it in corporate bonds.
- Define high-yield bonds, and describe types of high-yield bond issuers and some of the payment features unique to high yield bonds.
- Define and differentiate between an issuer default rate and a dollar default rate.
- Define recovery rates and describe the relationship between recovery rates and seniority.

Bruce Tuckman, Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 20. Mortgages and Mortgage-Backed Securities [FMP–19]

After completing this reading you should be able to:

- Describe the various types of residential mortgage products.
- Calculate a fixed rate mortgage payment, and its principal and interest components.
- Describe the mortgage prepayment option and the factors that influence prepayments.
- Summarize the securitization process of mortgage backed securities (MBS), particularly formation of mortgage pools including specific pools and TBAs.
- Calculate weighted average coupon, weighted average maturity, and conditional prepayment rate (CPR) for a mortgage pool.
- Describe a dollar roll transaction and how to value a dollar roll.
- Explain prepayment modeling and its four components: refinancing, turnover, defaults, and curtailments.
- Describe the steps in valuing an MBS using Monte Carlo Simulation.
- Define Option Adjusted Spread (OAS), and explain its challenges and its uses.

John B. Caouette, Edward I. Altman, Paul Narayanan, and Robert W.J. Nimmo, *Managing Credit Risk: The Great Challenge for Global Financial Markets, 2nd Edition* (New York: John Wiley & Sons, 2008).

Chapter 6. The Rating Agencies [FMP–20]

After completing this reading you should be able to:

- Describe the role of rating agencies in the financial markets.
- Explain market and regulatory forces that have played a role in the growth of the rating agencies.
- Describe a rating scale, define credit outlooks, and explain the difference between solicited and unsolicited ratings.
- Describe Standard and Poor's and Moody's rating scales and distinguish between investment and noninvestment
- grade ratings.
- Describe the difference between an issuer-pay and a subscriber-pay model and describe concerns regarding the issuer-pay model.
- Describe and contrast the process for rating corporate and sovereign debt and describe how the distribution of these ratings may differ.
- Describe the relationship between the rating agencies and regulators and identify key regulations that impact the rating agencies and the use of ratings in the market.
- Describe some of the trends and issues emerging from the recent credit crisis relevant to the rating agencies and the use of ratings in the market.

VALUATION AND RISK MODELS—PART I EXAM WEIGHT 30% (VRM)

The broad areas of knowledge covered in readings related to Valuation and Risk Models include the following:

- Value-at-Risk (VaR)

- Expected shortfall (ES)
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation
- Hedging
- Country and sovereign risk models and management
- External and internal credit ratings
- Expected and unexpected losses
- Operational risk

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

Linda Allen, Jacob Boudoukh and Anthony Saunders, *Understanding Market, Credit and Operational Risk: The Value at Risk Approach* (New York: Wiley-Blackwell, 2004).

Chapter 2. Quantifying Volatility in VaR Models [VRM–1]

After completing this reading you should be able to:

- Explain how asset return distributions tend to deviate from the normal distribution.
- Explain reasons for fat tails in a return distribution and describe their implications.
- Distinguish between conditional and unconditional distributions.
- Describe the implications of regime switching on quantifying volatility.
- Evaluate the various approaches for estimating VaR.
- Compare and contrast different parametric and non-parametric approaches for estimating conditional volatility.
- Calculate conditional volatility using parametric and non-parametric approaches.
- Explain the process of return aggregation in the context of volatility forecasting methods.
- Evaluate implied volatility as a predictor of future volatility and its shortcomings.
- Explain long horizon volatility/VaR and the process of mean reversion according to an AR(1) model.
- Calculate conditional volatility with and without mean reversion.
- Describe the impact of mean reversion on long horizon conditional volatility estimation

Chapter 3. Putting VaR to Work [VRM–2]

After completing this reading you should be able to:

- Explain and give examples of linear and non-linear derivatives.

- Describe and calculate VaR for linear derivatives.
- Describe the delta-normal approach to calculating VaR for non-linear derivatives.
- Describe the limitations of the delta-normal method.
- Explain the full revaluation method for computing VaR.
- Compare delta-normal and full revaluation approaches for computing VaR.
- Explain structured Monte Carlo, stress testing and scenario analysis methods for computing VaR. Identifying strengths and weaknesses of each approach.
- Describe the implications of correlation breakdown for scenario analysis.
- Describe worst-case scenario (WCS) analysis and compare WCS to VaR.

Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).

Chapter 2. Measures of Financial Risk [VRM–3]

After completing this reading you should be able to:

- Describe the mean-variance framework and the efficient frontier.
- Explain the limitations of the mean-variance framework with respect to assumptions about the return distributions.
- Define the Value-at-Risk (VaR) measure of risk, describe assumptions about return distributions and holding period, and explain the limitations of VaR.
- Define the properties of a coherent risk measure and explain the meaning of each property.
- Explain why VaR is not a coherent risk measure.
- Explain and calculate expected shortfall (ES), and compare and contrast VaR and ES.
- Describe spectral risk measures, and explain how VaR and ES are special cases of spectral risk measures.
- Describe how the results of scenario analysis can be interpreted as coherent risk measures.

John Hull, *Options, Futures, and Other Derivatives, 9th Edition* (New York: Pearson, 2014).

Chapter 13. Binomial Trees [VRM–4]

After completing this reading you should be able to:

- Calculate the value of an American and a European call or put option using a one-step and two-step binomial model.
- Describe how volatility is captured in the binomial model.
- Describe how the value calculated using a binomial model converges as time periods are added.
- Explain how the binomial model can be altered to price options on: stocks with dividends, stock indices, currencies, and futures.

Chapter 15. The Black-Scholes-Merton Model [VRM–5]

After completing this reading you should be able to:

- Explain the lognormal property of stock prices, the distribution of rates of return, and the calculation of expected return.
- Compute the realized return and historical volatility of a stock.
- Describe the assumptions underlying the Black-Scholes-Merton option pricing model.
- Compute the value of a European option using the Black-Scholes-Merton model on a non-dividend-paying stock.
- Compute the value of a warrant and identify the complications involving the valuation of warrants.
- Define implied volatilities and describe how to compute implied volatilities from market prices of options using the Black-Scholes-Merton model.
- Explain how dividends affect the decision to exercise early for American call and put options.
- Compute the value of a European option using the Black-Scholes-Merton model on a dividend-paying stock.

Chapter 19. Greek Letters [VRM–6]

After completing this reading you should be able to:

- Describe and assess the risks associated with naked and covered option positions.
- Explain how naked and covered option positions generate a stop loss trading strategy.
- Describe delta hedging for an option, forward, and futures contracts.
- Compute the delta of an option.
- Describe the dynamic aspects of delta hedging and distinguish between dynamic hedging and hedge-and-forget strategy.
- Define the delta of a portfolio.
- Define and describe theta, gamma, vega, and rho for option positions.
- Explain how to implement and maintain a delta neutral and a gamma neutral position.
- Describe the relationship between delta, theta, gamma, and vega.
- Describe how hedging activities take place in practice, and describe how scenario analysis can be used to formulate expected gains and losses with option positions.
- Describe how portfolio insurance can be created through option instruments and stock index futures.

Bruce Tuckman, *Fixed Income Securities, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 1. Prices, Discount Factors, and Arbitrage [VRM–7]

After completing this reading you should be able to:

- Define discount factor and use a discount function to compute present and future values.
- Define the "law of one price," explain it using an arbitrage argument, and describe how it can be applied to bond pricing.
- Identify the components of a U.S. Treasury coupon bond, and compare and contrast the structure to Treasury STRIPS, including the difference between P-STRIPS and C-STRIPS.
- Construct a replicating portfolio using multiple fixed income securities to match the cash flows of a given fixed income security.
- Identify arbitrage opportunities for fixed income securities with certain cash flows.
- Differentiate between "clean" and "dirty" bond pricing and explain the implications of accrued interest with respect to bond pricing.
- Describe the common day-count conventions used in bond pricing.

Chapter 2. Spot, Forward and Par Rates [VRM–8]

After completing this reading you should be able to:

- Calculate and interpret the impact of different compounding frequencies on a bond's value.
- Calculate discount factors given interest rate swap rates.
- Compute spot rates given discount factors.
- Interpret the forward rate, and compute forward rates given spot rates.
- Define par rate and describe the equation for the par rate of a bond.
- Interpret the relationship between spot, forward and par rates.
- Assess the impact of maturity on the price of a bond and the returns generated by bonds.
- Define the "flattening" and "steepening" of rate curves and describe a trade to reflect expectations that a curve will flatten or steepen.

