FRM®
STUDY GUIDE 2022

GARP

FRM | Financial Risk Manager

2022 Financial Risk Manager (FRM®) Exam Study Guide

Topic Outline, Readings, Test Weightings

The Study Guide sets forth primary topics and sub-topics covered in the FRM Exam Part I and Part II. The topics were selected by the FRM Committee as essential for today's risk managers to master. The topics and their respective weightings are reviewed yearly to ensure the Exams are timely and relevant. The Study Guide also contains a full listing of all the readings that are recommended as preparation for the FRM Exam Part I and Part II.

Key concepts appear as bullet points at the beginning of each section and are intended to help candidates identify the major themes and knowledge areas associated with that section.

FRM Exam Approach

The FRM Exams are practice oriented. The questions are derived from a combination of theory as set forth in the readings and real-world work experience. Candidates are expected to understand risk management concepts and approaches, as well as how they would apply to a risk manager's day-to-day activities. It is rare that a risk manager will be faced with an issue that can immediately be slotted into one category. In the real world, a risk manager must be able to identify any number of risk-related issues and deal with them effectively.

As such, the Exams are comprehensive in nature, testing a candidate on a number of risk management concepts and approaches.

Readings

Questions for the FRM Exams are related to and supported by the readings listed under each topic outline. These readings were selected by the FRM Committee to assist candidates in their review of the subjects covered by the Exams. It is strongly suggested that candidates review these readings in depth prior to sitting for each Exam. All of the readings listed in the FRM Study Guide are available through GARP. Further information can be found on the GARP website.

FRM Exam Prep Providers

Some candidates may want to review more formally the materials with FRM Exam Preparation Providers (EPPs). A list of EPPs that have registered with GARP can be found on the GARP website. GARP does not endorse any EPP, but merely lists them as a service to FRM candidates.

On the following pages, an asterisk after a reading indicates that the reading is freely available on the GARP website.

FRM Exam Part I

FOUNDATIONS OF RISK MANAGEMENT

QUANTITATIVE ANALYSIS

FINANCIAL MARKETS AND PRODUCTS

VALUATION AND RISK MODELS

FRM Exam Part II

MARKET RISK MEASUREMENT AND MANAGEMENT

CREDIT RISK MEASUREMENT AND MANAGEMENT

OPERATIONAL RISK AND RESILIENCY

LIQUIDITY AND TREASURY RISK MEASUREMENT AND MANAGEMENT

RISK MANAGEMENT AND INVESTMENT MANAGEMENT

CURRENT ISSUES IN FINANCIAL MARKETS

Foundations of
Risk Management

PART I EXAM WEIGHT | 20%

Topics and Readings

This area focuses on foundational concepts of risk management and how risk management can add value to an organization. The broad knowledge points covered in *Foundations of Risk Management* include the following:

- Basic risk types, measurement, and management tools
- Creating value with risk management
- Risk governance and corporate governance
- Credit risk transfer mechanisms
- The Capital Asset Pricing Model (CAPM)

- Risk-adjusted performance measurement
- Multifactor models
- Data aggregation and risk reporting
- Financial disasters and risk management failures
- Ethics and the GARP Code of Conduct

A proprietary book for FRM candidates has been created to cover these broad knowledge points. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Chapters 1 and 2 explore different risk types, how risks can arise in an organization, and how firms manage financial risks. Chapter 3 describes the role of corporate governance in risk management, including the role of the board of directors and other areas of an organization. The concept of risk appetite and how it is translated into a risk appetite framework and communicated throughout an organization is presented as well in this chapter.

Chapter 4 presents an overview of credit risk transfer mechanisms, including credit derivatives and securitization, and discusses issues with the securitization of subprime mortgages. Chapter 5 presents Modern Portfolio Theory (MPT) and the CAPM, one of the foundational developments in risk-adjusted pricing and valuation. This is followed by Chapter 6, which explains how the Arbitrage Pricing Theory (APT) and factor models can be used to model returns on investment assets.

Data is the lifeblood of many large financial organizations, and aggregating and reporting risk data have become increasingly important. Chapter 7 addresses this important topic. Chapter 8 introduces enterprise risk management (ERM), a common and important method for assessing and managing risk in an organizational context, and discusses its future trends.

