2015

FRM Program Manual

GARP | Global Association of Risk Professionals

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Introduction

As the leading professional association for risk managers, GARP's mission is to advance the risk profession through education, training and the promotion of best practices globally.

The Global Association of Risk Professionals (GARP®) created the FRM Program Manual to provide a comprehensive resource for those interested in becoming a certified Financial Risk Manager (FRM®).

Global Association of Risk Professionals

History and Mission

Founded in 1996, GARP is a not-for-profit organization and the leading global membership association for risk managers.

GARP sets the global professional standard in the areas of financial and energy risk management, with our FRM and ERP (Energy Risk Professional) certifications. Through the delivery of quality educational programs, specialized content, in-person and online events, and chapter program, GARP promotes best practices in risk management and supports ongoing professional and career development for risk managers.

The GARP community is comprised of over 150,000 risk professionals committed to better risk management practices. In 195 countries around the world, our members work in regional and global banks, asset management firms, insurance companies, central banks, securities regulators, hedge funds, universities, large industrial corporations and multinationals.

Oversight and Governance

GARP is governed by a Board of Trustees comprised of top risk professionals and academics from around the world. As a professional association with global membership, and an extensive professional and academic chapter network, GARP is in a unique position to determine standards and assess evolving trends in risk management practices. To calibrate and benchmark understanding of the demands of the global risk management community, GARP also conducts formal job task analysis surveys to determine the knowledge, skills and abilities required to function effectively as a financial risk manager in an evolving market.

The FRM Program is overseen by GARP's FRM Committee comprised of leading risk management professionals and academics. The FRM Committee reviews and revises the FRM curriculum on an annual basis to ensure that the certification remains relevant and in line with industry demands. The curriculum is published annually in the FRM Study Guide and is reproduced, along with more detailed Learning Objectives and other relevant information, in this Manual. To support the preparation of returning candidates, changes from the prior year's curriculum are published separately in the 2015 FRM Exam Study Guide Changes document.

THE FRM PROGRAM

The FRM is the globally recognized professional designation for financial risk managers. Becoming an FRM clearly distinguishes you as someone serious about managing risk. This competitive advantage holds across a wide range of financial services professions, including: risk manager, analyst, trader, portfolio manager, auditor, developer, or salesperson. Whether you are actively employed, or looking to break into the industry, achieving the FRM certification is a valuable career enhancer/accelerator.

Why Obtain FRM Certification?

Stand Out To Employers.
Employers around the world recognize that the FRM Program prepares candidates with the specialized knowledge and skills necessary to succeed in the dynamic financial services industry. The FRM designation is by far the best known and most respected designation for financial risk management, with all of the top 25 global banks, all of the top 20 global asset management firms, all of the 'big four' professional services firms, 14 of the top 15 global insurance firms and eight of the top 10 global hedge funds employing significant numbers of FRMs.

Develop Your Knowledge And Expertise.
Mastering the concepts underlying risk management in today's dynamic market environment gives you a holistic view of risk management. Because the FRM curriculum is meticulously reviewed and updated annually by some of the world's leading risk professionals to reflect current marketplace issues, preparing for the FRM Exam will give you current knowledge that is useful on the job every day. The program also provides a view of the risk horizon and what you need to be prepared for in the future.

Join An Elite Group.
The FRM certification provides you with a lifelong platform to network with some of the world's most prominent financial risk management professionals, expanding your professional opportunities within the world of finance globally. Approximately 32,000 individuals from 141 countries and territories have earned the right to call themselves an FRM and over 90% of those who sit for the FRM Exams say that they would recommend the program to colleagues.

Demonstrate Your Leadership.
Mastering the content of the FRM Exam and completing the many hours of self-study represents a significant commitment to the risk management profession, positions you as a leader in the field and signals your commitment to professional excellence, ethics and integrity.

Confirm Your Achievements.
Real-world experience is an essential component of attaining FRM certification. No other financial risk designation requires candidates to demonstrate related professional experience—becoming an FRM is much more than just passing an exam.

Enhance Your Reputation.
All FRMs are expected to adhere to principles that promote the highest levels of ethical conduct and disclosure beyond following the letter of applicable rules and regulations. Employers know that FRMs will help safeguard their firms' reputations.

Basic Program Requirements

To become a Certified FRM, you must successfully complete the FRM Program as outlined below:

- FRM Exam Part I
- FRM Exam Part II
- Demonstrate two (2) years of professional full-time financial risk management experience

Upon completion of these three steps, which are discussed in greater detail later in the Manual, you would become an FRM.

Getting Started—Registration

The first step in obtaining your FRM designation is to register for the exam. Registration may be completed online at the GARP website. A detailed discussion of the registration process and payment options can be found in the "Register for the Exam" section of this Manual.

THE FRM EXAM—OVERVIEW

Knowledge Areas Tested

The FRM is designed to cover a wide range of fundamental risk management topics and to prepare you to think about and handle risk in an integrated and coherent manner. A basic overview of the knowledge areas covered in the FRM exam is given below. More detailed learning objectives can be found in the FRM Exam Learning Objectives section of this Manual.

FRM Exam Part I

The FRM Exam Part I covers the fundamental tools and techniques used in risk management and the theories underlying their use. The four broad knowledge domains covered in the FRM Exam Part I and their approximate weighting are:

- Foundations of Risk Management (20%)
- Quantitative Analysis (20%)
- Financial Markets and Products (30%)
- Valuation Models (30%)

FRM Exam Part II

The FRM Exam Part II applies the tools and techniques covered in the FRM Exam Part I and delves more deeply into major sub-areas of risk management. The questions on the FRM Exam Part II are designed to test your ability to apply risk management concepts to real-world situations. The five broad knowledge domains covered in the FRM Exam Part II and their approximate weighting are:

- Market Risk Measurement and Management (25%)
- Credit Risk Measurement and Management (25%)
- Operational and Integrated Risk Management (25%)
- Risk Management and Investment Management (15%)
- Current Issues in Financial Markets (10%)

Exam Format

The FRM Exam consists of two parts, Part I and Part II, which are both offered twice a year—on the third Saturday of May and the third Saturday of November. Part I is an equally-weighted 100 question multiple-choice exam offered in the morning of the exam day and Part II is an equally weighted 80 question multiple-choice exam offered in the afternoon of the exam day. Both Exams are administered in a paper and pencil format.

Part I and Part II each have a maximum allowable time for completion of four hours. It is important to note that Part I and Part II of the FRM Exam must be passed sequentially. Therefore, while it is possible to sit for both parts of the Exam on the same day, you must receive a passing score on Part I of the Exam before GARP will score your Part II Exam. Most candidates elect to take Part I and Part II on separate exam administration days.

You should also be aware that the exams are offered in English only; specifically American English. GARP is aware that not every candidate's native language is American English. In the exam development process, GARP makes every effort to ensure that questions are written in a clear, concise form and avoids the use of colloquialisms or other terms and phrases that might confuse a non-native American English speaker.

Another consideration for potential candidates is the quantitative aspect of the subject matter. The level of mathematical difficulty of the Exam is consistent with an advanced undergraduate or introductory graduate level finance course at most universities. It should also be noted that while the FRM exam is conceptual in nature, you will still need to know important formulas and calculations and how to apply them correctly. Formula sheets are not provided with the exam. For guidance on which formulas to focus on, please refer to the learning objectives outlined later in the Manual and look for any statements that include the words 'Calculate,' 'Compute' or 'Derive.' These words will generally indicate an associated formula to commit to memory.

A standard table presenting the values for the cumulative distribution function (CDF) of the standard normal distribution (a "z-table") is provided however, as is other relevant information pertaining to the CDFs of other probability distributions (F, Chi-squared, etc.) where necessary and applicable. Memorization of CDF values is therefore not expected. A list of common abbreviations used throughout the exam is also provided.

EXAM LEARNING OBJECTIVES

The FRM is a comprehensive exam and you are expected to be familiar with a broad range of risk management concepts and techniques. Detailed information regarding the knowledge domains covered by the Exam, as well as the specific recommended readings and learning objectives for each of these readings are detailed in this section. Approximate FRM Exam weightings for each knowledge domain are provided. This information is intended to help guide you through the self-study process as these learning objectives form the backbone of the exam itself. You should be prepared to answer questions on any of the individual knowledge points.

Readings followed by an asterisk (*) are available for download from the GARP website.

FRM EXAM PART I

The FRM Exam Part I covers fundamental tools and techniques used in risk management and the theories underlying their use. There are four broad knowledge domains in the FRM Exam Part I:

- Foundations of Risk Management
- Quantitative Analysis
- Financial Markets and Products
- Valuation and Risk Models

FOUNDATIONS OF RISK MANAGEMENT (FRM)—20%

This area focuses on your knowledge of foundational concepts of risk management and how risk management can add value to an organization. The broad areas of knowledge covered in Foundations-related readings 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 listed as follows:

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.
- 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 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.
- 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.

***Implementing Robust Risk Appetite Frameworks to Strengthen Financial Institutions*, Institute of International Finance, June 2011 (Executive Summary—Section 4, pp. 10–40).* [FRM–5]**

After completing this reading you should be able to:

- Relate the use of risk appetite frameworks (RAF) to the management of risk in a firm.
- Define risk culture and assess the relationship between a firm's risk appetite and its risk culture.
- Describe and evaluate key challenges to the implementation of RAFs.
- Describe current best practices for the implementation and communication of RAFs.
- Explain the relationship between the RAF and the strategic and capital planning processes.
- Assess the role of stress testing within an RAF as well as challenges in firm-wide risk aggregation.

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, 3rd Edition* (New York: John Wiley & Sons, 2012).

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:

- Define the role of risk management and defend the position that a large financial loss is not necessarily a failure of risk management.
- Analyze instances of risk management failure.
- Assess the impact of error in risk measurement.
- Explain how a firm can fail to take known and unknown risks into account in making strategic decisions.
- Justify the importance of communication in effective risk management.
- Describe how firms can fail to correctly monitor and manage risk on an ongoing basis.
- 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.
- Interpret the Law of One Price and assess whether an arbitrage situation exists using 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.
- Compare the Arbitrage Pricing Theory (APT), the CAPM, and the Fama-French three-factor model, and evaluate the underlying assumptions of each.

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:

- Assess the potential negative impact poor data quality may have on a business.
- Identify the most common issues which result in data errors.
- Identify some key dimensions of data quality.
- Describe the operational data governance process and differentiate between data quality inspection and data validation.
- Summarize the process of creating a data quality scorecard and compare three different viewpoints for reporting data via a data quality scorecard.