Chapter 3. Returns, Spreads and Yields [VRM–9]

After completing this reading you should be able to:

- Distinguish between gross and net realized returns, and calculate the realized return for a bond over a holding period including reinvestments.
- Define and interpret the spread of a bond, and explain how a spread is derived from a bond price and a term structure of rates.
- Define, interpret, and apply a bond's yield-to-maturity (YTM) to bond pricing.
- Compute a bond's YTM given a bond structure and price.
- Calculate the price of an annuity and a perpetuity.
- Explain the relationship between spot rates and YTM.
- Define the coupon effect and explain the relationship between coupon rate, YTM, and bond prices.

- Explain the decomposition of P&L for a bond into separate factors including carry roll-down, rate change and spread change effects.
- Identify the most common assumptions in carry roll-down scenarios, including realized forwards, unchanged term structure, and unchanged yields.

Chapter 4. One-Factor Risk Metrics and Hedges [VRM–10]

After completing this reading you should be able to:

- Describe an interest rate factor and identify common examples of interest rate factors.
- Define and compute the DV01 of a fixed income security given a change in yield and the resulting change in price.
- Calculate the face amount of bonds required to hedge an option position given the DV01 of each.
- Define, compute, and interpret the effective duration of a fixed income security given a change in yield and the resulting change in price.
- Compare and contrast DV01 and effective duration as measures of price sensitivity.
- Define, compute, and interpret the convexity of a fixed income security given a change in yield and the resulting change in price.
- Explain the process of calculating the effective duration and convexity of a portfolio of fixed income securities.
- Explain the impact of negative convexity on the hedging of fixed income securities.
- Construct a barbell portfolio to match the cost and duration of a given bullet investment, and explain the advantages and disadvantages of bullet versus barbell portfolios.

Chapter 5. Multi-Factor Risk Metrics and Hedges [VRM–11]

After completing this reading you should be able to:

- Describe and assess the major weakness attributable to single-factor approaches when hedging portfolios or implementing asset liability techniques.
- Define key rate exposures and know the characteristics of key rate exposure factors including partial '01s and forward-bucket '01s.
- Describe key-rate shift analysis.
- Define, calculate, and interpret key rate '01 and key rate duration.
- Describe the key rate exposure technique in multi-factor hedging applications; summarize its advantages and disadvantages.
- Calculate the key rate exposures for a given security, and compute the appropriate hedging positions given a specific key rate exposure profile.
- Relate key rates, partial '01s and forward-bucket '01s, and calculate the forward bucket '01 for a shift in rates in one or more buckets.
- Construct an appropriate hedge for a position across its entire range of forward bucket exposures.

- Apply key rate and multi-factor analysis to estimating portfolio volatility.

Aswath Damodaran, *"Country Risk: Determinants, Measures and Implications - The 2015 Edition"* (July 2015). [VRM-12]

After completing this reading you should be able to:

- Identify sources of country risk.
- Explain how a country's position in the economic growth life cycle, political risk, legal risk, and economic structure affect its risk exposure.
- Evaluate composite measures of risk that incorporate all types of country risk and explain limitations of the risk services.
- Compare instances of sovereign default in both foreign currency debt and local currency debt, and explain common causes of sovereign defaults.
- Describe the consequences of sovereign default.
- Describe factors that influence the level of sovereign default risk; explain and assess how rating agencies measure sovereign default risks.
- Describe the advantages and disadvantages of using the sovereign default spread as a predictor of defaults.

Arnaud de Servigny and Olivier Renault, *Measuring and Managing Credit Risk* (New York: McGraw-Hill, 2004).

Chapter 2. External and Internal Ratings [VRM–13]

After completing this reading you should be able to:

- Describe external rating scales, the rating process, and the link between ratings and default.
- Describe the impact of time horizon, economic cycle, industry, and geography on external ratings.
- Explain the potential impact of ratings changes on bond and stock prices.
- Compare external and internal ratings approaches.
- Explain and compare the through-the-cycle and at-the-point internal ratings approaches.
- Describe a ratings transition matrix and explain its uses.
- Describe the process for and issues with building, calibrating and backtesting an internal rating system.
- Identify and describe the biases that may affect a rating system.

Gerhard Schroeck, *Risk Management and Value Creation in Financial Institutions* (New York: John Wiley & Sons, 2002).

Chapter 5. Capital Structure in Banks (pp. 170-186 only) [VRM–14]

After completing this reading you should be able to:

- Evaluate a bank's economic capital relative to its level of credit risk
- Identify and describe important factors used to calculate economic capital for credit risk: probability of default, exposure, and loss rate.
- Define and calculate expected loss (EL).
- Define and calculate unexpected loss (UL).
- Estimate the variance of default probability assuming a binomial distribution.
- Calculate UL for a portfolio and the risk contribution of each asset.
- Describe how economic capital is derived.
- Explain how the credit loss distribution is modeled.
- Describe challenges to quantifying credit risk.

John Hull, *Risk Management and Financial Institutions, 4th Edition* (Hoboken, NJ: John Wiley & Sons, 2015).

Chapter 23. Operational Risk [VRM-15]

After completing this reading you should be able to:

- Compare three approaches for calculating regulatory capital.
- Describe the Basel Committee's seven categories of operational risk.
- Derive a loss distribution from the loss frequency distribution and loss severity distribution using Monte Carlo simulations.
- Describe the common data issues that can introduce inaccuracies and biases in the estimation of loss frequency and severity distributions.
- Describe how to use scenario analysis in instances when data is scarce.
- Describe how to identify causal relationships and how to use risk and control self-assessment (RCSA) and key risk Indicators (KRIs) to measure and manage operational risks.
- Describe the allocation of operational risk capital to business units.
- Explain how to use the power law to measure operational risk.
- Explain the risks of moral hazard and adverse selection when using insurance to mitigate operational risks.

Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York: McGraw Hill, 2007).

Chapter 14. Stress Testing. [VRM–16]

After completing this reading you should be able to:

- Describe the purposes of stress testing and the process of implementing a stress testing scenario.
- Contrast between event-driven scenarios and portfolio-driven scenarios.
- Identify common one-variable sensitivity tests.
- Analyze drawbacks to scenario analysis.
- Distinguish between unidimensional and multidimensional scenarios.
- Compare and contrast various approaches to multidimensional scenario analysis.
- Define and distinguish between sensitivity analysis and stress testing model parameters.
- Explain how the results of a stress test can be used to improve risk analysis and risk management systems.

"Principles for Sound Stress Testing Practices and Supervision" (Basel Committee on Banking Supervision Publication, May 2009). [VRM–17]

After completing this reading you should be able to:

- Describe the rationale for the use of stress testing as a risk management tool.
- Describe weaknesses identified and recommendations for improvement in:
  - The use of stress testing and integration in risk governance
  - Stress testing methodologies
  - Stress testing scenarios
  - Stress testing handling of specific risks and products
- Describe stress testing principles for banks regarding the use of stress testing and integration in risk governance, stress testing methodology and scenario selection, and principles for supervisors.

2016
FRM LEARNING
OBJECTIVES

PART II

MARKET RISK MEASUREMENT AND MANAGEMENT—PART II EXAM WEIGHT 25% (MR)

The broad areas of knowledge covered in readings related to Market Risk Measurement and Management include the following:

- VaR and other risk measures
  - Parametric and non-parametric methods of estimation
  - VaR mapping
  - Backtesting VaR
  - Expected shortfall (ES) and other coherent risk measures
  - Extreme value theory (EVT)
- Modeling dependence: Correlations and copulas
- Term structure models of interest rates
- Discount rate selection
- Volatility: Smiles and term structures

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).

Chapter 3. Estimating Market Risk Measures: An Introduction and Overview [MR-1]

After completing this reading you should be able to:

- Estimate VaR using a historical simulation approach.
- Estimate VaR using a parametric approach for both normal and lognormal return distributions.
- Estimate the expected shortfall given P/L or return data.
- Define coherent risk measures.
- Estimate risk measures by estimating quantiles.
- Evaluate estimators of risk measures by estimating their standard errors.
- Interpret QQ plots to identify the characteristics of a distribution.

Chapter 4. Non-parametric Approaches [MR-2]

After completing this reading you should be able to:

- Apply the bootstrap historical simulation approach to estimate coherent risk measures.
- Describe historical simulation using non-parametric density estimation.
- Compare and contrast the age-weighted, the volatility-weighted, the correlation-weighted and the filtered historical simulation approaches.
- Identify advantages and disadvantages of non-parametric estimation methods.

Chapter 7. Parametric Approaches (II): Extreme Value [MR–3]

After completing this reading you should be able to:

- Explain the importance and challenges of extreme values in risk management.
- Describe extreme value theory (EVT) and its use in risk management.
- Describe the peaks-over-threshold (POT) approach.
- Compare and contrast generalized extreme value and POT.
- Evaluate the tradeoffs involved in setting the threshold level when applying the GP distribution.
- Explain the importance of multivariate EVT for risk management.

Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York: McGraw-Hill, 2007).