As it is always important to learn from historical experience, Chapter 9 describes various financial disasters from the past, and Chapter 10 focuses on the financial crisis of 2007-2009.

To help ensure ethical standards are upheld in the risk management profession, Chapter 11 contains GARP's Code of Conduct, a code which applies to all Certified FRMs.

Readings for Foundations of Risk Management

For 2022, the entirety of the Foundations of Risk Management curated readings has been replaced with GARP's proprietary *Foundations of Risk Management* book. The contents of this book are as follows:

- Chapter 1. The Building Blocks of Risk Management

- Chapter 2. How Do Firms Manage Financial Risk?

- Chapter 3. The Governance of Risk Management

- Chapter 4. Credit Risk Transfer Mechanisms

- Chapter 5. Modern Portfolio Theory and Capital Asset Pricing Model

- Chapter 6. The Arbitrage Pricing Theory and Multifactor Models of Risk and Return

- Chapter 7. Principles for Effective Data Aggregation and Risk Reporting

- Chapter 8. Enterprise Risk Management and Future Trends

- Chapter 9. Learning from Financial Disasters

- Chapter 10. Anatomy of the Great Financial Crisis of 2007-2009

- Chapter 11. GARP Code of Conduct*

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* This reading is freely available on the GARP website.

Quantitative Analysis

PART I EXAM WEIGHT | 20%

Topics and Readings

This area tests a candidate's knowledge of basic probability and statistics, regression and time series analysis, and various quantitative techniques useful in risk management. The broad knowledge points covered in *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
- Measures of correlation
- Linear regression with single and multiple regressors
- Time series analysis and forecasting
- Simulation methods

A proprietary book for FRM candidates has been created to cover these broad knowledge points. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Chapters 1 through 6 introduce fundamental concepts related to probability, statistics, probability distributions, Bayesian analysis, hypothesis testing, and confidence intervals.

Regression analysis is an important statistical tool used to investigate relationships between variables. Chapters 7 and 8 give a general introduction to single and multiple variable linear regression analysis. Chapter 9 examines model specification and potential deficiencies in model specification through the use of residual diagnostics and tests of statistical hypotheses.

Time series data occur frequently in finance. The next two chapters describe methods for analyzing time series data in order to estimate statistics and extract other meaningful data characteristics. Chapter 10 focuses on modeling stationary time series, while Chapter 11 takes up modeling non-stationary time series.

Dependence and variation are important subjects in risk management. Chapter 12 introduces volatility, correlation, and returns, as well as the properties of these three measures in the context of both normally and non-normally distributed variables.

Simulation methods are used to value and analyze complex financial instruments and portfolios. Chapter 13 introduces simulation methods, including Monte Carlo simulation, and the use of bootstrapping. It also explains the advantages and disadvantages of using simulations and the techniques to reduce Monte Carlo sampling error.

Readings for Quantitative Analysis

The entirety of the Quantitative Analysis curated readings are contained in GARP's proprietary *Quantitative Analysis* book. The contents of this book are as follows:

- Chapter 1. Fundamentals of Probability

- Chapter 2. Random Variables

- Chapter 3. Common Univariate Random Variables

- Chapter 4. Multivariate Random Variables

- Chapter 5. Sample Moments

- Chapter 6. Hypothesis Testing

- Chapter 7. Linear Regression

- Chapter 8. Regression with Multiple Explanatory Variables

- Chapter 9. Regression Diagnostics

- Chapter 10. Stationary Time Series

- Chapter 11. Non-stationary Time Series

- Chapter 12. Measuring Returns, Volatility, and Correlation

- Chapter 13. Simulation and Bootstrapping

Financial Markets and Products

PART I EXAM WEIGHT | 30%

Topics and Readings

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

- Structures and functions of financial institutions
- Structures and mechanics of over-the-counter (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 (MBS)

To cover these broad knowledge points, a proprietary book has been created exclusively for FRM candidates. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

The first chapter describes the structure of commercial and investment banking, the way banks are regulated, the nature of risks they face, the role of capital in providing cushion against losses, and the securitization process for MBS. Chapter 2 explains the risks and regulations faced by insurance companies, their capital requirements and performance ratios, as well as the types and key characteristics of pension funds. Chapter 3 introduces mutual funds, exchange-traded funds and hedge funds, and describes various hedge fund strategies and performance measures.