"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 (QA)—20%

This area tests your knowledge of basic probability and statistics. 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
- 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.
- Apply the Central Limit Theorem.
- Describe the properties of independent and identically distributed (i.i.d.) 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.

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, 3rd Edition* (Boston: Pearson Prentice Hall, 2012).

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 copula and copula correlation.
- Explain one tail dependence.
- Describe Gaussian copula, Student t-copula, multivariate copula and one factor copula.

James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston: Pearson Education, 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 R^2.
- 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 hypothesis tests and confidence intervals for multiple coefficients in a multiple regression.
- Interpret the F-statistic.
- Interpret tests of single restrictions involving multiple coefficients.
- Interpret confidence sets for multiple coefficients.
- Identify examples of omitted variable bias in multiple regressions.
- Interpret the R^2 and adjusted-R^2 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 s^2, 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 Prentice Hall, 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 auto regressive 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

Dessislava Pachamanova and Frank Fabozzi, *Simulation and Optimization in Finance* (Hoboken, NJ: John Wiley & Sons, 2010).

Chapter 4. Simulation Modeling [QA-15]

After completing this reading you should be able to:

- Describe different ways of choosing probability distributions in creating simulation models.
- Understand and interpret the results generated by Monte Carlo simulation.
- Describe the advantages of simulation modeling when multiple input variables and compounding distributions are involved.
- Illustrate how correlations can be incorporated into simulation modeling.
- Describe the relationship between the accuracy of a simulation model and the number of scenarios run in the simulation.
- Interpret discretization error bias and describe how to identify an efficient estimator.
- Describe the inverse transform method and its implementation in discrete and continuous distributions.
- Describe standards for an effective pseudorandom number generator and explain midsquare technique and congruential pseudorandom number generators.
- Describe quasi-random (low-discrepancy) sequences and explain how they work in simulations.
- Explain the mechanics and characteristics of the stratified sampling method and describe the Latin hypercube sampling method.

FINANCIAL MARKETS AND PRODUCTS (FMP)—30%

This area tests your knowledge of financial products and the markets in which they trade, more specifically, the following knowledge areas:

- 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:

***The Institute for Financial Markets, Futures and Options* (Washington, DC: The Institute for Financial Markets, 2011).**

Chapter 1. Introduction: Futures and Options Markets [FMP–1]

After completing this reading you should be able to:

- Evaluate how the use of futures contracts can mitigate common risks in the commodities business.
- Describe the key features and terms of a futures contract.
- Differentiate between equity securities and futures contracts.
- Define and interpret volume and open interest.
- Explain the requisites for a successful futures market.

Chapter 2. Futures Industry Institutions and Professionals [FMP–2]

After completing this reading you should be able to:

- Describe the features of a modern futures exchange and identify typical contract terms and trading rules.
- Explain the organization and administration of an exchange and clearinghouse.
- Describe exchange membership, the different types of exchange members, and the exchange rules for member trading.
- Explain original and variation margin, daily settlement, the guaranty deposit, and the clearing process.
- Summarize the steps that are taken when a clearinghouse member is unable to meet its financial obligations on its open contracts.
- Describe the mechanics of futures delivery and the roles of the clearinghouse, buyers, and sellers in this process.
- Explain the role of futures commission merchants, introducing brokers, account executives, commodity trading advisors, commodity pool operators, and customers.

Chapter 7. Hedging with Futures and Options [FMP–3]

After completing this reading you should be able to:

- Define the terms “long the basis” and “short the basis.”
- Explain exchange for physical (EFP) transactions and their role in the energy and financial futures markets.
- Outline and calculate the payoffs on the various scenarios for hedging with options on futures.

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

Chapter 1. Introduction [FMP–4]

After completing this reading you should be able to:

- Differentiate between an open outcry system and electronic trading.
- 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–5]

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–6]

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–7]

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.

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

Chapter 5. Determination of Forward and Futures Prices [FMP–8]

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–9]

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–10]

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–11]

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–12]

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.

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

Chapter 12. Trading Strategies Involving Options [FMP–13]

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–14]

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: Addison-Wesley, 2013).

Chapter 6. Commodity Forwards and Futures [FMP–15]

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-16]

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.

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

Chapter 12. Corporate Bonds [FMP-17]

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* (New York: John Wiley & Sons, 2011).

Chapter 20. Mortgages and Mortgage-Backed Securities [FMP–18]

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, 2nd Edition* (New York: John Wiley & Sons, 2008).

Chapter 6. The Rating Agencies [FMP–19]

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 distributions 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 (VRM)—30%

This area tests your knowledge of valuation techniques and risk models. This includes the following broad areas of knowledge:

- Value-at-Risk (VaR)
- Expected shortfall
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation
- 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* (Oxford: Blackwell Publishing, 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.

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 structural 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.

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

Chapter 14. Stress Testing. [VRM–4]

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–5]

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.

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

Chapter 13. Binomial Trees [VRM–6]

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–7]

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.
- 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 early decision for American call and put options.
- Compute the value of a European option using the Black-Scholes-Merton model on a dividend-paying stock.
- Describe the use of Black's Approximation in calculating the value of an American call option on a dividend paying stock.

Chapter 19. Greek Letters [VRM–8]

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.
- Define the delta of a portfolio.
- Define and describe theta, gamma, vega, and rho for option positions.
- Explain how to implement and maintain a gamma neutral position.
- Describe the relationship between delta, theta, and gamma.
- 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–9]

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–10]

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–11]

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–12]

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–13]

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/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.

Daniel Wagner, *Managing Country Risk: A Practitioner’s Guide to Effective Cross-Border Risk Analysis* (Boca Raton, FL: Taylor & Francis Group, 2012).

Chapter 3. Assessing Country Risk [VRM–14]

After completing this reading you should be able to:

- Identify characteristics and guidelines leading to effective country risk analysis.
- Identify key indicators used by rating agencies to analyze a country’s debt and political risk, and describe challenges faced by country risk analysts in using external agency ratings.
- Describe factors which are likely to influence the political stability and economic openness within a country.
- Apply basic country risk analysis in comparing two countries as illustrated in the case study.

Chapter 4. Country Risk Assessment in Practice [VRM–15]

After completing this reading you should be able to:

- Explain key considerations when developing and using analytical tools to assess country risk.
- Describe a process for generating a ranking system and selecting risk management tools to compare risk among countries.
- Describe qualitative and quantitative factors that can be used to assess country risk.
- Describe alternative measures and indices that can be useful in assessing country risk.

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

Chapter 2. External and Internal Ratings [VRM–16]

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–17]

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).
- 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, 3rd Edition* (Boston: Pearson Prentice Hall, 2012).

Chapter 18. Operational Risk [VRM-18]

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 and the use of scorecards.
- 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.

FRM EXAM PART II

The FRM Exam Part II applies the tools and techniques covered in the FRM Exam Part I, and delves more deeply into major sub-areas of risk management. The questions on the FRM Exam Part II are designed to test your ability to apply risk management concepts to real-world situations.

There are five broad domains of knowledge in the FRM Exam Part II:

- Market Risk Measurement and Management
- Credit Risk Measurement and Management
- Operational and Integrated Risk Management
- Risk Management and Investment Management
- Current Issues in Financial Markets

MARKET RISK MEASUREMENT AND MANAGEMENT (MR)—25%

This section tests your knowledge of market risk measurement and management techniques. This includes the following broad areas of knowledge:

- 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:

- Calculate VaR using a historical simulation approach.
- Calculate VaR using a parametric estimation approach assuming that the return distribution is either normal or lognormal.
- Calculate the expected shortfall given P/L or return data.
- Define coherent risk measures.
- Describe the method of estimating coherent risk measures by estimating quantiles.
- Describe the method of estimating standard errors for estimators of coherent risk measures.
- Describe the use of QQ plots for identifying the distribution of data.

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

After completing this reading you should be able to:

- Describe the bootstrap historical simulation approach to estimating coherent risk measures.
- Describe historical simulation using non-parametric density estimation.
- Distinguish among the age-weighted, the volatility-weighted, the correlation-weighted and the filtered historical simulation approaches.
- Describe the 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 generalized extreme value and POT.
- Describe the parameters of a generalized Pareto (GP) distribution.
- 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.
- Describe the process of model verification based on exceptions or failure rates.
- Define and identify type I and type II errors.
- Explain why it is necessary 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.
- List and describe 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.
- Summarize the recent state of stress testing research and practice.
- Compare unified and compartmentalized risk measurement.
- Describe the results of research on "top-down" and "bottom-up" risk aggregation methods.
- Explain intermediary balance sheet management and the cyclical feedback loop caused by VaR constraints on leveraged investors.

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.
- Explain the role of correlation risk in market, credit, 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 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, *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 between level and change regressions.
- Describe principal component analysis and explain how it is applied in 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.
- Explain why a call option on a zero-coupon security cannot be properly priced using expected discounted values.
- Explain the role of up-state and down-state probabilities in the valuation of a call option on a zero-coupon security.
- 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.
- 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.
- Explain why the Black-Scholes-Merton model is not appropriate to value 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.
- Calculate the convexity effect using Jensen's inequality.
- 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 Prentice Hall, 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.
- Explain why the OIS rate is a good proxy for the risk-free rate.
- Describe how to construct the OIS zero curve, and using it, determine forward LIBOR rates.

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 asset price jumps on volatility smiles.

CREDIT RISK MEASUREMENT AND MANAGEMENT (CR)—25%

This area focuses on your understanding of credit risk management with some focus given to structured finance and credit products, such as collateralized debt obligations and credit derivatives. It will test your understanding of the following broad areas of knowledge that are key to credit risk management:

- Credit analysis
- Default risk: Quantitative methodologies
- Expected and unexpected loss
- Credit VaR
- Counterparty risk
- Credit derivatives
- Structured finance and securitization

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

Jonathan Golin and Philippe Delhaise, *The Bank Credit Analysis Handbook* (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.
- 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 debt and equity and the volatility of firm value
  - 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:

- 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.
- 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 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 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.
- 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 explain their advantages and disadvantages.

Chapter 5. Collateral [CR–11]

After completing this reading you should be able to:

- 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 8. Credit Exposure [CR–12]

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.
- 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–13]

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–14]

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–15]

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.

Christopher Culp, *Structured Finance and Insurance: The Art of Managing Capital and Risk* (Hoboken, NJ: John Wiley & Sons, 2006).