Chapter 6. Backtesting VaR [MR–4]

After completing this reading you should be able to:

- Define backtesting and exceptions and explain the importance of backtesting VaR models.
- Explain the significant difficulties in backtesting a VaR model.
- Verify a model based on exceptions or failure rates.
- Define and identify type I and type II errors.
- Explain the need to consider conditional coverage in the backtesting framework.
- Describe the Basel rules for backtesting.

Chapter 11. VaR Mapping [MR–5]

After completing this reading you should be able to:

- Explain the principles underlying VaR mapping, and describe the mapping process.
- Explain how the mapping process captures general and specific risks.
- Differentiate among the three methods of mapping portfolios of fixed income securities.
- Summarize how to map a fixed income portfolio into positions of standard instruments.

- Describe how mapping of risk factors can support stress testing.
- Explain how VaR can be used as a performance benchmark.
- Describe the method of mapping forwards, forward rate agreements, interest rate swaps, and options.

"Messages from the Academic Literature on Risk Measurement for the Trading Book," Basel Committee on Banking Supervision, Working Paper, No. 19, Jan 2011. [MR–6]

After completing this reading you should be able to:

- Explain the following lessons on VaR implementation: time horizon over which VaR is estimated, the recognition of time varying volatility in VaR risk factors, and VaR backtesting.
- Describe exogenous and endogenous liquidity risk and explain how they might be integrated into VaR models.
- Compare VaR, expected shortfall, and other relevant risk measures.
- Compare unified and compartmentalized risk measurement.
- Compare the results of research on "top-down" and "bottom-up" risk aggregation methods.
- •. Describe the relationship between leverage, market value of asset, and VaR within an active balance sheet management framework.

Gunter Meissner, *Correlation Risk Modeling and Management* (New York: John Wiley & Sons, 2014).

Chapter 1. Some Correlation Basics: Properties, Motivation, Terminology [MR-7]

After completing this reading you should be able to:

- Describe financial correlation risk and the areas in which it appears in finance.
- Explain how correlation contributed to the global financial crisis of 2007 to 2009.
- Describe the structure, uses, and payoffs of a correlation swap.
- Estimate the impact of different correlations between assets in the trading book on the VaR capital charge.
- Explain the role of correlation risk in market risk and credit risk.
- Relate correlation risk to systemic and concentration risk.

Chapter 2. Empirical Properties of Correlation: How Do Correlations Behave in the Real World? [MR–8]

After completing this reading you should be able to:

- Describe how equity correlations and correlation volatilities behave throughout various economic states.
- Calculate a mean reversion rate using standard regression and calculate the corresponding autocorrelation.
- Identify the best-fit distribution for equity, bond, and default correlations.

Chapter 3. Statistical Correlation Models—Can We Apply Them to Finance? [MR–9]

After completing this reading you should be able to:

- Evaluate the limitations of financial modeling with respect to the model itself, calibration of the model, and the model's output.
- Assess the Pearson correlation approach, Spearman's rank correlation, and Kendall's τ, and evaluate their limitations and usefulness in finance.

Chapter 4. Financial Correlation Modeling— Bottom-Up Approaches (Sections 4.3.0 (intro), 4.3.1, and 4.3.2 only) [MR–10]

After completing this reading you should be able to:

- Explain the purpose of copula functions and the translation of the copula equation.
- Describe the Gaussian copula and explain how to use it to derive the joint probability of default of two assets.
- Summarize the process of finding the default time of an asset correlated to all other assets in a portfolio using the Gaussian copula.

Bruce Tuckman and Angel Serrat, *Fixed Income Securities, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 6. Empirical Approaches to Risk Metrics and Hedges [MR–11]

After completing this reading you should be able to:

- Explain the drawbacks to using a DV01-neutral hedge for a bond position.
- Describe a regression hedge and explain how it can improve a standard DV01-neutral hedge.
- Calculate the regression hedge adjustment factor, beta.
- Calculate the face value of an offsetting position needed to carry out a regression hedge.
- Calculate the face value of multiple offsetting swap positions needed to carry out a two-variable regression hedge.
- Compare and contrast level and change regressions.
- Describe principal component analysis and explain how it is applied to constructing a hedging portfolio.

Chapter 7. The Science of Term Structure Models [MR–12]

After completing this reading you should be able to:

- Calculate the expected discounted value of a zero-coupon security using a binomial tree.
- Construct and apply an arbitrage argument to price a call option on a zero-coupon security using replicating portfolios.
- Define risk-neutral pricing and apply it to option pricing.
- Distinguish between true and risk-neutral probabilities, and apply this difference to interest rate drift.
- Explain how the principles of arbitrage pricing of derivatives on fixed income securities can be extended over multiple periods.
- Define option-adjusted spread (OAS) and apply it to security pricing.
- Describe the rationale behind the use of recombining trees in option pricing.
- Calculate the value of a constant maturity Treasury swap, given an interest rate tree and the risk-neutral probabilities.
- •Evaluate the advantages and disadvantages of reducing the size of the time steps on the pricing of derivatives on fixed income securities.
- Evaluate the appropriateness of the Black-Scholes-Merton model when valuing derivatives on fixed income securities.
- Describe the impact of embedded options on the value of fixed income securities.

Chapter 8. The Evolution of Short Rates and the Shape of the Term Structure [MR–13]

After completing this reading you should be able to:

- Explain the role of interest rate expectations in determining the shape of the term structure.
- Apply a risk-neutral interest rate tree to assess the effect of volatility on the shape of the term structure.
- Estimate the convexity effect using Jensen's inequality.
- Evaluate the impact of changes in maturity, yield and volatility on the convexity of a security.
- Calculate the price and return of a zero coupon bond incorporating a risk premium.

Chapter 9. The Art of Term Structure Models: Drift [MR–14]

After completing this reading you should be able to:

- Construct and describe the effectiveness of a short term interest rate tree assuming normally distributed rates, both with and without drift.
- Calculate the short-term rate change and standard deviation of the rate change using a model with normally distributed rates and no drift.
- Describe methods for addressing the possibility of negative short-term rates in term structure models.
- Construct a short-term rate tree under the Ho-Lee Model with time-dependent drift.
- Describe uses and benefits of the arbitrage-free models and

assess the issue of fitting models to market prices.

- Describe the process of constructing a simple and recombining tree for a short-term rate under the Vasicek Model with mean reversion.
- Calculate the Vasicek Model rate change, standard deviation of the rate change, expected rate in T years, and half-life.
- Describe the effectiveness of the Vasicek Model.

Chapter 10. The Art of Term Structure Models: Volatility and Distribution [MR–15]

After completing this reading you should be able to:

- Describe the short-term rate process under a model with time-dependent volatility.
- Calculate the short-term rate change and determine the behavior of the standard deviation of the rate change using a model with time dependent volatility.
- Assess the efficacy of time-dependent volatility models.
- Describe the short-term rate process under the Cox-Ingersoll-Ross (CIR) and lognormal models.
- Calculate the short-term rate change and describe the basis point volatility using the CIR and lognormal models.
- Describe lognormal models with deterministic drift and mean reversion.

John Hull, *Options, Futures, and Other Derivatives, 9th Edition* (New York: Pearson, 2014).

Chapter 9. OIS Discounting, Credit Issues, and Funding Costs [MR–16]

After completing this reading you should be able to:

- Explain the main considerations in choosing a risk-free rate for derivatives valuation.
- Describe the OIS rate and the LIBOR-OIS spread, and explain their uses.
- Evaluate the appropriateness of OIS rate as a proxy for the risk-free rate.
- Describe how to use the OIS zero curve in determining forward LIBOR rates and valuing swaps.

Chapter 20. Volatility Smiles [MR–17]

After completing this reading you should be able to:

- Define volatility smile and volatility skew.
- Explain the implications of put-call parity on the implied volatility of call and put options.
- Compare the shape of the volatility smile (or skew) to the shape of the implied distribution of the underlying asset price and to the pricing of options on the underlying asset.
- Describe characteristics of foreign exchange rate distributions and their implications on option prices and implied volatility.

- Describe the volatility smile for equity options and foreign currency options and provide possible explanations for its shape.

- Describe alternative ways of characterizing the volatility smile.

- Describe volatility term structures and volatility surfaces and how they may be used to price options.

- Explain the impact of the volatility smile on the calculation of the "Greeks."

- Explain the impact of a single asset price jump on a volatility smile.

CREDIT RISK MEASUREMENT AND MANAGEMENT—PART II EXAM WEIGHT 25%. (CR)

The broad areas of knowledge covered in readings related to Credit Risk Management include the following:

- Credit analysis

- Default risk: Quantitative methodologies

- Expected and unexpected loss

- Credit VaR

- Counterparty risk

- Credit derivatives

- Structured finance and securitization

The readings that candidates should focus on for this section and the specific learning objectives that should be achieved with each reading are listed as follows:

Jonathan Golin and Philippe Delhaise, *The Bank Credit Analysis Handbook, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2013).