Financial derivatives play a key role in risk management. Chapter 4 describes options, forwards, and futures, along with the derivatives markets and the risks faced by market participants. The exchange-traded and OTC markets are explained in Chapter 5. Chapter 6 describes the structures and operations of central counterparties (CCPs), and the types of risks faced by CCPs. Chapters 7 and 8 explain the mechanics of futures markets and how futures are used for hedging. Chapter 9 describes the foreign exchange markets and explains methods for estimating foreign exchange risk, multicurrency hedging strategies using options, the determination of exchange rates, and the covered interest rate parity theorem.

The next two chapters provide deeper coverage of financial forwards and futures, including their pricing, and the determination of no-arbitrage values for commodity forwards and futures. The following four chapters examine options and their use in risk management, including the properties of different options, option market mechanics, multi-option and hedging strategies, and different exotic options.

Interest rates and two important classes of fixed income securities are covered in the next three chapters. Chapter 16 describes properties of interest rates and explains bond valuation, duration, and convexity, the pricing of forward rate agreements, and the theories of term structure. Chapter 17 describes corporate

bonds, their types and characteristics and credit ratings. Chapter 18 defines mortgages, explains the valuation of MBS pools, prepayment modeling, and calculations of mortgage pool metrics.

The last two chapters examine two additional derivative instruments. Chapter 19 describes interest rates and Treasury bonds in relation to forward and futures prices, along with the use of interest rate futures in hedging. The mechanics, types, and the pricing of swaps contracts used for hedging are described in Chapter 20.

Readings for Financial Markets and Products

For 2022, the entirety of the Financial Markets and Products curated readings are contained in GARP's proprietary *Financial Markets and Products* book. The contents of this book are as follows:

- Chapter 1. Banks

- Chapter 2. Insurance Companies and Pension Plans

- Chapter 3. Fund Management

- Chapter 4. Introduction to Derivatives

- Chapter 5. Exchanges and OTC Markets

- Chapter 6. Central Clearing

- Chapter 7. Futures Markets

- Chapter 8. Using Futures for Hedging

- Chapter 9. Foreign Exchange Markets

- Chapter 10. Pricing Financial Forwards and Futures

- Chapter 11. Commodity Forwards and Futures

- Chapter 12. Options Markets

- Chapter 13. Properties of Options

- Chapter 14. Trading Strategies

- Chapter 15. Exotic Options

- Chapter 16. Properties of Interest Rates

- Chapter 17. Corporate Bonds

- Chapter 18. Mortgages and Mortgage-Backed Securities

- Chapter 19. Interest Rate Futures

- Chapter 20. Swaps

Valuation and Risk Models

PART I EXAM WEIGHT | 30%

Topics and Readings

This area will test a candidate's knowledge of valuation techniques and risk models. The broad knowledge points covered in *Valuation and Risk Models* include the following:

- Value-at-risk (VaR)
- Expected shortfall (ES)
- Estimating volatility and correlation
- Economic and regulatory capital
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation

- Hedging
- Country and sovereign risk models and management
- External and internal credit ratings
- Expected and unexpected losses
- Operational risk

To cover these broad knowledge points, a proprietary book has been created exclusively for FRM candidates. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

The first three chapters introduce financial risk measures and models. Chapter 1 examines measures of financial risk and describes measurement frameworks such as the mean-variance approach, VaR, and ES. Chapter 2 covers VaR and ES estimation approaches and applications. Chapter 3 discusses the calculation and monitoring of volatility used in the VaR and ES models.

The next three chapters introduce credit risk. Chapter 4 describes credit rating and presents a review of external and internal rating methodologies, along with their relative strengths and weaknesses. Chapter 5 explains specific sources of country risk and the use of external ratings in assessing sovereign default risk. Chapter 6 covers the basics of credit risk, specifically expected loss (EL) and unexpected loss (UL), for both individual assets and portfolios, and describes default risk models such as the Gaussian copula model, Vasicek's model, and CreditMetrics.

Chapter 7 introduces aspects of operational risk and discusses various approaches for determining capital for operational risk. Stress testing, its importance, applications, and practices are explained in Chapter 8.