Chapter 12. Credit Derivatives and Credit-Linked Notes [CR–16]

After completing this reading you should be able to:

- Describe the mechanics and attributes of a single named credit default swap (CDS).
- Describe the mechanics and attributes of portfolio CDS.
- Describe the composition and use of CDS indices.
- Describe the mechanics and attributes of asset default swaps, equity default swaps, total return swaps and credit linked notes.

Chapter 13. The Structuring Process [CR–17]

After completing this reading you should be able to:

- Describe the objectives of structured finance and explain the motivations for asset securitization.
- Describe the process and benefits of ring-fencing assets.
- Describe the role of structured finance in venture capital formation, risk transfer, agency cost reduction, and satisfaction of specific investor demands.
- Explain the steps involved and the various participants in the structuring process.
- Describe the role of loss distributions and credit ratings in the structuring process.

Chapter 16. Securitization [CR–18]

After completing this reading you should be able to:

- Define securitization, describe the securitization process and explain the role of participants in the process.
- Analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose entity.
- Describe and assess the various types of internal and external credit enhancements.
- Explain the impact of liquidity, interest rate and currency risk on a securitized structure, and identify securities that hedge these exposures.
- Describe the securitization process for mortgage backed securities and asset backed commercial paper.

Chapter 17. Cash Collateralized Debt Obligations [CR–19]

After completing this reading you should be able to:

- Describe collateralized debt obligations (CDOs) and explain the motivations of CDO buyers and sellers.
- Describe the types of collateral used in CDOs.
- Explain the structure and benefits of balance sheet CDOs and arbitrage CDOs, and the motivations for using them.
- Compare cash flow and market value CDOs.
- Compare static and managed portfolios of CDOs.

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 (OR)—25%

This area addresses your knowledge of two areas of increasing importance for many firms—operational risk management and integrated risk management. Key areas of knowledge in this domain include:

- Principles for sound operational risk management
- Enterprise Risk Management (ERM)
- Modeling operational loss distributions
- Liquidity risk (including repurchase agreements and funding risks)
- Model risk
- Risk appetite frameworks
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital allocation
- Stress testing banks
- Evaluating the performance of risk management systems
- Failure mechanics of dealer banks
- Regulation and the Basel Accords

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

"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.
- Define and describe the corporate operational risk function (CORF) and compare and contrast the structure and responsibilities of the CORF at smaller and larger banks.
- 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.

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.
- Explain the relationship between economic value and accounting performance.
- 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.
- Explain the use of economic capital in the corporate decision making process.

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

Chapter 7. Internal Loss Data [OR–3]

After completing this reading you should be able to:

- Summarize the process of collecting internal operational loss data.
- Describe the seven categories of operational risk events as defined in Basel II and identify examples of each.
- Explain the process a bank should use to report operational loss data, including the setting of thresholds, determining the loss amount, setting a reference date, and describing the causes of a loss event.
- Describe criteria for allocating operational losses to individual business lines within a firm and for the handling of boundary events.

Chapter 8. External Loss Data [OR–4]

After completing this reading you should be able to:

- Explain the motivations for using external operational loss data and common sources of external data.
- Compare the characteristics of external operational loss data from different sources.
- Describe challenges which can arise through the use of external data.
- Describe the Société Générale operational loss event, explain the lessons learned from the event and summarize how this event was classified by external data vendors.

Chapter 12. Capital Modeling [OR–5]

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-6]

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 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.

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

Chapter 14. Estimating Liquidity Risks [OR–7]

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.
- 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.

Chapter 16. Model Risk [OR–8]

After completing this reading you should be able to:

- Define model risk; identify and describe sources of model risk.
- Describe the challenges involved with quantifying model risk, and explain quantitative methods for estimating model risk given unknown parameters in a financial model.
- Identify ways risk managers can manage and mitigate model risk.
- Summarize the role of senior managers in managing model risk.
- Describe procedures for vetting and reviewing a model.
- Explain the function of an independent risk oversight (IRO) unit.

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–9]

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.
- Identify challenges related to mapping of risk factors to positions in making VaR calculations.
- 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–10]

After completing this reading you should be able to:

- Define and differentiate between sources of liquidity risk, including transactions liquidity risk, balance sheet/funding liquidity risk and systemic risk.
- Summarize the process by which a fractional-reserve bank engages in asset liability management.
- Describe issues related to systematic funding liquidity risk with respect to leveraged buyouts, merger arbitrage hedge funds, and convertible arbitrage hedge funds.
- Explain specific liquidity issues faced by money market mutual funds.
- Describe the economics of the collateral market and explain the mechanics of the following transactions using collateral: margin lending, repos, securities lending, and total return swaps.
- Calculate a firm's leverage ratio, describe the formula for the leverage effect, and explain the relationship between leverage and a firm's return on equity.
- 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.
- Identify the main sources of transactions liquidity risk.
- Calculate the expected transactions cost and the 99 percent spread risk factor for a transaction.
- Calculate the liquidity-adjusted VaR for a position to be liquidated over a number of trading days.
- Define characteristics used to measure market liquidity, including tightness, depth and resiliency.
- Explain the challenges posed by liquidity constraints on hedge funds during times of financial distress.

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

Chapter 12. Repurchase Agreements and Financing [OR–11]

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 value of a bond trading special when used in a repo transaction.

"Observations on Developments in Risk Appetite Frameworks and IT Infrastructure," Senior Supervisors Group, December 2010.* [OR–12]

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.

Michel Crouhy, Dan Galai and Robert Mark, *Risk Management* (New York: McGraw-Hill, 2001).

Chapter 14. Capital Allocation and Performance Measurement [OR–13]

After completing this reading you should be able to:

- Describe the RAROC (risk-adjusted return on capital) methodology and its benefits.
- Define, compare and contrast economic and regulatory capital.
- Compute and interpret the RAROC for a loan or loan portfolio, and use RAROC to compare business unit performance.
- Explain how capital is attributed to market, credit, and operational risk.
- Calculate the capital charge for market risk and credit risk.
- Explain the difficulties encountered in attributing economic capital to operational risk.
- Describe the Loan Equivalent Approach and use it to calculate RAROC capital.
- Explain how the second-generation RAROC approaches improve economic capital allocation decisions.
- Compute the adjusted RAROC for a project to determine its viability.

"Range of Practices and Issues in Economic Capital Frameworks," (Basel Committee on Banking Supervision Publication, March 2009).* [OR-14]

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–15]

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.

Til Schuermann. "Stress Testing Banks," April 2012.* [OR–16]

After completing this reading you should be able to:

- Compare and contrast the features and scope of 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.
- Describe the challenges in modeling losses under adverse market conditions, including the mapping of macroeconomic risk factors to specific intermediate risk factors.
- 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.

Darrell Duffie, 2010. "The Failure Mechanics of Dealer Banks," Journal of Economic Perspectives 24:1, 51-72.* [OR–17]

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.

John Hull, *Risk Management and Financial Institutions, 3rd Edition* (New York: John Wiley & Sons, 2012).

Chapter 12. Basel I, Basel II, and Solvency II [OR–18]

After completing this reading you should be able to:

- 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:
  - Standardised Measurement Method
  - Internal Models Approach
- Calculate VaR and the capital charge using the internal models approach, and explain the guidelines for backtesting VaR according to the 1996 Basel guideline.
- Describe and contrast the major elements of the three options available for the calculation of credit risk:
  - Standardised 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 13. Basel 2.5, Basel III, and Dodd-Frank [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.

REGULATORY REFERENCE READINGS

The following readings, all of which are available for free download from the GARP website, are provided for candidates who would like to review the Basel regulations in more detail, with Learning Objectives provided to guide you through each reading. You are expected to know and understand the general regulatory capital framework but are not required to memorize specific details.

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

After completing this reading you should be able to:

- Describe the key elements of the three pillars of Basel II: minimum capital requirements, supervisory review and market discipline.
- Describe and contrast the major elements of the three options available for the calculation of credit risk: Standardised Approach, Foundation IRB Approach and Advanced IRB Approach.
- Describe and contrast the major elements of the three options available for the calculation of operational risk: Basic Indicator Approach, Standardised Approach and Advanced Measurement Approach.
- Describe and contrast the major elements—including a description of the risks covered—of the two options available for the calculation of market risk: Standardised Measurement Method and Internal Models Approach.
- Define in the context of Basel II and calculate where appropriate:

Capital ratio	Capital charge
Tier 1 capital and its components	Tier 2 capital and its components
Tier 3 capital and its components	Probability of default (PD)
Loss given default (LGD)	Exposure at default (EAD)
Maturity (M)	Stress tests
Concentration risk	Residual risk

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

After completing this reading you should be able to:

- Describe reasons for the changes implemented through the Basel III framework.
- Describe changes to the regulatory capital framework, including changes to:
  - The measurement, treatment, and calculation of Tier 1 and Tier 2 capital
  - Risk coverage, the use of stress tests, the treatment of counter-party risk with credit valuation adjustments, the use of external ratings, and the use of leverage ratios
- Explain changes designed to dampen the pro-cyclical amplification of financial shocks and to promote countercyclical buffers.
- Describe changes intended to improve the handling of systemic risk.
- Describe changes intended to improve the management of liquidity risk, including liquidity coverage ratios, net stable funding ratios, and the use of monitoring metrics.

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

After completing this reading you should be able to:

- Define and describe the minimum liquidity coverage ratio.
- Describe the characteristics of high quality liquid assets (HQLA) and operational requirements for assets to qualify as HQLA.
- Differentiate between Level 1, Level 2A, and Level 2B assets, and define the respective cap for each asset class as a percentage of total HQLA.
- Define how total net cash outflows are calculated for the minimum liquidity coverage ratio.
- Describe additional metrics to be used by supervisors as monitoring tools when assessing the liquidity risk of a bank.

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

After completing this reading you should be able to:

- Describe the objectives for revising the Basel II market risk framework.
- Define the capital charge for specific risk and general market risk.
- Explain the relationship regulators require between market risk factors used for pricing versus those used for calculating value-at-risk, and the risks captured by the value-at-risk model.
- Explain and calculate the stressed value-at-risk measure and the frequency which it must be calculated.
- Explain and calculate the market risk capital requirement.
- Describe the qualitative disclosures for the incremental risk capital charge.
- Describe the quantitative disclosures for trading portfolios under the internal models approach.
- Describe the regulatory guidance on prudent valuation of illiquid positions.

RISK MANAGEMENT AND INVESTMENT MANAGEMENT (IM)—15%

This area focuses on your knowledge of risk management techniques applied to the investment management process. Topics such as portfolio construction and performance analysis are covered, as well as risk budgeting and portfolio and component VaR. Issues related to hedge funds are also covered.