Chapter 1. The Credit Decision [CR – 1]

After completing this reading you should be able to:

- Define credit risk and explain how it arises using examples.

- Explain the components of credit risk evaluation.

- Describe, compare and contrast various credit risk mitigants and their role in credit analysis.

- Compare and contrast quantitative and qualitative techniques of credit risk evaluation.

- Compare the credit analysis of consumers, corporations, financial institutions, and sovereigns.

- Describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss, and time horizon.

- Compare bank failure and bank insolvency.

Chapter 2. The Credit Analyst [CR – 2]

After completing this reading you should be able to:

- Describe, compare and contrast various credit analyst roles.

- Describe common tasks performed by a banking credit analyst.

- Describe the quantitative, qualitative, and research skills a banking credit analyst is expected to have.

- Assess the quality of various sources of information used by a credit analyst

Arnaud de Servigny and Olivier Renault, *Measuring and Managing Credit Risk* (New York: McGraw-Hill, 2004).

Chapter 3. Default Risk: Quantitative Methodologies [CR – 3]

After completing this reading you should be able to:

- Describe the Merton model for corporate security pricing, including its assumptions, strengths and weaknesses:

  - Illustrate and interpret security-holder payoffs based on the Merton model.

  - Using the Merton Model, calculate the value of a firm's equity and the default probability of a firm's debt.

  - Describe the results and practical implications of empirical studies that use the Merton model to value debt.

- Describe key qualities of credit scoring models.

- Compare the following quantitative methodologies for credit analysis and scoring: linear discriminant analysis, parametric discrimination, K nearest neighbor approach, and support vector machines.

- Differentiate between the following decision rules: minimum error, minimum risk, Neyman-Pearson and Minimax.

- Identify the problems and tradeoffs between classification and prediction models of performance.

- Describe important factors in the choice of a particular class of model.

René Stulz, *Risk Management & Derivatives* (Florence, KY: Thomson South-Western, 2002).

Chapter 18. Credit Risks and Credit Derivatives [CR – 4]

After completing this reading you should be able to:

- Using the Merton model, calculate the value of a firm's debt and equity and the volatility of firm value.

- Explain the relationship between credit spreads, time to maturity, and interest rates.

- Explain the differences between valuing senior and subordinated debt using a contingent claim approach.

- Explain, from a contingent claim perspective, the impact of stochastic interest rates on the valuation of risky bonds, equity, and the risk of default.

- Compare and contrast different approaches to credit risk modeling, such as those related to the Merton model, CreditRisk+, CreditMetrics, and the KMV model.

- Assess the credit risks of derivatives.
- Describe a credit derivative, credit default swap, and total return swap.
- Explain how to account for credit risk exposure in valuing a swap.

Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 6. Credit and Counterparty Risk [CR – 5]

After completing this reading you should be able to:

- Describe the credit risks associated with different types of securities.
- Differentiate between book and market values in a firm's capital structure.
- Describe common frictions that arise with the use of credit contracts.
- Explain the following concepts related to default and recovery: default events, probability of default, credit exposure, and loss given default.
- Calculate expected loss from recovery rates, the loss given default, and the probability of default.
- Differentiate between a credit risk event and a market risk event for marketable securities.
- Summarize credit assessment techniques such as credit ratings and rating migrations, internal ratings, and risk models.
- Describe counterparty risk, compare counterparty risk to credit risk, and explain how counterparty risk can be mitigated.
- Describe the Merton Model, and use it to calculate the value of a firm, the values of a firm's debt and equity, and default probabilities.
- Explain the drawbacks of and assess possible improvements to the Merton Model.
- Describe credit factor models and evaluate an example of a single-factor model.
- Define and calculate Credit VaR

Chapter 7. Spread Risk and Default Intensity Models [CR – 6]

After completing this reading you should be able to:

- Compare the different ways of representing credit spreads.
- Compute one credit spread given others when possible.
- Define and compute the Spread '01.
- Explain how default risk for a single company can be modeled as a Bernoulli trial.
- Explain the relationship between exponential and Poisson distributions.
- Define the hazard rate and use it to define probability functions for default time and conditional default probabilities.

- Calculate the conditional default probability given the hazard rate.
- Calculate risk-neutral default rates from spreads.
- Describe advantages of using the CDS market to estimate hazard rates.
- Explain how a CDS spread can be used to derive a hazard rate curve.
- Explain how the default distribution is affected by the sloping of the spread curve.
- Define spread risk and its measurement using the mark-to-market and spread volatility

Chapter 8. Portfolio Credit Risk (Sections 8.1, 8.2, 8.3 only) [CR – 7]

After completing this reading you should be able to:

- Define and calculate default correlation for credit portfolios.
- Identify drawbacks in using the correlation-based credit portfolio framework.
- Assess the impact of correlation on a credit portfolio and its Credit VaR.
- Describe the use of a single factor model to measure portfolio credit risk, including the impact of correlation.
- Describe how Credit VaR can be calculated using a simulation of joint defaults with a copula.

Chapter 9. Structured Credit Risk [CR – 8]

After completing this reading you should be able to:

- Describe common types of structured products.
- Describe tranching and the distribution of credit losses in a securitization.
- Describe a waterfall structure in a securitization.
- Identify the key participants in the securitization process, and describe conflicts of interest that can arise in the process.
- Compute and evaluate one or two iterations of interim cashflows in a three tiered securitization structure.
- Describe a simulation approach to calculating credit losses for different tranches in a securitization.
- Explain how the default probabilities and default correlations affect the credit risk in a securitization.
- Explain how default sensitivities for tranches are measured.
- Describe risk factors that impact structured products.
- Define implied correlation and describe how it can be measured.
- Identify the motivations for using structured credit products

Jon Gregory, *Counterparty Credit Risk and Credit Value Adjustment: A Continuing Challenge for Global Financial Markets, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2012).

Chapter 3. Defining Counterparty Credit Risk [CR – 9]

After completing this reading you should be able to:

- Describe counterparty risk and differentiate it from lending risk.
- Describe transactions that carry counterparty risk and explain how counterparty risk can arise in each transaction.
- Identify and describe institutions that take on significant counterparty risk.
- Describe credit exposure, credit migration, recovery, mark-to-market, replacement cost, default probability, loss given default and the recovery rate.
- Identify and describe the different ways institutions can manage and mitigate counterparty risk.

Chapter 4. Netting, Compression, Resets, and Termination Features [CR – 10]

After completing this reading you should be able to:

- Explain the purpose of an ISDA master agreement.
- Summarize netting and close-out procedures (including multilateral netting), explain their advantages and
- disadvantages, and describe how they fit into the framework of the ISDA master agreement.
- Describe the effectiveness of netting in reducing credit exposure under various scenarios.
- Describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.

Chapter 5. Collateral [CR – 11]

After completing this reading you should be able to:

- Describe the rationale for collateral management.
- Describe features of a credit support annex (CSA) within the ISDA Master Agreement.
- Describe the role of a valuation agent.
- Describe types of collateral that are typically used.
- Explain the process for the reconciliation of collateral disputes.
- Explain the features of a collateralization agreement.
- Differentiate between a two-way and one-way CSA agreement and describe how collateral parameters can be linked to credit quality.
- Explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.

Chapter 7. Central Counterparties [CR – 12]

After completing this reading you should be able to:

- Explain the objectives and functions of central counterparties (CCPs).
- Discuss the strengths and weaknesses of CCPs.
- Describe the different CCP netting schemes, the benefit of netting and distinguish between bilateral netting and multilateral netting.
- Discuss the key challenges in relation to the clearing of over-the-counter (OTC) derivative products.
- Describe the three types of participants that channel trade through a CCP.
- Explain the loss waterfall in a CCP structure.
- Define initial margin and variation margin and describe the different approaches and factors in calculating initial margin.
- Discuss the impact of initial margin on prices, volume, volatility, and credit quality.
- Explain factors that can lead to failure of a CCP and discuss measures to protect CCPs from default.

Chapter 8. Credit Exposure [CR – 13]

After completing this reading you should be able to:

- Describe and calculate the following metrics for credit exposure: expected mark-to-market, expected exposure, potential future exposure, expected positive exposure and negative exposure, effective exposure, and maximum exposure.
- Compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.
- Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.
- Identify typical credit exposure profiles for various derivative contracts and combination profiles.
- Explain how payment frequencies and exercise dates affect the exposure profile of various securities.
- Explain the impact of netting on exposure, the benefit of correlation, and calculate the netting factor.
- Explain the impact of collateralization on exposure, and assess the risk associated with the remargining period, threshold, and minimum transfer amount.
- Explain the difference between risk-neutral and real-world parameters, and describe their use in assessing risk.