Chapters 9 through 13 focus on risk management for fixed income securities. The first three chapters cover the various tools of fixed income valuation, while Chapters 12 and 13 explain risk metrics and hedging.

The last three chapters discuss key elements of option pricing and option sensitivities. Chapters 14 and 15 cover option valuation using binominal trees and the Black-Scholes-Merton model. Chapter 16 presents applications of options for hedging and risk management.

Readings for Valuation and Risk Models

For 2022, the entirety of the Valuation and Risk Models curated readings are contained in GARP's proprietary *Valuation and Risk Models* book. The contents of this book are as follows:

- Chapter 1. Measures of Financial Risk

- Chapter 2. Calculating and Applying VaR

- Chapter 3. Measuring and Monitoring Volatility

- Chapter 4. External and Internal Credit Ratings

- Chapter 5. Country Risk: Determinants, Measures, and Implications

- Chapter 6. Measuring Credit Risk

- Chapter 7. Operational Risk

- Chapter 8. Stress Testing

- Chapter 9. Pricing Conventions, Discounting, and Arbitrage

- Chapter 10. Interest Rates

- Chapter 11. Bond Yields and Return Calculations

- Chapter 12. Applying Duration, Convexity, and DV01

- Chapter 13. Modeling Non-Parallel Term Structure Shifts and Hedging

- Chapter 14. Binomial Trees

- Chapter 15. The Black-Scholes-Merton Model

- Chapter 16. Option Sensitivity Measures: The "Greeks"

Market Risk Measurement and Management

PART II EXAM WEIGHT | 20%

Topics and Readings

This area focuses on market risk measurement and management techniques. The broad knowledge points covered in *Market Risk Measurement and Management* include the following:

- VaR and other risk measures
  - Parametric and non-parametric methods of estimation
  - VaR mapping
  - Backtesting VaR
  - ES and other coherent risk measures
  - Extreme Value Theory (EVT)
- Modeling dependence: correlations and copulas
- Term structure models of interest rates
- Volatility: smiles and term structures
- Fundamental Review of the Trading Book (FRTB)

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

The importance of VaR and other common risk measures used to assess risk cannot be overstated. Reading 1 presents both parametric and non-parametric estimation techniques for VaR and ES. Backtesting as a form of model validation, as support for the use of VaR and VaR mapping, and as a tool to address portfolio risk factors are presented in the two chapters of Reading 2. Reading 3 completes the risk measures coverage by showing the uses and applications of VaR and ES in a trading book context while addressing some of the recent academic literature associated with market risk management.

Modern risk management requires an understanding of correlation risk. Reading 4 explains the basics of correlation risk and explores the empirical properties, models, and modeling approaches related to correlation risk. The first chapter covers the basics of correlation risk and how it is related to credit risk, market risk, systematic risk, and concentration risk. The second chapter explores how correlations behave in different economic states as well as mean reversion and autocorrelation. The third chapter explains the purpose and uses of copula functions.

The five chapters in Reading 5 are all associated with term structure models and their impact on hedging. Various regression hedges are explained in the first chapter. Term structure models that deal with drifts, mean reversions, negative short-term rates, and time-dependent volatilities are all reviewed. Specific term structure models, such as the Ho-Lee, Vasicek, Cox-Ingersoll-Ross, and lognormal models, are discussed in this reading.

Reading 6 covers very specific concepts related to the occurrence of volatility smiles. The fundamental review of trading book capital requirements is covered in Reading 7.

Readings for Market Risk Measurement and Management

1. **Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).**
   - Chapter 3. Estimating Market Risk Measures: An Introduction and Overview
   - Chapter 4. Non-parametric Approaches
   - Chapter 7: Parametric Approaches (II): Extreme Value

2. **Philippe Jorion, *Value at Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York, NY: McGraw-Hill, 2007).**
   - Chapter 6. Backtesting VaR
   - Chapter 11. VaR Mapping

3. **"Messages from the academic literature on risk measurement for the trading book," (Basel Committee on Banking Supervision, Working Paper No. 19, January 2011).**