- Portfolio construction
- Portfolio risk measures
- Risk budgeting
- Risk monitoring and performance measurement
- Portfolio-based performance analysis
- Hedge funds

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

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 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 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 objectives of performance measurement.

Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 9th Edition* (New York: McGraw-Hill, 2010).

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.
- 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.
- 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: 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 (10%)

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:

- Role of clearinghouses in limiting systemic risk
- Evolution of high frequency trading (HFT)
- Risk management in an HFT environment
- Current environment for derivatives trading
- Funding value adjustments
- Cyber security

The readings that you should focus on for this section, all of which are available for download at the GARP website, and the specific learning objectives that should be achieved with each reading are:

Roe, M. (2013) *Clearinghouse Overconfidence.* California Law Review, 101 (6), pp. 1641-1703.*

After completing this reading you should be able to:

- Synthesize the advantages of using clearinghouses for the trading derivatives.
- Analyze the role of clearinghouses in reducing contagion and systemic risk in financial markets.
- Apply the concept of "too big to fail" to the use of clearinghouses.
- Evaluate the shortcomings of clearinghouses in reducing risk.

O'Hara, M. (2014). *High-Frequency Trading and Its Impact on Markets.* Financial Analysts Journal, 70, 3. pp. 18-27.*

After completing this reading you should be able to:

- Distinguish between algorithmic trading and high frequency trading (HFT).
- Identify factors that drove the evolution of HFT.
- Discuss the implications of HFT on regulation in financial markets.
- Distinguish between liquidity and timing risk.

Clark, C. & Ranjan, R. (2012). *How Do Proprietary Trading Firms Control the Risks of High Speed Trading?**

After completing this reading you should be able to:

- Summarize the lifecycle of a new trading strategy for a trading firm.
- Describe a firm's risk management structure and the role of risk platforms.
- Explain the pre-trade and post-trade risk controls employed by trading firms.
- Describe the key challenges and best practices in firms' risk management.

Clark, C. (2011). *How Do Exchanges Control the Risk of High Speed Trading?**

After completing this reading you should be able to:

- Explain the pre-trade risk controls used by exchanges.
- Describe offerings exchanges make to their clients to help manage risk.
- Describe monitoring for and mitigation of abnormal trading and market manipulation.

Clark, C. (2010). *Controlling Risk in a Lightning-Speed Trading Environment.

After completing this reading you should be able to:

- Explain the importance of speed to high frequency trading.
- Describe ways in which market participants can speed up their trading.
- List the advantages and disadvantages of speed.
- Describe pre-trade and post-trade risk controls used in the marketplace.

"Report on Cyber Security in the Banking Sector," New York State Department of Financial Services. May 2014.*

After completing this reading you should be able to:

- Describe factors contributing to the rise of cyber crime against financial institutions.
- Discuss present trends in corporate governance as it relates to cyber security, and explain implications of these trends.
- Assess the greatest challenges financial institutions face in achieving adequate cyber security.

"Framework for Improving Critical Infrastructure Cybersecurity, (excluding Appendices)" National Institute of Standards and Technology. February 2014.*

After completing this reading you should be able to:

- Explain the five core functions in the framework that an organization can use to mitigate cyber security risk, and provide examples of activities associated with each function.
- Explain how an organization can implement and communicate a process to manage cyber security risk.
- Describe methodologies an organization can use to address privacy and civil liberties concerns associated with cyber security operations.

Hull, J. (2014) "The Changing Landscape for Derivatives," by John Hull, Joseph L. Rotman School of Management University of Toronto.*

After completing this reading you should be able to:

- Discuss the background and current status of OTC trading.
- Discuss how a central counterparty (CCP) can operate as an OTC derivative trading venue with respect to clearing and reporting.
- Explain the concept of too-big-to-fail CCPs, and discuss some points of weakness in this concept.

Hull, J. & White, A. (2014). *Valuing Derivatives: Funding Value Adjustments and Fair Value*, Financial Analysts Journal 70 (3), pp. 46-56.*

After completing this reading you should be able to:

- Understand the use and purpose of funding value adjustments (FVA).
- Compare and contrast the view on funding FVA from the perspectives of trading, accounting and financial theory.
- Distinguish between FVA and debit (or debt) value adjustment (DVA) and credit value adjustment (CVA).
- Evaluate the implications of using FVA, including the potential for arbitrage.

REGISTER FOR THE EXAM

The first step in obtaining your FRM designation is to register for the exam. The FRM Exam is divided into two parts, which must be taken consecutively. Registration may be completed online at the GARP website. A detailed discussion of the registration process and payment options are on the following pages.

Current Program Schedule and Fees

To be eligible to sit for the FRM Exam you must be enrolled in the FRM Program. The current fee for enrollment in the FRM program is USD 300.00. This fee automatically entitles you to a complimentary one year Individual Membership in GARP (a USD 195.00 value), access to a wealth of premium risk content (Special Reports, CRO Interviews, webcasts), special pricing on other GARP products, programs and events, the opportunity to network with influencers and peers together with many other benefits.

The FRM Exams are offered on the third Saturday in May and the third Saturday in November. The 2015 schedule of important registration dates and fees is provided below:

FRM Program Enrollment and Exam Registration Fees

	FRM	**May 16, 2015**	**November 21, 2015**
Program Enrollment Fee	USD 300.00	Valid for 4 Years*	Valid for 4 Years*
	Exam Fee	**If you register between these dates:**	
Exam Early Registration**	USD 350.00	Dec 1, 2014—Jan 31, 2015	May 1, 2015—Jul 31, 2015
Exam Standard Registration**	USD 475.00	Feb 1, 2015—Feb 28, 2015	Aug 1, 2015—Aug 31, 2015
Exam Late Registration**	USD 650.00	Mar 1, 2015—Apr 15, 2015	Sep 1, 2015—Oct 15, 2015

**4 Years after passing FRM Exam Part I*

***Fees per FRM Part I and II*

If you have any questions or encounter any difficulties in registering, please contact memberservices@garp.com for assistance.

Your Payment Options

Secure Online Payment

It's easy to register online and this is the preferred method of payment. GARP accepts Visa, MasterCard, and American Express. Only single payments per Candidate registrations are accepted online. If you are paying for more than one candidate using the same credit card, please submit your payment via fax.

Payment by Check

GARP accepts checks on a US bank issued draft or check and payable in US Dollars. Please note only foreign checks having US intermediate banks will be accepted. There is a USD 50.00 processing charge that will be added to your fee for payment by check.

1. Print out your invoice in order to post it with a US issued bank draft/check. The check amount should include the USD 50.00 processing fee.
2. Checks should be made payable to Global Association of Risk Professionals.
3. Your full name and GARP ID must be written on your check. If this information is not provided, your payment will not be processed.
4. Your invoice and check should be sent to:

   Attn: FRM Administration
   Global Association of Risk Professionals
   111 Town Square Place, 14th Floor
   Jersey City, NJ 07310 USA

Credit Card Payment by Fax or Mail

Credit card payments not made online can also be made by fax or mail. There is a USD 50.00 processing charge that will be added to your fee for manual credit card payments. Complete the credit card portion found on the bottom of your invoice. Be sure to include your entire credit card number, expiration date and CVV code. Do not forget to sign your authorization. Fax your completed form to us at: +1.201.222.5022 or mail the form to:

Attn: FRM Administration
Global Association of Risk Professionals
111 Town Square Place, 14th Floor
Jersey City, NJ 07310 USA

Payment by Wire Transfer

Please direct wire transfer payments in US dollars as per the instructions that appear on your invoice. A USD 50.00 bank charge will be added to your invoice for each wire transfer. Please note that this bank charge is imposed by the bank. GARP has no control over this fee and does not receive any portion of the fee. Be sure to include your full name, GARP ID and invoice number on your wire transfer. If this is not provided, your payment will not be processed.

Important Payment Notice

In order for your exam registration to be considered complete, payment must have been received by GARP or postmarked by midnight, EDT, on the closing date of each registration period. Submitting your registration/invoice without the correct amount due at that time will result in an incomplete payment and registration. If your fee is paid at a later date, you will be charged the applicable fee as of the date that the payment is received by GARP.

Scholarship Opportunities

GARP is pleased to offer a competitive scholarship program for qualified applicants as part of our commitment to providing the future leaders of the risk profession with the opportunity to sit for the FRM Exam, regardless of their ability to self-fund. Scholarships cover the cost of the Exam Registration Fee for the FRM Exam Part I only; scholarships are not available for the FRM Exam Part II. Awarded scholarships are based on merit and the final decision is at the sole discretion of GARP. A candidate may be awarded only one scholarship, no exceptions.

Qualifications

In order to qualify for a scholarship, the candidate must meet the following guidelines:

- Students must demonstrate full-time enrollment in a graduate degree program at the time of the Exam. Students currently enrolled in an undergraduate or certificate program do not qualify and will not be considered.
- Faculty members are deemed eligible if they can demonstrate full-time employment at their institution. A completed scholarship application must be submitted, along with all supporting documents by the current deadline in order to be considered. Application forms can be found on the GARP website.

Special Accommodations for Individuals with Disabilities

GARP provides reasonable and appropriate testing accommodations for both FRM Exam Part I and Part II for those candidates who are disabled. An "accommodation" is defined by GARP as any modification in the standard administration of the Exam. A candidate requesting an accommodation must document the existence of a physical or mental impairment which significantly limits the candidate's ability to perform a major life function, the current impact of the impairment and how it affects the candidate's ability to take the Exam under standard conditions, including a justification and unbiased objective of the requested accommodation.

Process for Requesting an Accommodation

Once you have registered for the Exam, you must submit an application for the Accommodation. The application form to be completed can be found on the GARP website at www.garp.org. All documentation must be submitted in one package in order to be considered. The deadline for the May 2015 Exam Date is February 28, 2015 while the deadline for the November 2015 Exam Date is August 31, 2015. Late applications will not be considered. Fax your completed application to us at: +1.201.222.5022 or mail it to:

Attn: ADA Administration
Global Association of Risk Professionals
111 Town Square Place, 14th Floor
Jersey City, NJ 07310 USA

If GARP cannot grant your request for an accommodation, you will be notified not later than April 1, 2015 (May Exam date) or October 1, 2015 (November Exam date).