Chapter 10. Default Probability, Credit Spreads, and Credit Derivatives [CR – 14]

After completing this reading you should be able to:

- Distinguish between cumulative and marginal default probabilities.
- Calculate risk-neutral default probabilities, and compare the use of risk-neutral and real-world default probabilities in pricing derivative contracts.

- Compare the various approaches for estimating price: historical data approach, equity based approach, and risk neutral approach.
- Describe how recovery rates may be estimated.
- Describe credit default swaps (CDS) and their general underlying mechanics.
- Describe the credit spread curve and explain the motivation for curve mapping.
- Describe types of portfolio credit derivatives.
- Describe index tranches, super senior risk, and collateralized debt obligations (CDO).

Chapter 12. Credit Value Adjustment [CR – 15]

After completing this reading you should be able to:

- Explain the motivation for and the challenges of pricing counterparty risk.
- Describe credit value adjustment (CVA).
- Calculate CVA and the CVA spread with no wrong-way risk, netting, or collateralization.
- Evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.
- Explain how netting can be incorporated into the CVA calculation.
- Define and calculate incremental CVA and marginal CVA, and explain how to convert CVA into a running spread.
- Explain the impact of incorporating collateralization into the CVA calculation.

Chapter 15. Wrong-Way Risk [CR – 16]

After completing this reading you should be able to:

- Describe wrong-way risk and contrast it with right-way risk.
- Identify examples of wrong-way risk and examples of right-way risk.

Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York: McGraw-Hill, 2014).

Chapter 9. Credit Scoring and Retail Credit Risk Management [CR – 17]

After completing this reading you should be able to:

- Analyze the credit risks and other risks generated by retail banking.
- Explain the differences between retail credit risk and corporate credit risk.
- Discuss the "dark side" of retail credit risk and the measures that attempt to address the problem.
- Define and describe credit risk scoring model types, key variables, and applications.

- Discuss the key variables in a mortgage credit assessment and describe the use of cutoff scores, default rates and loss rates in a credit scoring model.
- Discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.
- Describe the customer relationship cycle and discuss the trade-off between creditworthiness and profitability.
- Discuss the benefits of risk-based pricing of financial services.

Chapter 12. The Credit Transfer Markets-and Their Implications [CR – 18]

After completing this reading you should be able to:

- Discuss the flaws in the securitization of subprime mortgages prior to the financial crisis of 2007.
- Identify and explain the different techniques used to mitigate credit risk, and describe how some of these techniques are changing the bank credit function.
- Describe the originate-to-distribute model of credit risk transfer and discuss the two ways of managing a bank credit portfolio.
- Describe the different types and structures of credit derivatives including credit default swap (CDS), first-to-default put, total return swaps (TRS), asset-backed credit-linked note (CLN), and their applications.
- Explain the credit risk securitization process and describe the structure of typical collateralized loan obligations (CLOs) or collateralized debt obligations (CDOs).
- Describe synthetic CDOs and single-tranche CDOs.
- Assess the rating of CDOs by rating agencies prior to the 2007 financial crisis.

Moorad Choudhry, *Structured Credit Products: Credit Derivatives & Synthetic Securitization, 2nd Edition* (New York: John Wiley & Sons, 2010)

Chapter 12. An Introduction to Securitization [CR – 19]

After completing this reading you should be able to:

- Define securitization, describe the securitization process and explain the role of participants in the process.
- Explain the terms *over-collateralization*, *first-loss piece*, *equity piece*, and *cash waterfall* within the securitization process.
- Analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose vehicle (SPV) and distinguish between the three main SPV structures: amortizing, revolving, and master trust.
- Explain the reasons for and the benefits of undertaking securitization.
- Describe and assess the various types of credit enhancements.

- Explain the various performance analysis tools for securitized structures and identify the asset classes to which they are most applicable.
- Define and calculate the delinquency ratio, default ratio, monthly payment rate (MPR), debt service coverage ratio (DSCR), the weighted average coupon (WAC), the weighted average maturity (WAM), and the weighted average life (WAL) for relevant securitized structures.
- Explain the prepayment forecasting methodologies and calculate the constant prepayment rate (CPR) and the Public Securities Association (PSA) rate.
- Explain the decline in demand in the new-issue securitized finance products market following the 2007 financial crisis.

Adam Ashcraft and Til Schuermann, *"Understanding the Securitization of Subprime Mortgage Credit,"* Federal Reserve Bank of New York Staff Reports, No. 318 (March 2008). [CR – 20]

After completing this reading you should be able to:

- Explain the subprime mortgage credit securitization process in the United States.
- Identify and describe key frictions in subprime mortgage securitization, and assess the relative contribution of each factor to the subprime mortgage problems.
- Describe the characteristics of the subprime mortgage market, including the creditworthiness of the typical borrower and the features and performance of a subprime loan.
- Describe the credit ratings process with respect to subprime mortgage backed securities.
- Explain the implications of credit ratings on the emergence of subprime related mortgage backed securities.
- Describe the relationship between the credit ratings cycle and the housing cycle.
- Explain the implications of the subprime mortgage meltdown on portfolio management.
- Compare predatory lending and borrowing.

OPERATIONAL AND INTEGRATED RISK MANAGEMENT—PART II EXAM WEIGHT 25% (OR)

The broad areas of knowledge covered in readings related to Operational and Integrated Risk Management include:

- Principles for sound operational risk management
- Enterprise Risk Management (ERM)
- Risk appetite frameworks and IT infrastructure
- Internal and external operational loss data
- Modeling operational loss distributions
- Model risk
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital allocation

- Liquidity risk:
  - Liquidity adjustments to VaR measures
  - Liquidity risk in financial and collateral markets
  - Repurchase agreements and refinancing
- Failure mechanics of dealer banks
- Stress testing banks
- Regulation and the Basel Accords

"Principles for the Sound Management of Operational Risk," (Basel Committee on Banking Supervision Publication, June 2011). [OR–1]

After completing this reading you should be able to:

- Describe the three "lines of defense" in the Basel model for operational risk governance.
- Summarize the fundamental principles of operational risk management as suggested by the Basel committee.
- Evaluate the role of the Board of Directors and senior management in implementing an effective operational risk structure per the Basel committee recommendations.
- Describe the elements of a framework for operational risk management.
- Identify examples of tools which can be used to identify and assess operational risk.
- Describe features of an effective control environment and identify specific controls which should be in place to address operational risk.
- Describe the Basel committee's suggestions for managing technology risk and outsourcing risk.
- Describe and outline business resiliency and continuity plans for banks under the Basel Committee framework.
- Identify and discuss the role of a bank's public disclosures.

Brian Nocco and René Stulz, *"Enterprise Risk Management: Theory and Practice,"* Journal of Applied Corporate Finance 18, No. 4 (2006): 8–20. [OR–2]

After completing this reading you should be able to:

- Define enterprise risk management (ERM).
- Explain how implementing ERM practices and policies can create shareholder value both at the macro and the micro level.
- Explain how a company can determine its optimal amount of risk through the use of credit rating targets.
- Describe the development and implementation of an ERM system.
- Describe the role of and issues with correlation in risk aggregation, and describe typical properties of a firm's market risk, credit risk and operational risk distributions.
- Distinguish between regulatory and economic capital, and explain the use of economic capital in the corporate decision making process.

"Observations on Developments in Risk Appetite Frameworks and IT Infrastructure," Senior Supervisors Group, December 2010. [OR–3]

After completing this reading you should be able to:

- Describe the concept of a risk appetite framework (RAF), identify the elements of a RAF and explain the benefits to a firm of having a well developed RAF.

- Describe best practices for a firm's Chief Risk Officer (CRO), Chief Executive Officer (CEO) and Board of Directors in the development and implementation of an effective RAF.

- Explain the role of a RAF in managing the risk of individual business lines within a firm.

- Describe the classes of risk metrics to be communicated to managers within the firm.

- Explain the benefits to a firm from having a robust risk data infrastructure, and describe key elements of an effective IT risk management policy at a firm.

- Describe factors which could lead to poor or fragmented IT infrastructure at an organization.

- Explain the challenges and best practices related to data aggregation at an organization.

Marcelo G. Cruz, Gareth W. Peters, and Pavel V. Shevchenko, *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk* (Hoboken, NJ: John Wiley & Sons, 2015)

Chapter 2: OpRisk Data and Governance [OR-4]

After completing this reading you should be able to:

- Describe the seven Basel II event risk categories and identify examples of operational risk events in each category.

- Summarize the process of collecting and reporting internal operational loss data, including the selection of thresholds, the timeframe for recoveries, and reporting expected operational losses.

- Explain the use of a Risk Control Self Assessment (RCSA) and key risk indicators (KRI's) in identifying, controlling and assessing operational risk exposures.

- Describe and assess the use of scenario analysis in managing operational risk, and identify biases and challenges which can arise when using scenario analysis.