4. **Gunter Meissner, *Correlation Risk Modeling and Management, 2nd Edition* (Risk Books, 2019).**
   - Chapter 1. Correlation Basics: Definitions, Applications, and Terminology
   - Chapter 2. Empirical Properties of Correlation: How Do Correlations Behave in the Real World?
   - Chapter 5. Financial Correlation Modeling—Bottom-Up Approaches (pages 126-134 only)

5. **Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).**
   - Chapter 6. Empirical Approaches to Risk Metrics and Hedging
   - Chapter 7. The Science of Term Structure Models
   - Chapter 8. The Evolution of Short Rates and the Shape of the Term Structure
   - Chapter 9. The Art of Term Structure Models: Drift
   - Chapter 10. The Art of Term Structure Models: Volatility and Distribution

6. **John C. Hull, Options, *Futures, and Other Derivatives, 10th Edition* (New York, NY: Pearson, 2017).**
   - Chapter 20. Volatility Smiles

7. **John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).**
   - Chapter 18. Fundamental Review of the Trading Book

Credit Risk Measurement and Management

PART II EXAM WEIGHT | 20%

Topics and Readings

This area focuses on a candidate's understanding of credit risk management, with some attention given to structured finance and credit products such as collateralized debt obligations and credit derivatives. The broad areas of knowledge covered in readings related to *Credit Risk Measurement and Management* include the following:

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

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 8 includes two chapters that introduce the key themes of credit risk management. The first chapter discusses the components of credit risk, types of credit risk analysis, and credit risk measurements. The second chapter describes the tools and methods of credit analysis. Reading 9 covers measurement of credit risk, especially expected loss and unexpected loss, and the effect of correlation on portfolio unexpected loss.

The role of ratings in supporting credit risk management and rating assignment methodologies are presented in Reading 10. The reading describes key features of a good rating system, relates ratings to the probability of default, and analyzes different approaches to predicting default. Reading 11 describes different approaches to credit risk modeling and assesses credit derivatives.

Reading 12 includes three chapters that cover portfolio and structured credit risk. The first chapter describes default intensity models, explains credit spread risk and defines the relationship between a default probability and a hazard rate. The second chapter defines default correlation for credit portfolios and assesses the impact of correlation on credit VaR. The third chapter describes common types of structured products and the mechanics of a securitization, and explains how default sensitivities for tranches are measured.

Counterparty risk is covered in five chapters that form Reading 13. The first three chapters identify ways of managing and mitigating counterparty risk and describe the effects of netting, close-out, and collateral

on credit exposure. The fourth chapter describes the determination of credit exposure, the pricing of exposure profiles for derivative contracts, and the impact of collateral on funding, while the last chapter covers the analysis of credit value adjustment (CVA) and debt value adjustment (DVA), and the concept of wrong-way risk. Reading 14 describes stress tests on CVA and counterparty credit risk (CCR).

Reading 15 defines and compares the risk management and scoring models of retail and corporate credit risk. Reading 16 describes special purpose vehicles (SPVs) and explains performance analysis tools for securitized structures. Finally, Reading 17 examines the subprime mortgage credit securitization in the US and details the players and information frictions in the securitization process.

Readings for Credit Risk Measurement and Management

8. **Jonathan Golin and Philippe Delhaise, *The Bank Credit Analysis Handbook, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2013).**
    *   Chapter 1. The Credit Decision
    *   Chapter 2. The Credit Analyst

9. **Gerhard Schroeck, *Risk Management and Value Creation in Financial Institutions* (New York, NY: John Wiley & Sons, 2002).**
    *   Chapter 5. Capital Structure in Banks (pages 170-186 only)

10. **Giacomo De Laurentis, Renato Maino, and Luca Molteni, *Developing, Validating and Using Internal Ratings: Methodologies and Case Studies* (West Sussex, UK: John Wiley & Sons, 2010).**
    *   Chapter 3. Rating Assignment Methodologies

11. **René Stulz, *Risk Management & Derivatives* (Florence, KY: Thomson South-Western, 2002).**
    *   Chapter 18. Credit Risks and Credit Derivatives

12. **Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).**
    *   Chapter 7. Spread Risk and Default Intensity Models
    *   Chapter 8. Portfolio Credit Risk (Sections 8.1, 8.2, 8.3 only)
    *   Chapter 9. Structured Credit Risk