Returning ADA Candidates

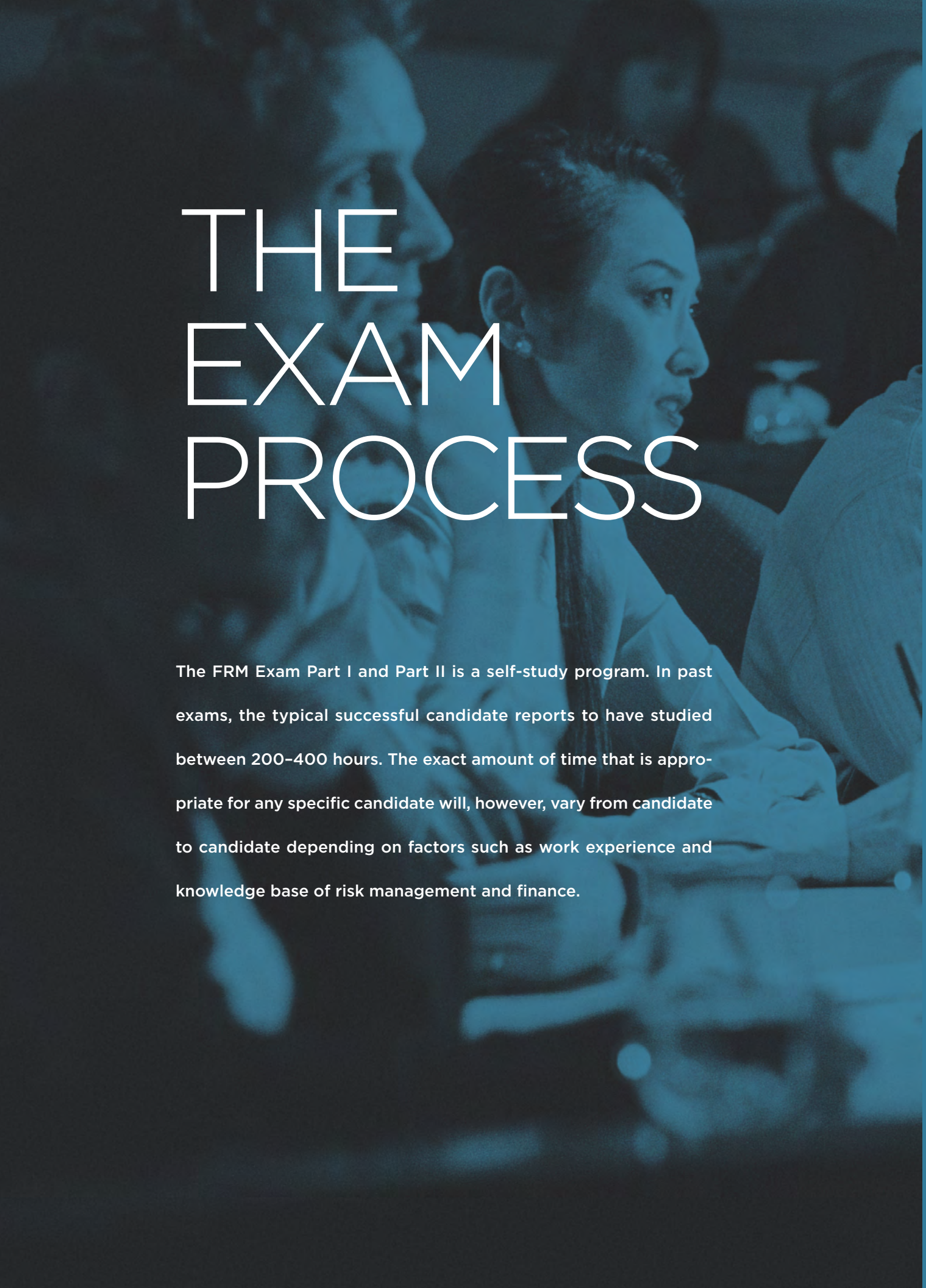
If you are a returning candidate and have previously submitted documentation which is not more than two years old, you are not required to resubmit the entire application again. Upon registration however, you will need to notify us via email at ADA@garp.com of your request and submit Section 1 of the application in order to inform GARP of the Exam you are registered for and the accommodation that is required. Please include in the subject heading of your email "A second request for Special Accommodations for Americans (ADA)."

Deferral Policy

In some instances you may not be able to take the Exam as planned. If an issue arises, a deferral may be obtained. You may only defer their Exam registration once, to the next exam date. Please note:

- A deferral to the next exam period must be submitted by the last day of registration. For example, the last day of registration for the May Exam is April 15; for the November Exam the last day of registration is October 15.
- There is an administrative processing fee of USD 100.00 to defer your Exam. This fee must be paid via credit card at the time of your request.
- As a deferred candidate, you will automatically be re-enrolled in the next Exam cycle. If you decide not to attend the next Exam, you will forfeit your Exam registration fee and will need to re-register as a returning candidate should you choose to sit for the Exam at a later date.
- Second deferral requests will not be considered. There are no exceptions to this.
- Once the deferral deadline has passed, special requests for deferrals will not be considered. There are no exceptions to this.
- Any study materials you purchased for this year's Exam may not be applicable for next year's Exam since the Study Guide and suggested readings will change from year to year. Deferral and Returning candidates should refer to the 2015 FRM Exam Study Guide Changes, posted on our website, to review the updates to the current Study Guide.
- If a candidate who defers the FRM Exam Part II registration does not first pass the FRM Exam Part I, their deferred registration will automatically be converted to a FRM Exam Part I registration in the next administration. Unless a candidate is sitting for both Parts on the same day, they cannot sit for the FRM Exam Part II without having first passed the FRM Exam Part I.

If, after submitting your Deferral request, you change your mind and want to sit for the Exam during the current Exam period, you must contact GARP by the last day of the current registration period. This will incur an additional administrative processing fee of USD 100.00.



THE EXAM PROCESS

The FRM Exam Part I and Part II is a self-study program. In past exams, the typical successful candidate reports to have studied between 200–400 hours. The exact amount of time that is appropriate for any specific candidate will, however, vary from candidate to candidate depending on factors such as work experience and knowledge base of risk management and finance.

General Guidelines

Due to the sizeable amount of material covered in the Exam, it is important that a candidate adhere to a study schedule that is designed to spread out learning of the material over an extended period. Cramming for the exam is not recommended. Later in this section, we present a sample reading/study plan for both FRM Exam Part I and Part II. Each plan is split into 15 modules intended to serve as a framework for you to structure your own schedule and pace to properly prepare for the exam.

Study Resources

GARP has prepared several materials in order to assist you in successfully preparing for the FRM Exam.

2015 FRM Books

GARP publishes a series of soft bound books to help you prepare for the FRM Exam Part I and Part II. These books are curated by the FRM Committee and contain readings drawn from leading textbooks, scholarly journals and practitioner publications selected to provide candidates with a concise source of information for preparing for the exams.

These volumes are currently only available in printed format and can be ordered through the GARP website. While purchasing these books is not required to participate in the FRM Program, knowledge of the material covered in them is expected of all candidates.

The FRM Exam Part I series include four volumes:

- Foundations of Risk Management
- Quantitative Analysis
- Financial Markets and Products
- Valuation and Risk Models

The FRM Exam Part II series include four volumes:

- Market Risk Measurement and Management
- Credit Risk Measurement and Management
- Operational and Integrated Risk Management
- Risk Management and Investment Management

Note: All materials related to Current Issues in Financial Markets, which are typically journal articles and other practitioner materials published in recent years, are generally available for digital download for free on the GARP website.

Practice Exams

You are strongly encouraged to download and take the FRM Practice Exams from the GARP website. These Practice Exams contain actual FRM Exam questions that have appeared on prior Exams and are designed to reflect the breadth of coverage and the difficulty level of the FRM Exam.

While not every reading referenced in the Practice Exams is currently being used on the FRM Exam, the underlying concepts remain largely consistent and the Practice Exams will provide you with a good sense of the question types to expect when sitting for the actual FRM Exam. Working through a Practice Exam can also help you estimate how much time you can expect to spend answering individual questions. The Practice Exams also include an explanation for each correct answer so that you can better understand any incorrect replies and identify areas of weakness that need emphasis.

Reading Plans

Outlined on the following pages are suggested reading plans—split into 15 modules each—for learning the material covered in the 2015 FRM Exam Part I Books and the 2015 FRM Exam Part II Books. Reading sessions are sometimes paired across sections where appropriate to complement each other. The primary goal of this section is to break the curriculum down into logical pieces that can be learned efficiently. Some modules are longer than others; it is up to you to determine each week's optimal reading level. The reading notations correspond to the notations listed with each reading and the learning objectives above. For example FRM-1 refers to the first reading in Foundations, while QA-7 refers to the seventh reading in Quantitative Analysis.

FRM Exam Part I

Module Number	Module Name	Suggested Readings
1	Overview of Risk Management, Code of Conduct	FRM—1, 2, 3, 4, 5, 8 and 14
2	Quantitative Analysis of Risk	FRM—6, 7, 9, 10, and 11
3	Information and Data Risk	FRM—12 and 13
4	Probability and Statistics	QA—1, 2, 3, 4 and 5
5	Regression (Part I)	QA—7, 8, 9 and 10
6	Regression (Part II)	QA—6, 14 and 15
7	Forecasting	QA—11, 12 and 13
8	Derivative Markets	FMP—1, 2, 3, 4, 5, 6 and 7
9	Commodities and Foreign Exchange	FMP—15 and 16
10	Fixed Income	FMP—17, VRM—9, 10, 11, 12 and 13
11	Derivative Products	FMP—8, 9, 10, 11, 12 and 18
12	Valuing Options	FMP—13 and 14, VRM—6, 7 and 8
13	Value at Risk (VaR)/Capital Allocation	VRM—1, 2, 3 and 16
14	Credit Ratings and Country Risk	VRM—14 and 15, FMP—19
15	Operational Risk	VRM—4, 5, 17 and 18

FRM Exam Part II

Module Number	Module Name	Suggested Readings
1	Fixed Income	MR—11, 12, 13, 14 and 15
2	Correlation Risk Modeling	MR—7, 8, 9 and 10
3	Volatility	MR—16 and 17
4	Value at Risk (VaR)	MR—4 and 5, IM 2 and 3
5	Measuring Market Risk	MR—1, 2, 3 and 6
6	Structured Finance	CR—16, 17, 18 and 19
7	Credit Risk (Part I)	CR—5, 6, 7 and 8
8	Credit Risk (Part II)	CR—9, 10, 11, 12, 13, 14 and 15
9	Credit Risk and Subprime Mortgages	CR—1, 2, 3, 4 and 20
10	Portfolio Management	IM—1, 4, 5 and 6
11	Hedge Funds and Enterprise Risk Management (ERM)	IM—7 and 8, OR—2, 10 and 11
12	Capital Management and Modeling	OR—5, 6, 12, 13, 16 and 17
13	Operational and Liquidity/Funding Risk	OR—1, 3, 4, 5, 6, 7, 8, 9, 14 and 15
14	Basel II/III and other Regulatory Readings	OR—18 and 19, Online regulatory readings noted previously
15	Current Issues in Financial Markets	Online current issues readings noted previously

Other Resources Available to Candidates

Study Groups

While the FRM curriculum is designed to be a self-study undertaking, many candidates find that studying with their peers positively impacts their exam preparation. Our surveys indicate that the vast majority of candidates who work within a study group find it very helpful. You can connect with other FRM candidates to form study groups by joining our Facebook or LinkedIn groups. Alternatively, many GARP Professional and University Chapters now facilitate study group sessions that enable FRM candidates in the same city or region to meet each other and ask GARP Regional Chapter Directors questions about the Exam.