- Compare the typical operational risk profiles of firms in different financial sectors.

- Compare different organizational designs for a risk management framework.

Philippa X. Girling, *Operational Risk Management: A Complete Guide to a Successful Operational Risk Framework* (Hoboken: John Wiley & Sons, 2013).

Chapter 8. External Loss Data [OR–5]

After completing this reading you should be able to:

- Explain the motivations for using external operational loss data and common sources of external data.

- Explain ways in which data from different external sources may differ.

- Describe challenges which can arise through the use of external data.

- Describe the Société Générale operational loss event and explain the lessons learned from the event.

Chapter 12. Capital Modeling [OR–6]

After completing this reading you should be able to:

- Compare the basic indicator approach, the standardized approach and the alternative standardized approach for calculating the operational risk capital charge and calculate the Basel operational risk charge using each approach.

- Describe the modeling requirements for a bank to use the Advanced Measurement Approach (AMA).

- Describe the loss distribution approach to modeling operational risk capital.

- Explain how frequency and severity distributions of operational losses are obtained, including commonly used distributions and suitability guidelines for probability distributions.

- Explain how Monte Carlo simulation can be used to generate additional data points to estimate the 99.9th percentile of an operational loss distribution.

- Explain the use of scenario analysis and the hybrid approach in modeling operational risk capital.

- Describe the AMA guidelines for the use of insurance in reducing a bank's operational risk capital charge.

"Operational Risk—Supervisory Guidelines for the Advanced Measurement Approaches," (Basel Committee on Banking Supervision Publication, June 2011). Paragraphs 1-42 (intro) and 160-261 (Modeling) only [OR-7]

After completing this reading you should be able to:

- Summarize key guidelines for verification and validation of a bank's operational risk management framework (ORMF) and its operational risk management system (ORMS), including the use test and experience.

- Describe key guidelines for the selection of a bank's Operational Risk Categories (ORCs).

- Describe commonly used distributions used to model the frequency and severity of a bank's operational loss events.

- Explain key guidelines for modeling the distribution of losses within individual ORCs, including the selection of thresholds, necessary adjustments, and selection of statistical tools and probability distributions.

- Describe techniques used to get an aggregated loss distribution from frequency and severity distributions.

- Explain supervisory guidelines for modeling dependence and correlation effects between operational risk factors across different operational risk categories.

- Describe the four required data elements in an AMA model and the guidelines for combining data from each element in modeling the capital charge.

Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York: McGraw-Hill, 2014).

Chapter 15. Model Risk [OR-8]

After completing this reading you should be able to:

- Identify and explain errors in modeling assumptions that can introduce model risk.

- Explain how model risk can arise in the implementation of a model.

- Explain methods and procedures risk managers can use to mitigate model risk.

- Explain the impact of model risk and poor risk governance in the 2012 London Whale trading loss and the 1998 collapse of Long Term Capital Management.

Chapter 17. Risk Capital Attribution and Risk-Adjusted Performance Measurement [OR–9]

After completing this reading you should be able to:

- Define, compare and contrast risk capital, economic capital and regulatory capital, and explain the motivations for using economic capital.

- Describe the RAROC (risk-adjusted return on capital) methodology and its benefits.

- Compute and interpret the RAROC for a project, loan, or loan portfolio, and use RAROC to compare business unit performance.

- Explain the impact of changing assumptions used in calculating economic capital, including choosing a time horizon, measuring default probability, and choosing a confidence level.

- Calculate the hurdle rate and apply this rate in making business decisions using RAROC.

- Compute the adjusted RAROC for a project to determine its viability.

- Explain challenges in modeling diversification benefits, including aggregating a firm's risk capital and allocating economic capital to different business lines.

- Explain best practices in implementing a RAROC approach.

"Range of Practices and Issues in Economic Capital Frameworks," (Basel Committee on Banking Supervision Publication, March 2009). [OR-10]

After completing this reading you should be able to:

- Within the economic capital implementation framework describe the challenges that appear in:
  - Defining risk measures
  - Risk aggregation
  - Validation of models
  - Dependency modeling in credit risk
  - Evaluating counterparty credit risk
  - Assessing interest rate risk in the banking book

- Describe the BIS recommendations that supervisors should consider to make effective use of risk measures not designed for regulatory purposes.

- Describe the constraints imposed and the opportunities offered by economic capital within the following areas:
  - Credit portfolio management
  - Risk based pricing
  - Customer profitability analysis
  - Management incentives

"Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice," Board of Governors of the Federal Reserve System, August 2013. [OR–11]

After completing this reading you should be able to:

- Describe the Federal Reserve's Capital Plan Rule and explain the seven principles of an effective capital adequacy process for bank holding companies (BHC's) subject to the Capital Plan Rule.

- Describe practices which can result in a strong and effective capital adequacy process for a BHC in the following areas:
  - Risk identification
  - Internal controls, including model review and validation
  - Corporate governance
  - Capital policy, including setting of goals and targets and contingency planning
  - Stress testing and stress scenario design
  - Estimating losses, revenues, and expenses, including quantitative and qualitative methodologies
  - Assessing the impact of capital adequacy, including RWA and balance sheet projections.

Bruce Tuckman, Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 12. Repurchase Agreements and Financing [OR–12]

After completing this reading you should be able to:

- Describe the mechanics of repurchase agreements (repos) and calculate the settlement for a repo transaction.
- Explain common motivations for entering into repos, including their use in cash management and liquidity management.
- Explain how counterparty risk and liquidity risk can arise through the use of repo transactions.
- Assess the role of repo transactions in the collapses of Lehman Brothers and Bear Stearns during the 2007-2008 credit crisis.
- Compare the use of general and special collateral in repo transactions.
- Describe the characteristics of special spreads and explain the typical behavior of US Treasury special spreads over an auction cycle.
- Calculate the financing advantage of a bond trading special when used in a repo transaction.

Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, England: John Wiley & Sons, 2005).

Chapter 14. Estimating Liquidity Risks [OR–13]

After completing this reading you should be able to:

- Define liquidity risk and describe factors that influence liquidity, including the bid-ask spread.
- Differentiate between exogenous and endogenous liquidity.
- Describe the challenges of estimating liquidity-adjusted VaR (LVaR).
- Describe and calculate LVaR using the constant spread approach and the exogenous spread approach.
- Describe endogenous price approaches to LVaR, their motivation and limitations, and calculate the elasticity-based liquidity adjustment to VaR.
- Describe liquidity at risk (LaR) and compare it to VaR, describe the factors that affect future cash flows, and explain challenges in estimating and modeling LaR.
- Explain the role of liquidity in crisis situations and describe approaches to estimating crisis liquidity risk.

Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).

Chapter 11. Section 11.1. Assessing the Quality of Risk Measures [OR–14]

After completing this reading you should be able to:

- Describe ways that errors can be introduced into models.
- Describe how horizon, computational and modeling decisions can impact VaR estimates.
- Explain how model risk and variability can arise through the implementation of VaR models and the mapping of risk factors to portfolio positions.
- Identify reasons for the failure of the long-equity tranche, short-mezzanine credit trade in 2005 and describe how such modeling errors could have been avoided.
- Identify two major defects in model assumptions which led to the underestimation of systematic risk for residential mortgage backed securities (RMBS) during the 2008-2009 financial downturn.

Chapter 12. Liquidity and Leverage [OR–15]

After completing this reading you should be able to:

- Differentiate between sources of liquidity risk, including balance sheet/funding liquidity risk, systematic funding liquidity risk, and transactions liquidity risk, and explain how each of these risks can arise for financial institutions.
- Summarize the asset-liability management process at a fractional reserve bank, including the process of liquidity transformation.
- Explain the liquidity characteristics and risks of structured credit products.
- Describe specific liquidity challenges faced by money market mutual funds and by hedge funds, particularly in stress situations.
- Describe transactions used in the collateral market and explain risks that can arise through collateral market transactions.
- Describe the relationship between leverage and a firm's return profile and calculate the leverage effect.
- Explain the impact on a firm's leverage and its balance sheet of the following transactions: purchasing long equity positions on margin, entering into short sales, and trading in derivatives.
- Explain methods to measure and manage funding liquidity risk and transactions liquidity risk.
- Calculate the expected transactions cost and the spread risk factor for a transaction, and calculate the liquidity adjustment to VaR for a position to be liquidated over a number of trading days.
- Explain interactions between different types of liquidity risk and explain how liquidity risk events can increase systemic risk.

Darrell Duffie, 2010. *"The Failure Mechanics of Dealer Banks,"* Journal of Economic Perspectives 24:1, 51-72. [OR–16]

After completing this reading you should be able to:

- Describe the major lines of business in which dealer banks operate and the risk factors they face in each line of business.
- Identify situations that can cause a liquidity crisis at a dealer bank and explain responses that can mitigate these risks.