13. **Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020).**
    *   Chapter 3. Counterparty Risk and Beyond
    *   Chapter 6. Netting, Close-out and Related Aspects
    *   Chapter 7. Margin (Collateral) and Settlement
    *   Chapter 11. Future Value and Exposure
    *   Chapter 17. CVA

14. ***Stress Testing: Approaches, Methods, and Applications*, Edited by Akhtar Siddique and Iftekhar Hasan (London, UK: Risk Books, 2013).**
    *   Chapter 4. The Evolution of Stress Testing Counterparty Exposures

15. **Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York, NY: McGraw-Hill, 2014).**
    - Chapter 9. Credit Scoring and Retail Credit Risk Management
    - Chapter 12. The Credit Transfer Markets — and Their Implications

16. **Moorad Choudhry, *Structured Credit Products: Credit Derivatives & Synthetic Securitisation, 2nd Edition* (New York, NY: John Wiley & Sons, 2010).**
    - Chapter 12. An Introduction to Securitisation

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

Operational Risk and Resiliency

PART II EXAM WEIGHT | 20%

Topics and Readings

This area focuses on methods to measure and manage operational risk as well as methods to manage risk across an organization, including risk governance, stress testing, and regulatory compliance. The broad knowledge points covered in *Operational Risk and Resiliency* include the following:

- Principles for sound operational risk management
- Risk appetite frameworks and enterprise risk management (ERM)
- Risk culture and conduct
- Analyzing and reporting operational loss data
- Model risk and model validation
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital planning

- Stress testing banks
- Third-party outsourcing risk
- Risks related to money laundering and financing of terrorism
- Regulation and the Basel Accords
- Cyber risk and cyber resilience
- Operational resilience

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives, a brief summary of how to relate these readings to the knowledge points follows.

Readings 18 through 21 cover operational risk governance and ERM, including recommended principles to manage operational risk, best practices in implementing an ERM program, and governance principles for risk appetite frameworks. Readings 22 and 23 follow with a discussion of risk culture and conduct, a topic that is becoming increasingly important with financial institutions worldwide, by presenting recommended principles in this area. Reading 24 presents a more analytical discussion of operational risk by providing guidelines for measuring and reporting operational losses.

Readings 25 through 28 follow with a discussion of model risk. Important concepts presented in this area include best practices for identifying and mitigating model risk, addressing data quality issues, and validating models.

Reading 29 introduces capital planning and RAROC, while readings 30 and 31 extend the discussion by presenting best practices in capital planning and recommended practices for stress testing. Reading 32 continues the discussion of stress testing by comparing different stress testing approaches. This is followed by a discussion of regulatory guidelines and requirements, including guidelines for managing outsourcing risk in Reading 33, risks related to money laundering and financing of terrorism in Reading 34, and a comprehensive overview of the Basel regulations in Readings 35 through 39. For the interested candidate, the full Basel regulation documents are presented as optional readings.

The section concludes with a discussion of resilience. Readings 40 and 41 explain principles and practices to help organizations become more resilient to cyber risks, while Readings 42 through 44 extend this discussion to explore current practices and recommended guidelines in the area of operational resilience.

Readings for Operational Risk and Resiliency

18. **"Revisions to the Principles for the Sound Management of Operational Risk," (Basel Committee on Banking Supervision Publication, March 2021).**

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

20. **James Lam,** *Enterprise Risk Management: From Incentives to Controls, 2nd Edition* **(Hoboken, NJ: John Wiley & Sons, 2014).**
     - Chapter 4. What is ERM?

21. **"Implementing Robust Risk Appetite Frameworks to Strengthen Financial Institutions," Institute of International Finance, June 2011. (Introduction through Section 4 and Annex 1 only)**

22. **"Banking Conduct and Culture: A Permanent Mindset Change," G30 Working Group, 2018. (Introduction through Lessons Learned only)**

23. **Alessandro Carretta, Franco Fiordelisi and Paola Schwizer,** *Risk Culture in Banking* **(Palgrave Macmillan, 2017).**
     - Chapter 2: Risk Culture

24. **Marcelo G. Cruz, Gareth W. Peters and Pavel V. Shevchenko,** *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk* **(Hoboken, NJ: John Wiley & Sons, 2015).**
     - Chapter 2: OpRisk Data and Governance