Exam Preparation Courses

While GARP does not conduct exam preparation courses; there are third party firms that do provide such services. The following Exam Preparation Providers are currently approved by GARP for the 2014 FRM Exam. This list may be updated further for 2015, please check the GARP website for the most recent list.

- Ace3Levels Financial Learning Pvt. Ltd. Hyderabad, India
- Africa Risk Institute (Nairobi, Kenya, Africa)
- Ariel University External Studies and Continued Learning Unit (Israel)
- Association of Professional Risk Managers in Bosnia and Herzegovina
- Bionic Turtle, LLC (Rancho Palos Verdes, CA, USA)
- CfBS Center for Business Studies AG (Zurich, Switzerland)
- Corporate Bridge Consultancy Pvt. Ltd. (Mumbai, India)
- Decision Science Co., Ltd. (Seoul, Korea)
- EduPristine (Global, India)
- EduPristine-Neev Knowledge Management Private Ltd
- Financial Services Academy (FSA) (Bangkok, Thailand)
- Finlearning (New Delhi, India)
- Finstructor (New Delhi, India)
- FRM Study Course by Christian H. Cooper (New York, NY)
- Globecon Group/Achievelive (Jersey City, NJ, USA)
- Gocharter Company (Taipei City, Taiwan)
- IAB Centre (Yerevan, Armenia)
- IEB (Instituto De Estudios Bursatiles)(Madrid, Spain)
- IFBL L'Institut (Luxembourg)
- Indian Institute of Quantitative Finance (Mumbai, India)
- iPlan Education (New Delhi, India)
- Jiangsu Caixin Education and Training Center (Nanjing, China)
- Kaplan Financial (Hong Kong)—with Schweser
- Kaplan Financial (London, UK)
- Kaplan Schweser (La Crosse, WI, USA)
- Kesdee Inc. (San Diego, CA, USA)
- Kornerstone Institute Ltd. (Hong Kong)
- National University of Singapore (Singapore)
- NIBE-SVV (Amsterdam, The Netherlands)
- Sanjay Saraf Educational Institute Ltd. (West Bengal, India)
- Simplilearn Solutions Pvt. Ltd.
- Smart Risk Financial Training (Amsterdam, The Netherlands)
- Top Finance (Paris, Brussels, Luxembourg, Frankfurt, Zurich and Geneva)
- University of Dubai (United Arab Emirates)
- University of San Francisco (San Francisco, CA, USA)
- University of Toronto School of Continuing Studies
- Goethe Business School GmbH (Frankfurt, Germany)
- Zhuo Qin You Dao International Education and Consulting Co., ltd. BJ
- HKU School of Professional and Continuing Education (HKU Space) (Hong Kong, Hong Kong)
- Lynchpin Financial Training Centre, (Dubai, UAE)

It should be noted that GARP does not endorse, promote, review, or warrant the accuracy or the products or services offered by Exam Preparation Providers of FRM-related information. Nor does it endorse pass rates claimed by any Exam Preparation Provider. Further, GARP is not responsible for any fees or costs paid by the user to an FRM Exam Preparation Provider. GARP provides candidates with this information solely as a service to them.

Academic Offerings

Another component of GARP's risk education offerings includes partnerships with various colleges and universities to craft programs that offer rigorous academic instruction aligned with the FRM curriculum. Students who matriculate in such programs can be better prepared to succeed in the challenging field of risk management. More detailed information about GARP's academic partners and the programs they offer can be found on the GARP website.

Test Day Materials

All candidates must present a printed Admission Ticket in order to sit for the Exam. Each registered candidate will receive an email approximately two weeks prior to the Exam date containing instructions on how to download the ticket.

As the Exam is a multiple choice test, you will need to bring #2 pencils. You are also permitted to bring a GARP-approved calculator, which includes the following business calculators:

- Texas Instruments BA II Plus (both versions), including the BA II Plus Professional;
- Hewlett Packard 10B II, 10B II+, 20 B;
- Hewlett Packard 12C, including the HP 12C Platinum and the Anniversary Edition.

All Exam materials, including Exam booklets and answer sheets, are the sole property of GARP. Completed examinations will not be returned or shared partially or fully with candidates. Your Exam materials must be given to the proctor prior to leaving the Exam room for any reason including trips to the restroom.

Acceptable ID

You are also required to have an acceptable form of government issued identification. Ensure that your current government issued photo ID matches the name under which you are registering for the Exam. Only a current, not expired and original valid government issued passport or driver's license which must include a photograph of the candidate will be accepted for identification purposes. GARP will not accept work/employer identification cards, voter's identification cards, a learner's permit or student ID cards. The name on your government issued identification (passport, driver's license) must be exactly the same as the name on your Exam registration. For example, the name 李学成 cannot be used to register for the exam; Xuecheng Li would be the correct name to use to register using the phonetic alphabet. If the name on your Exam registration does not match that of your government-issued identification, please contact us at memberservices@garp.com.

There are NO exceptions to this policy, regardless of what form of identification a candidate may have used in past Exam administrations. Should a candidate arrive on exam day without any of the GARP approved forms of government issued ID, they will not be allowed to sit for the exam. There are no exceptions to this rule. GARP typically administers its exams in approximately 90 locations in more than 50 countries; because all of the different forms of identification that are used worldwide, and which differ greatly from country to country and from culture to culture, we cannot list all forms of identification that are not acceptable. This is why we only accept an original country-issued passport or a driver's license for admission. We require that all candidates must abide by this same rule, worldwide.

Exam Center/Room Policies

Proctors and security personnel may ask to inspect your belongings at check-in to ensure that prohibited items are not carried into the testing room. Please comply with all of these requests. You must follow these guidelines at your testing center. With your cooperation, we are able to ensure that candidates are checked in promptly and seated on time.

The following items must be kept on your desk during the exam:

- FRM Admission Ticket(s)
- Current government-issued photo identification
- Approved calculator(s), including calculator case(s)
- Pencils or pencil lead for mechanical pencils

The following items are permitted in the testing room but must remain in your pockets or in transparent plastic bags under your chair when not in use:

- Wallet (money purse)
- Calculator batteries, pencil sharpeners, eyeglasses, earplugs
- Medicine, tissues, and other medically necessary or personal items
- Food and drinks (Please note containers cannot be opened in the testing room. All food and drinks must be consumed outside the testing room)

The following items are not permitted in the testing room:

- Baggage of any kind including backpacks, handbags, tote bags, briefcases, laptop bags, luggage, carrying cases, or pencil cases

- Study materials including notes, pens, papers, textbooks, study guides, scratch paper, present/future value tables, or calculator manuals, highlighters, correction fluid, correction tape, or rulers
- Knives of any type, including box cutter and X-ACTO knives for use as pencil sharpeners
- Cellular telephones, cameras, pagers, headsets, computers, electronic organizers, personal data assistants, or any remote communication or photographic devices
- Wristwatches with engaged audible alarms/timers or any type of desk clock/time

If you finish either session before the end of the allotted time, you may leave the testing room but only after you have handed in all your exam materials to the proctor. Once you leave the testing room after completing a session, you may not return. No one may leave during the last 30 minutes of either session. If you leave the testing room and inadvertently take the exam materials with you, your Exam will not be graded. This is a violation of GARP's testing policies.

Smartphones and Your Exam

Smartphones (such as iPhones, Blackberries, Windows phones, Android devices and all other cellular/mobile phones) are not allowed in the Exam room under any circumstances, and must be stored outside of the Exam room. If a candidate is found to have a smartphone or cellular phone in the Exam room, an Exam Violation Report will be issued and their Exam will not be graded.

Candidates should not expect to gain admission to their Exam via a smartphone that contains an electronic copy of their Admission Ticket. A paper Admission Ticket is required for entry to the Exam. There are no exceptions to this. If proctors or security personnel find items that are not permitted in the testing room, you will be required to place them in a designated area away from the testing room during the exam. You will not have access to these items during the exam, but may access them during the lunch break and at the conclusion of the exam. GARP, the test center, testing personnel, and vendors will NOT assume responsibility or liability for stolen, lost, or damaged personal property left in this area.

Misconduct During the Exams

GARP seriously reviews each and every Exam Violation Report. We list below some of the violations that have resulted in a Candidate Violation Report being filed and, subsequently, an exam not graded.