- Compare a liquidity crisis at a dealer bank to a traditional bank run.

- Describe policy measures that can alleviate firm-specific and systemic risks related to large dealer banks.

"Stress Testing Banks," Til Schuermann, prepared for the Committee on Capital Market Regulation, Wharton Financial Institutions Center (April 2012). [OR–17]

After completing this reading you should be able to:

- Compare and contrast the features and scope of supervisory stress tests before and after the Supervisory Capital Assessment Program (SCAP).

- Explain challenges in designing stress test scenarios, including the problem of coherence in modeling risk factors.

- Identify and explain challenges in modeling a bank's losses and revenues over a stress test horizon period.

- Explain the challenges in modeling a bank's balance sheet over a stress test horizon period.

- Compare and contrast the 2009 SCAP stress test, the 2011 and 2012 CCAR, and the 2011 EBA Irish and EBA European stress tests in their methodologies and key findings.

John Hull, *Risk Management and Financial Institutions, 4th Edition* (Hoboken, NJ: John Wiley & Sons, 2015).

Chapter 15. Basel I, Basel II, and Solvency II [OR–18]

After completing this reading you should be able to:

- Explain the motivations for introducing the Basel regulations, including key risk exposures addressed, and explain the reasons for revisions to Basel regulations over time.

- Explain the calculation of risk-weighted assets and the capital requirement per the original Basel I guidelines.

- Describe and contrast the major elements—including a description of the risks covered—of the two options available for the calculation of market risk:
  - Standardized Measurement Method
  - Internal Models Approach

- Calculate VaR and the capital charge using the internal models approach, and explain the guidelines for backtesting VaR.

- Describe and contrast the major elements of the three options available for the calculation of credit risk:
  - Standardized Approach
  - Foundation IRB Approach
  - Advanced IRB Approach

- Describe and contrast the major elements of the three options available for the calculation of operational risk: basic indicator approach, standardized approach, and the Advanced Measurement Approach.

- Describe the key elements of the three pillars of Basel II: minimum capital requirements, supervisory review, and market discipline.

- Define in the context of Basel II and calculate where appropriate:
  - Probability of default (PD)
  - Loss given default (LGD)
  - Exposure at default (EAD)
  - Worst-case probability of default

- Differentiate between solvency capital requirements (SCR) and minimum capital requirements (MCR) in the Solvency II framework, and describe the repercussions to an insurance company for breaching the SCR and MCR.

- Compare the standardized approach and the internal models approach for calculating the SCR in Solvency II.

Chapter 16. Basel II.5, Basel III, and Other Post-Crisis Changes [OR–19]

After completing this reading you should be able to:

- Describe and calculate the stressed value-at-risk measure introduced in Basel 2.5, and calculate the market risk capital charge.

- Explain the process of calculating the incremental risk capital charge for positions held in a bank's trading book.

- Describe the comprehensive risk measure (CRM) for positions which are sensitive to correlations between default risks.

- Define in the context of Basel III and calculate where appropriate:
  - Tier 1 capital and its components
  - Tier 2 capital and its components
  - Required Tier 1 equity capital, total Tier 1 capital, and total capital

- Describe the motivations for and calculate the capital conservation buffer and the countercyclical buffer introduced in Basel III.

- Describe and calculate ratios intended to improve the management of liquidity risk, including the required leverage ratio, the liquidity coverage ratio, and the net stable funding ratio.

- Describe the mechanics of contingent convertible bonds (CoCos) and explain the motivations for banks to issue them.

- Explain the major changes to the U.S. financial market regulations as a result of Dodd-Frank.

Chapter 17. Fundamental Review of the Trading Book [OR-20]

After completing this reading you should be able to:

- Describe the proposed changes to the Basel market risk capital calculation and the motivations for these changes, and calculate the market risk capital under this method.

- Compare the various liquidity horizons proposed by the FRTB for different asset classes and explain how a bank can calculate its expected shortfall using the various horizons.

- Explain proposed modifications to Basel regulations in the following areas:
  - Classification of positions in the trading book compared to the banking book
  - Treatment of credit spread and jump-to-default risk, including the incremental default risk charge

Optional Regulatory Readings for Reference

Candidates are expected to understand the objective and general structure of important international regulatory frameworks and general application of the various approaches for calculating minimum capital requirements, as described in the readings above. Candidates interested in the complete regulatory framework can review the following:

"Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework—Comprehensive Version," **(Basel Committee on Banking Supervision Publication, June 2006).* [OR-21]**

"Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised Version," **(Basel Committee on Banking Supervision Publication, June 2011).* [OR-22]**

"Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools," **(Basel Committee on Banking Supervision Publication, January 2013).* [OR-23]**

"Revisions to the Basel II Market Risk Framework—Updated as of 31 December 2010," **(Basel Committee on Banking Supervision Publication, February 2011).* [OR-24]**

"Basel III: the net stable funding ratio." **(Basel Committee on Banking Supervision Publication, October 2014).* [OR-25]**

RISK MANAGEMENT AND INVESTMENT MANAGEMENT – PART II EXAM WEIGHT 15%. (IM)

The broad areas of knowledge covered in readings related to Risk Management and Investment Management include the following:

- Portfolio construction
- Portfolio risk measures
- Risk budgeting

- Risk monitoring and performance measurement
- Portfolio-based performance analysis
- Hedge funds

The readings that candidates should focus on for this section and the specific learning objectives that should be achieved with each reading are listed as follows:

Richard Grinold and Ronald Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, 2nd Edition* (New York: McGraw-Hill, 2000).

Chapter 14. Portfolio Construction [IM -1]

After completing this reading you should be able to:

- Distinguish among the inputs to the portfolio construction process.
- Evaluate the methods and motivation for refining alphas in the implementation process.
- Describe neutralization and methods for refining alphas to be neutral.
- Describe the implications of transaction costs on portfolio construction.
- Assess the impact of practical issues in portfolio construction, such as determination of risk aversion, incorporation of specific risk aversion, and proper alpha coverage.
- Describe portfolio revisions and rebalancing and evaluate the tradeoffs between alpha, risk, transaction costs and time horizon.
- Determine the optimal no-trade region for rebalancing with transaction costs.
- Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming, and quadratic programming.
- Describe dispersion, explain its causes and describe methods for controlling forms of dispersion.

Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York: McGraw-Hill, 2007).

Chapter 7. Portfolio Risk: Analytical Methods [IM -2]

After completing this reading you should be able to:

- Define, calculate, and distinguish between the following portfolio VaR measures: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR.
- Explain the role of correlation on portfolio risk.

- Describe the challenges associated with VaR measurement as portfolio size increases.
- Apply the concept of marginal VaR to guide decisions about portfolio VaR.
- Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio.
- Explain the difference between risk management and portfolio management, and describe how to use marginal VaR in portfolio management.

Chapter 17. VaR and Risk Budgeting in Investment Management [IM – 3]

After completing this reading you should be able to:

- Define risk budgeting.
- Describe the impact of horizon, turnover and leverage on the risk management process in the investment management industry.
- Describe the investment process of large investors such as pension funds.
- Describe the risk management challenges associated with investments in hedge funds.
- Distinguish among the following types of risk: absolute risk, relative risk, policy-mix risk, active management risk, funding risk and sponsor risk.
- Apply VaR to check compliance, monitor risk budgets and reverse engineer sources of risk.
- Explain how VaR can be used in the investment process and the development of investment guidelines.
- Describe the risk budgeting process and calculate risk budgets across asset classes and active managers.

Robert Litterman and the Quantitative Resources Group, *Modern Investment Management: An Equilibrium Approach* (Hoboken, NJ: John Wiley & Sons, 2003).

Chapter 17. Risk Monitoring and Performance Measurement [IM – 4]

After completing this reading you should be able to:

- Define, compare and contrast VaR and tracking error as risk measures.
- Describe risk planning, including its objectives, effects and the participants in its development.
- Describe risk budgeting and the role of quantitative methods in risk budgeting.
- Describe risk monitoring and its role in an internal control environment.
- Identify sources of risk consciousness within an organization.
- Describe the objectives and actions of a risk management unit in an investment management firm.
- Describe how risk monitoring can confirm that investment activities are consistent with expectations.
- Explain the importance of liquidity considerations for a portfolio.

- Describe the use of alpha, benchmark, and peer group as inputs in performance measurement tools.
- Describe the objectives of performance measurement.

Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 10th Edition* (New York: McGraw-Hill, 2013).