25. **"Supervisory Guidance on Model Risk Management," Federal Deposit Insurance Corporation, June 7, 2017.**

26. **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

27. **Giacomo De Laurentis, Renato Maino, Luca Molteni,** *Developing, Validating and Using Internal Ratings* **(Hoboken, NJ: John Wiley & Sons, 2010).**
     - Chapter 5. Validating rating models

28. **Allan Malz, Financial Risk Management:** *Models, History, and Institutions* **(Hoboken, NJ: John Wiley & Sons, 2011).**
     - Chapter 11. Assessing the Quality of Risk Measures (Section 11.1)

29. **Michel Crouhy, Dan Galai and Robert Mark,** *The Essentials of Risk Management, 2nd Edition* **(New York, NY: McGraw-Hill, 2014).**
     - Chapter 17. Risk Capital Attribution and Risk-Adjusted Performance Measurement

30. **"Range of practices and issues in economic capital frameworks," (Basel Committee on Banking Supervision Publication, March 2009).**

31. **"Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice," Board of Governors of the Federal Reserve System, August 2013.**

32. **Til Schuermann, "Stress Testing Banks,"** *International Journal of Forecasting* **30, no. 3, (2014): 717–728.**

33. **"Guidance on Managing Outsourcing Risk," Board of Governors of the Federal Reserve System, December 2013.**

34. **Mark Carey, "Management of Risks Associated with Money Laundering and Financing of Terrorism," GARP Risk Institute, February 2019.**

35. **John C. Hull,** *Risk Management and Financial Institutions, 5th Edition* **(Hoboken, NJ: John Wiley & Sons, 2018).**
    • Chapter 17. Regulation of the OTC Derivatives Market

36. **Mark Carey, "Capital Regulation Before the Global Financial Crisis," GARP Risk Institute, April 2019.**

37. **Mark Carey, "Solvency, Liquidity and Other Regulation After the Global Financial Crisis," GARP Risk Institute, April 2019.**

38. **"High-level summary of Basel III reforms," (Basel Committee on Banking Supervision Publication, December 2017).**

39. **"Basel III: Finalising post-crisis reforms," (Basel Committee on Banking Supervision Publication, December 2017): (pages 128-136 only).**

40. **Andrew Coburn, Eireann Leverett, and Gordon Woo,** *Solving Cyber Risk: Protecting Your Company and Society* **(Hoboken, NJ: Wiley, 2019).**
    • Chapter 8: The Cyber-Resilient Organization

41. **"Cyber-resilience: Range of practices," (Basel Committee on Banking Supervision Publication, December 2018). (Introduction through Section 6 only)**

42. **"Operational Resilience: Impact tolerance for important business services," (Bank of England Policy Statement 6/21, March 2021). (Include Appendix 2 and 3)**

43. **"Principles for Operational Resilience," (Basel Committee on Banking Supervision Publication, March 2021).**

44. **"Striving for Operational Resilience: The Questions Boards and Senior Management Should Ask," Oliver Wyman, 2019.**

Optional Regulatory Readings for Reference

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

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

"Basel III: A global regulatory framework for more resilient banks and banking systems—revised version," (Basel Committee on Banking Supervision Publication, June 2011).*

"Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools," (Basel Committee on Banking Supervision Publication, January 2013).*

"Revisions to the Basel II market risk framework—updated as of 31 December 2010," (Basel Committee on Banking Supervision Publication, February 2011).*

"Basel III: The net stable funding ratio." (Basel Committee on Banking Supervision Publication, October 2014).*

"Minimum capital requirements for market risk" (Basel Committee on Banking Supervision Publication, January 2016).*

"Basel III: Finalising post-crisis reforms," (Basel Committee on Banking Supervision Publication, December 2017).*

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* This reading is freely available on the GARP website.

Liquidity and Treasury Risk Measurement and Management

PART II EXAM WEIGHT | 15%

Topics and Readings

This area focuses on methods to measure and manage liquidity and treasury risk. The broad knowledge points covered in the *Liquidity and Treasury Risk Management* section include the following:

- Liquidity risk principles and metrics
- Liquidity portfolio management
- Cash flow modeling, liquidity stress testing, and reporting
- Contingency funding plan
- Funding models
- Funds transfer pricing
- Cross-currency funding
- Balance sheet management
- Asset liquidity

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives, a brief summary of how to relate these readings to the knowledge points follows.