- Candidate used a pen on the answer sheet and/or the exam booklet
- Candidate began the exam early
- Candidate opened the exam booklet early
- Continued to write after the session ended
- Brought a cellular telephone into the exam room
- Candidate caught cheating
- Violation of calculator policy

Exam Day Schedule

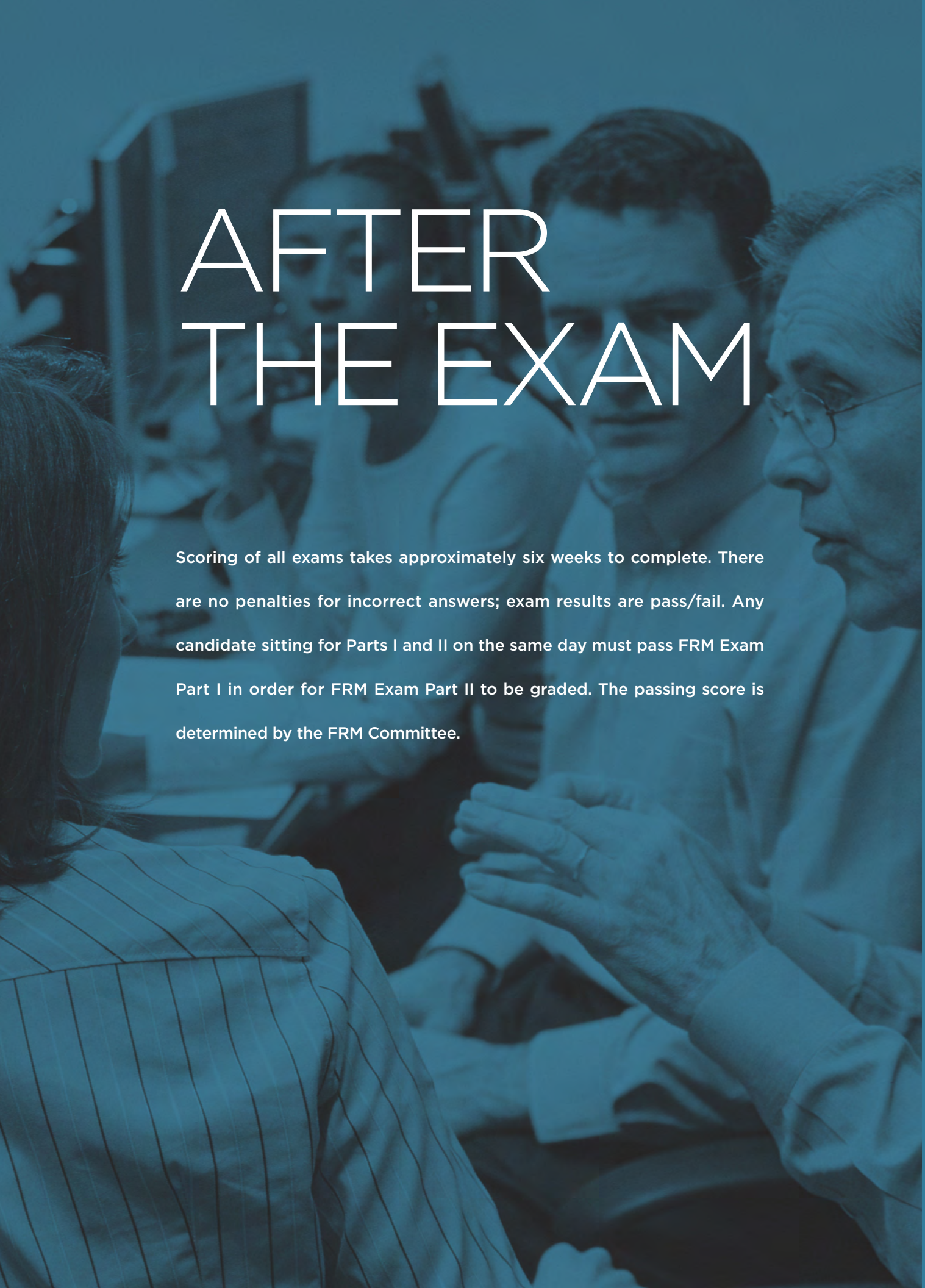
Once the exam doors have closed, for both the morning and afternoon session, candidates are not allowed to enter and sit for the FRM Exam. No exceptions to this rule.

FRM Exam Part I Session

7:00 am	Candidates may begin to check in
7:45 am	Doors close promptly. No late candidates will be permitted to enter.
7:46 am	Once doors close, the exam is distributed and instructions are read.
8:00 am	Exam begins
11:30 am	30 minutes remaining announcement made
11:55 am	5 minutes remaining announcement made
12:00 pm	Exam is over, materials are collected and candidates are released.

FRM Exam Part II Session

1:00 pm	Candidates may begin to check in
1:45 pm	Doors close promptly. No late candidates will be permitted to enter.
1:46 pm	Once doors close, the exam is distributed and instructions are read.
2:00 pm	Exam begins
5:30 pm	30 minutes remaining announcement made
5:55 pm	5 minutes remaining announcement made
6:00 pm	Exam is over, materials are collected and candidates are released.



AFTER THE EXAM

Scoring of all exams takes approximately six weeks to complete. There are no penalties for incorrect answers; exam results are pass/fail. Any candidate sitting for Parts I and II on the same day must pass FRM Exam Part I in order for FRM Exam Part II to be graded. The passing score is determined by the FRM Committee.

After the Exam

Scoring and Obtaining Your Results

You will be notified via e-mail of your results and are also provided with quartile results that will enable you to see how you scored on specific areas of the exam relative to other candidates.

Reregistering

Candidates who do not receive a passing score are strongly encouraged to register to retake the exam on the next administration date. Those candidates who pass FRM Exam Part I are equally encouraged to continue on and register for the FRM Exam Part II on the next administration date. Returning candidates do not have to pay an additional program fee but are required to pay the exam fee. Early bird discounts and late registration penalties will apply.

Work Experience Requirements

Once you have passed both parts of the FRM Exam, in order to become a Certified FRM, you must then demonstrate a minimum of two years of risk-related full-time professional experience in the area of financial risk management or another related field including, but not limited to: trading, portfolio management, academia, industry research, economics, auditing, risk consulting, and/or risk technology.

Once you receive an email notification from GARP that you passed the FRM Exam, you will also be instructed as to how to provide your CV/Resume to demonstrate your professional experience as well as a brief statement describing how you manage financial risk in your day-to-day work. Your professional experience must encompass two years of full-time work experience. Experience completed for school will not be considered, including internships, part-time jobs, or student teaching.

You have five years from the date you passed the FRM Exam Part II to have your work experience verified, which you can complete online by submitting your professional experience. If you fail to provide this information within the five-year time frame, you will then be required to re-enroll in the FRM Program and retake the FRM Exam again as a new candidate. GARP strongly encourages FRMs to further their risk management skills and knowledge through our Continuing Professional Development (CPD) Program. This helps FRMs develop their expertise and stay current in a dynamic industry.

Receiving Your Certificate

Only candidates who have passed the FRM Exam and provided GARP with proof of their two years of professional work experience as outlined above will receive a certificate. You may not use the FRM designation until GARP verifies that you have met the two year full-time professional work experience requirement.

Note: All Certificates are sent via the United States Postal Service. Delivery may take up to 10 weeks, depending on your mailing address.

If your certificate does not arrive due to an incorrect or insufficient address, you will be assessed a USD 100.00 fee to re-issue the certificate. For GARP members that have lost their certificates, or wish to receive a duplicate certificate, there is a USD 100.00 replacement fee. You can either fax your request to GARP at +1.201.222.5022, or send it via email to memberservices@garp.com. Your credit card information and expiration date are required in order to have your certificate re-issued.

Proper Usage of the FRM Designation

The FRM designation adds significant value to your credentials. Having earned the FRM certification, you are eligible and encouraged to acknowledge your achievement by using the certification designation on your business cards, on LinkedIn or other professional social media, and where appropriate in your business activities.

The FRM Designation should only be used as follows:

- FRM
- Certified FRM
- Financial Risk Manager—Certified by the Global Association of Risk Professionals

Suggested Uses for the FRM Designation

- After your name in written correspondence and/or as part of your email signature
- After your name on business cards, letterheads and/or name plates
- As an identifier in resumes, curricula vitae, biographies, personal statements and/or published articles
- On LinkedIn and other professional social networking platforms.

More detailed information regarding usage guidelines for the FRM designation can be found on the GARP website. If you have any questions about how to use the FRM designation properly, please contact us at memberservices@garp.com or +1.201.719.7210.

FRM Digital Badge

As a Certified FRM, you will also have access to an FRM digital badge. You can increase the visibility of your certification by placing your digital badge on your favorite professional or social networks, a blog or website. Wherever you choose to place your badge, your FRM credential will be immediately validated. By displaying your digital badge, potential employers, recruiters and other contacts will immediately recognize your skills and achievement.

Resources for FRMs

Passing both parts of the FRM Exam doesn't mean that the FRM Program has ended—in fact, it's likely to be the beginning of a new phase of your career, as you put your hard-earned skills and knowledge to work. The following resources are meant to help those who pass the FRM Exam, from becoming certified to continuing their professional development and utilizing the global FRM network.

Maintaining GARP Membership

Participation in the world's leading professional association for risk practitioners communicates your commitment to shared knowledge and expertise, and the advancement of global best practices. It informs and reinforces the day-to-day decisions and strategies which define your professional experience and become your unique contribution to risk management.

There are three types of membership: Individual, Student and Affiliate. As noted previously, the enrollment fee paid when registering for the FRM Exam entitles the candidate to a complimentary one year Individual Membership in GARP. Certified FRM's are then entitled to pay a reduced annual Membership fee in recognition of their achievement and commitment to best practices, as evidenced by attaining the certification.

Maintaining GARP membership provides the candidate with unlimited access to online news articles, white papers and other analysis.

The Daily Limit

The Daily Limit is an informal discussion forum for FRMs and ERPs to share information and ideas. Please be sure you are logged on to the GARP website in order to be given access. Do you have content, ideas, papers, projects you wish to share on the blog? Tell us about your interest by contacting Chris Donohue at cdonohue@garp.com.

Chapter Meetings

Participation in local chapters is a core benefit of GARP membership and is offered to all members. GARP supports Professional and University Chapters around the globe to enable risk practitioners, and students developing their understanding of risk, to share their knowledge and expertise while building their network of professional contacts. The chapter network is organized around five regions: Africa, Americas, Asia-Pacific, Europe and the Middle East. GARP members and guests can attend GARP chapter meetings anywhere in the world and be welcomed as part of the global risk community. GARP's Professional Chapter meetings are a way to make new contacts, gain new knowledge about important topics, and stay on the cutting edge of risk management.

GARP Events

GARP Events further the advancement of risk management and best practice by preparing risk professionals around the world to make better informed decisions through their participation in conferences, conventions, executive briefings and master classes. GARP Events bring together leading CROs, senior risk managers, leading academic thinkers, regulators and policy makers to present, discuss and debate the latest developments in the practice of risk management.

Continuing Professional Development (CPD)

Maintaining Your Certification

Risk Management is an evolving discipline with new challenges emerging every day. These challenges make continued learning essential for FRMs. GARP's Continuing Professional Development program provides the resources you need to maintain your knowledge and expertise, and advance your professional development.

The CPD program delivers a broad range of accessible learning opportunities and provides the tools you need to track and document your activities. Certified FRMs and ERPs are expected to actively participate throughout their careers.

Credits may be earned by participating in structured, self-study, live or online learning activities. You may choose an activity of your own or access the extensive offerings available through your GARP account.