Chapter 24. Portfolio Performance Evaluation [IM – 5]

After completing this reading you should be able to:

- Differentiate between time-weighted and dollar-weighted returns of a portfolio and describe their appropriate uses.
- Describe and distinguish between risk-adjusted performance measures, such as Sharpe's measure, Treynor's measure, Jensen's measure (Jensen's alpha), and information ratio.
- Describe the uses for the Modigliani-squared and Treynor's measure in comparing two portfolios, and the graphical representation of these measures.
- Determine the statistical significance of a performance measure using standard error and the t-statistic.
- Explain the difficulties in measuring the performance of hedge funds.
- Explain how changes in portfolio risk levels can affect the use of the Sharpe ratio to measure performance.
- Describe techniques to measure the market timing ability of fund managers with a regression and with a call option model and compute return due to market timing.
- Describe style analysis.
- Describe and apply performance attribution procedures, including the asset allocation decision, sector and security selection decision and the aggregate contribution.

Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York: Oxford University Press, 2014).

Chapter 13. Illiquid Assets (excluding section 13.5 – Portfolio Choice with Illiquid Assets) [IM – 6]

After completing this reading you should be able to:

- Evaluate the characteristics of illiquid markets.
- Examine the relationship between market imperfections and illiquidity.
- Assess the impact of biases on reported returns for illiquid assets.
- Describe the unsmoothing of returns and its properties.
- Compare illiquidity risk premiums across and within asset categories.
- Evaluate portfolio choice decisions on the inclusion of illiquid assets.

G. Constantinides, M. Harris and R. Stulz, eds., *Handbook of the Economics of Finance, Volume 2B* (Oxford, UK: Elsevier, 2013).

Chapter 17. Hedge Funds, by William Fung and David Hsieh [IM – 7]

After completing this reading you should be able to:

- Describe the characteristics of hedge funds and the hedge fund industry, and compare hedge funds with mutual funds.
- Explain biases which are commonly found in databases of hedge funds.
- Explain the evolution of the hedge fund industry and describe landmark events which precipitated major changes in the development of the industry.
- Evaluate the role of investors in shaping the hedge fund industry.
- Explain the relationship between risk and alpha in hedge funds.
- Compare and contrast the different hedge fund strategies, describe their return characteristics, and describe the inherent risks of each strategy.
- Describe the historical portfolio construction and performance trend of hedge funds compared to equity indices.
- Describe market events which resulted in a convergence of risk factors for different hedge fund strategies, and explain the impact of such a convergence on portfolio diversification strategies.
- Describe the problem of risk sharing asymmetry between principals and agents in the hedge fund industry.
- Explain the impact of institutional investors on the hedge fund industry and assess reasons for the growing concentration of assets under management (AUM) in the industry.

Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance* (Hoboken, NJ: Wiley Finance, 2013).

Chapter 11 . Performing Due Diligence on Specific Managers and Funds [IM- 8]

After completing this reading you should be able to:

- Identify reasons for the failures of funds in the past.
- Explain elements of the due diligence process used to assess investment managers.
- Identify themes and questions investors can consider when evaluating a manager.
- Describe criteria that can be evaluated in assessing a fund's risk management process.
- Explain how due diligence can be performed on a fund's operational environment.
- Explain how a fund's business model risk and its fraud risk can be assessed.
- Describe elements that can be included as part of a due diligence questionnaire.

CURRENT ISSUES IN FINANCIAL MARKETS – PART II EXAM WEIGHT 10% (CI)

You are expected to familiarize yourself with the readings from this section, approaching each paper critically as a risk manager equipped with the knowledge from the other sections. This area of the exam will test your knowledge of the material covered by each paper. The broad categories covered in this section include:

- Risk measurement
- Funding and liquidity during market shocks
- Liquidity regulation and lender of last resort
- Global financial markets liquidity
- Benchmark rates
- Risk in central counterparties
- Regulatory stress testing
- Cybersecurity

The readings that you should focus on for this section and the specific learning objectives that should be achieved with each reading are:

Glasserman, Paul. (2012). *Forging Best Practices in Risk Management* (Note: Only Section 2: Firm-Level Issues in Risk Measurement). Office of Financial Research Working Paper #0002.* [CI - 1]

After completing this reading you should be able to:

- Identify the areas of risk management that have been most affected by the recent financial crisis and describe the major trends and developments brought on by the crisis.
- Evaluate the presence of volatility regimes in market data.
- Analyze the implications of multiple firms attempting to take the same risk-mitigating steps.
- Describe the implications of risk-mitigation strategies employed by firms and how they can amplify risk.
- Explain practices to address and alleviate amplified risk.

Yorulmazer, Tanju. (2014). *"Case Studies on Disruptions During the Crisis"*. FRBNY Economic Policy Review.* [CI - 2]

After completing this reading you should be able to:

- Understand the use and purpose of funding mechanisms and describe the distress in the markets during the recent credit crisis.
- Distinguish between Commercial Paper and Asset-Backed Commercial Paper and describe the policy responses to recent market collapses.

- Compare and contrast sources of disruption in the money market mutual funds, rep markets, and credit commitments.

- Evaluate the implications of the dollar funding model of non-U.S. banks during the recent crisis.

"Why do we need both liquidity regulations and a lender of last resort? A perspective from Federal Reserve lending during the 2007-09 U.S. financial crisis". Federal Reserve Board. February 2015.* [CI - 3]

After completing this reading you should be able to:

- Compare the advantages and disadvantages of liquidity regulations and a lender of last resort in managing liquidity and systemic risk during a financial crisis, and identify situations where each is more effective.

- Explain how the existence of a lender of last resort can create moral hazard.

- Describe situations where a central bank should begin lending to banks before liquidity buffers are exhausted.

- Describe challenges and constraints to a central bank acting as a lender of last resort.

- Analyze the Federal Reserve's lending policies and lending decisions during the 2007-2009 financial crisis, and describe the effectiveness of each.

- Explain how a combination of liquidity regulations and lender of last resort can lead to an optimal policy mix to manage systemic risk during financial downturns.

Global financial markets liquidity study (Note: Sections 1, 2, and 4 only). PwC. August 2015.* [CI-4]

After completing this reading you should be able to:

- Define liquidity and describe the dimensions by which liquidity can be measured.

- Explain how liquidity is provided in different financial markets, including the role of market makers and the economics of market making.

- Describe current global trends and factors which have impacted liquidity in financial markets and explain their liquidity impact.

- Summarize trends over the past 10 years in the volume and liquidity of the following financial markets: interest rates and interest rate derivatives, sovereign bonds, repos, corporate bonds, CDS, securitized products, foreign exchange, equities, and emerging market financial products.

Duffie, Darrell and Stein, C. Jeremy. (2015). "Reforming LIBOR and Other Financial Market Benchmarks." Journal of Economic Perspectives—Volume 29, Number 2. Spring 2015. pp 191–212.* [CI-5]

After completing this reading you should be able to:

- Discuss the recommended principles to make benchmark rates such as LIBOR and other interbank offered rates less susceptible to manipulation.

- Evaluate the implications, advantages, and disadvantages of using benchmarks.

- Assess the types of agglomeration effects after a benchmark has been established.

- Explain the motives for manipulating benchmarks and describe the processes to alleviate manipulation.

- Describe how the US dollar LIBOR is used and identify the costs associated with the increase in trading of LIBOR-linked contracts.

- Explain and assess some proposed methodologies to reform LIBOR.

Froukelien Wendt. (2015). "Central Counterparties: Addressing their Too Important to Fail Nature". IMF Working Paper.* [CI-6]

After completing this reading you should be able to:

- Describe the benefits of central counterparties (CCP's) and the potential risks which can arise when clearing through a CCP.

- Explain the interconnections between central counterparties and other financial institutions, including banks, clearing members, financial markets, and other CCP's.

- Explain how the failure of a CCP can spread systemic risk to other financial markets or institutions.

- Identify policy measures designed to reduce the probability or impact of potential CCP failures, and describe limitations to these measures.

- Explain measures which can be adopted to mitigate systemic risks related to interconnections and interdependence of CCP's.

German Gutierrez Gallardo (NYU), Til Schuermann (Oliver Wyman), Michael Duane (Oliver Wyman). 2015. "Stress Testing Convergence"* [CI-7]

After completing this reading you should be able to:

- • Explain how trends in stress testing and capital management have evolved from the 2009 SCAP to the 2015 CCAR.

- • Compare trends in capital management approaches by different classes of CCAR institutions from 2012 to 2015, and explain the motivations for each class of institutions to adopt their approach.

- • Identify and describe factors that have encouraged banks to manage capital more closely to regulatory minimum levels.

- • Describe potential consequences as stress test results from different banks have appeared to converge and more institutions begin to manage capital to Fed-projected results.

"Cybersecurity 101: A Resource Guide for Bank Executives". Conference of State Banking Supervisors. December 2014.* [CI-8]

After completing this reading you should be able to:

- Identify the five core functions of the NIST's Cybersecurity Framework.

- Explain the risk assessment process to identify threats to information or information systems.

- Describe various measures to protect banks' systems, assets, and data.

- Describe approaches to detect system intrusions, data breaches, and unauthorized access.

- Explain the incident response plan and the recovery plan.