The CPD program is based on two-year cycles and participants are expected to earn 40 credits each cycle. Credits are typically measured by one hour of learning activity equaling one credit. Credits may be earned by participating in a wide range of learning activities, and FRMs are afforded broad latitude in selecting both activities and providers.

Activities and programs eligible for credit should be educational in nature and focus on risk-relevant topics at an advanced level.

Typical activities:

- **Attend:** Conferences, forum, seminars, chapter or society meetings or other live events
- **Read or Publish:** In-depth articles, journals or books, whitepapers, research papers
- **Participate:** Training courses, employer training or programs, college or university courses (including MOOCs)
- **View or Listen:** Webcasts, podcasts, videos or on-line training
- **Achieve:** Earning a passing score on risk relevant certification or licensing exams
- **Speak or Teach:** Featured or panel speaker at event, on a webcast or video; teach a risk-relevant course
- **Volunteer:** GARP committees and chapters, SMEs, Item writers

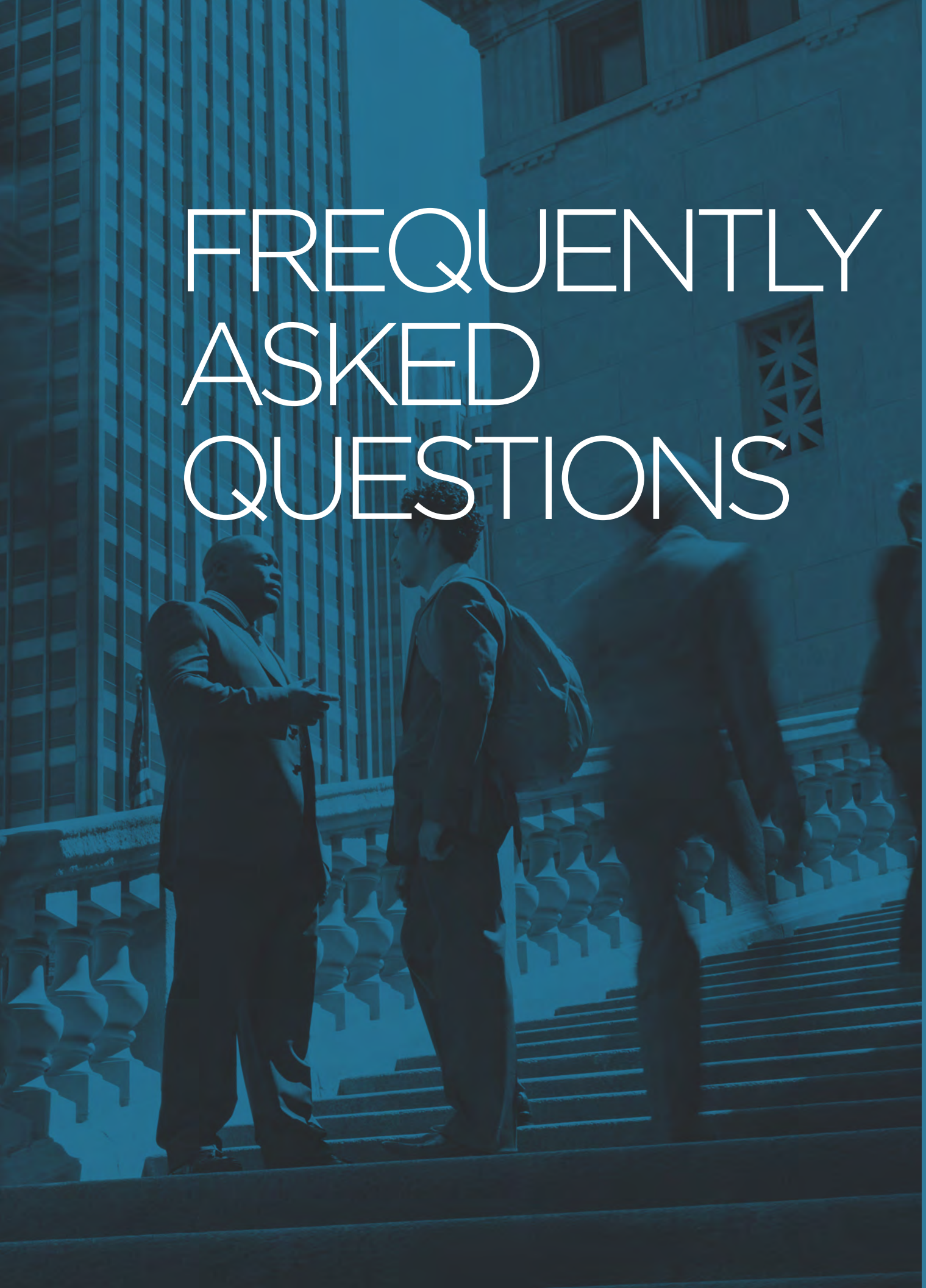
Recognition for Maintaining a Higher Standard

FRMs and ERPs actively participating in CPD can be acknowledged in a number of ways.

DIGITAL BADGE
Provides online verification of your certification and validates your participation in CPD on professional and social networking pages like LinkedIn, Twitter, a blog or website

FRM|ERP DIRECTORY
Provides verification of your participation in the official directory of FRMs and ERPs, including the date of your last completed cycle

ACKNOWLEDGEMENT OF COMPLETION
Provides printable proof of your achievement in meeting the standards set forth in the CPD program



FREQUENTLY ASKED QUESTIONS

Q. How much time is needed to prepare for the FRM Exam?

A. Candidates' preparation times will vary based on their prior professional experience level, academic backgrounds, and familiarity with the concepts tested on the curriculum. Therefore, it is difficult to recommend a particular number of hours to dedicate to studying. For some guidance, however, a survey of May 2014 FRM Exam test takers indicates that, on average, individuals devoted about 250 hours to Exam preparation. Individual figures, however, varied from less than 100 hours to more than 400 hours.

Q. Does the FRM Exam provide formula sheets?

A. No, the Exam does not include formula sheets. While the FRM Exam is conceptual in nature, candidates will still need to know important formulas and calculations and how to apply them correctly. For guidance on which formulas to focus on, please refer to the learning objectives delineated earlier in the Manual and look for any statements that include the words 'Calculate,' 'Compute' or 'Derive.' These words will generally indicate an associated formula to commit to memory.

A standard table presenting the values for the cumulative distribution function (CDF) of the standard normal distribution (a "z-table") is provided however, as is other relevant information pertaining to the CDFs of other probability distributions (F, Chi-squared, etc.) where necessary and applicable. Memorization of CDF values is therefore not expected. A list of common abbreviations used throughout the exam is also provided.

Q. What types of institutions is the FRM relevant to?

A. The FRM is designed to address the practical knowledge needed to function effectively as a financial risk manager globally, across all institutional settings. The FRM Committee, which guides the development of the FRM curriculum, consists of seasoned risk professionals and academics with a wide range of professional back-grounds. The broader risk management community is regularly surveyed through a formal job task analysis process to determine the knowledge, skills, and abilities required to function effectively as a financial risk manager in the global marketplace. Survey participants come from a wide range of industries including (but not limited to) banking, consulting, traditional asset management and hedge funds, technology, insurance and nonfinancial corporations.

Q. What are my career prospects after becoming a Certified FRM?

A. Demand for financial risk managers remains strong. While individuals' career prospects will always vary according to the nature of their prior professional experience, by choosing the FRM you are selecting the best known, most global, and most widely accepted risk management designation in the world. Becoming a FRM will differentiate you from your peers and serves as a validation of your knowledge of the tools and techniques currently demanded by the risk management profession. The FRM designation is valued by employers in regions all over the world. FRMs are employed by most every major banking institution, government regulator, consulting firm and financial services institution around the world. This, along with career-long opportunities for networking and further professional education, enhances the career prospects of FRMs.

Q. How much work experience is required before sitting for the FRM Exam?

A. To become an FRM, candidates must meet a two-year professional work experience requirement. However, there are no educational or professional prerequisites to sit for either part of the FRM Exam. Once candidates pass both parts of the FRM Exam, candidates must satisfy the work experience requirement before they can become certified and use the FRM designation.

Q. Who is GARP, and why is GARP qualified to certify risk managers?

A. The Global Association of Risk Professionals is the leading global professional association for financial and energy risk certification and education. In fulfilling our unique mission to elevate the practice of risk management at all levels throughout an organization, GARP sets the global standard for the risk profession. Founded in 1996, we are a nonprofit, nonpartisan membership organization of over 150,000 individuals that does not engage in political lobbying. This independence allows us to develop design, and administer certification programs that reflect industry best practices. We are governed by a Board of Trustees composed of distinguished risk management practitioners drawn from some of the most prominent global financial firms and universities.

Q. What is the difference between the FRM and the CFA?

A. The FRM is an excellent way for candidates to improve their knowledge of market risk, operational risk, credit risk, integrated risk management, valuation and risk models, and risk management in investment management, among other topics. There are many CFA holders who are also FRMs, as the designations attest to different skills and aspects of a candidate's capabilities and the two professional designations complement each other very well. Demonstrating your competencies in financial risk via the FRM designation is a win-win for CFA charter holders especially given the prominent role that CROs and risk managers are now taking in financial institutions in the wake of the global financial crisis.

Q. Do you offer any exemptions for either part of the FRM Exam?

A. While there are many other notable professional designations in the financial services industry, GARP does not accept other designations in partial fulfillment of our requirements. GARP feels strongly that the FRM certification must represent an individual's competency in the risk management skill set as defined by our FRM Committee, and as objectively set forth in the FRM Study Guide. A critical component of GARP's assessment of an individual is the instrument with which that competency is measured—the FRM exams. To maintain the integrity of the FRM certification and to fulfill our obligations to the risk management community, therefore, GARP cannot rely on the assessments performed by other designation-granting organizations. Thus, candidates for the FRM may not waive either part of the FRM Exam despite any certifications they may have achieved from other certifying bodies.

Q. What is the pass rate?

A. The historical pass rates for the FRM Exam can be found on the GARP website.

Q. How is the Exam scored?

A. The passing score is determined by the FRM Committee.

Q. If a candidate sits for both the FRM Exam Part I and the FRM Exam Part II in one day and does not pass Part I, Part II will not be marked. Why is it done this way? Will I have to retake Part I as well?

A. The FRM Exam tests progressive, cumulative knowledge, meaning the concepts tested on Part I are needed for Part II. Thus, in order for GARP to grade Part II, you must first pass Part I. Hence, if you sat for both Part I and Part II on the same day, we will not grade Part II, unless you already passed Part I.

NOTES

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