Readings 45, 46, and 47 discuss potential sources of liquidity risk, quantitative liquidity metrics, and institutional liquidity risk management methods. Readings 49, 50, 52, 53, and 54 take this discussion further and present the major components of a holistic liquidity risk management framework, including the development and monitoring of internal liquidity metrics, cash flow modeling, liquidity stress testing, contingency funding planning, managing intraday liquidity, and liquidity risk reporting. Reading 51 addresses liquidity from a dealer bank perspective by explaining potential warning signs that a bank could be failing, potential systemic liquidity risks, and possible policy responses to address these scenarios.

Readings 48, 55, and 60 provide more detail on day-to-day techniques that banks use to manage liquidity and treasury risk, including asset-liability management, liquidity portfolio management, determining funding sources to address liquidity mismatches, and managing deposit accounts and liabilities. Reading 56 explains the market for repurchase agreements.

Transfer pricing, a more technical aspect of liquidity and treasury risk management, is covered in Reading 57. Readings 58 and 59 then provide an international perspective to liquidity risk management by presenting topics such as cross-currency funding and violations of covered interest rate parity.

Finally, Reading 61 addresses liquidity risk from the perspective of an asset manager by providing insights on how to measure and manage the risks of illiquid assets.

Readings for Liquidity and Treasury Risk Measurement and Management

45. **John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).**
    - Chapter 24. Liquidity Risk

46. **Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).**
    - Chapter 12. Liquidity and Leverage

47. **Shyam Venkat, Stephen Baird, *Liquidity Risk Management : A Practitioner's Perspective* (Hoboken, NJ: John Wiley & Sons, 2016).**
    - Chapter 6. Early Warning Indicators

48. **Peter Rose, Sylvia Hudgins, *Bank Management & Financial Services, 9th Edition* (New York, NY: McGraw-Hill, 2013).**
    - Chapter 10. The Investment Function in Financial-Services Management
    - Chapter 11. Liquidity and Reserves Management: Strategies and Policies

49. **Shyam Venkat, Stephen Baird, *Liquidity Risk Management* (Hoboken, NJ: John Wiley & Sons, 2016).**
    - Chapter 4. Intraday Liquidity Risk Management

50. **Antonio Castagna, Francesco Fede, *Measuring and Managing Liquidity Risk* (United Kingdom, John Wiley & Sons, 2013).**
    - Chapter 6. Monitoring Liquidity

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

52. **Shyam Venkat, Stephen Baird, *Liquidity Risk Management* (Hoboken, NJ: John Wiley & Sons, 2016).**
    - Chapter 3. Liquidity Stress Testing

53. **Moorad Choudhry, *The Principles of Banking* (Singapore: John Wiley & Sons, 2012).**
    - Chapter 14. Liquidity Risk Reporting and Stress Testing

54. **Shyam Venkat, Stephen Baird, *Liquidity Risk Management* (Hoboken, NJ: John Wiley & Sons, 2016).**
    - Chapter 7. Contingency Funding Planning

55. **Peter Rose, Sylvia Hudgins, *Bank Management & Financial Services, 9th Edition* (New York, NY: McGraw-Hill, 2013).**
    - Chapter 12. Managing and Pricing Deposit Services
    - Chapter 13. Managing Nondeposit Liabilities

56. **Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).**
    - Chapter 12. Repurchase Agreements and Financing

57. **Joel Grant, 2011. "Liquidity Transfer Pricing: A Guide to Better Practice," Occasional Paper, Financial Stability Board, Bank for International Settlements.**

58. **Patrick McGuire, Goetz von Peter, 2009. "The US Dollar Shortage in Global Banking and the International Policy Response," BIS Working Papers, Bank for International Settlements.**

59. **Claudio Borio, Robert McCauley, Patrick McGuire, Vladyslav Sushko, 2016. "Covered Interest Parity Lost: Understanding the Cross-Currency Basis," BIS Quarterly Review.**

60. **Peter Rose, Sylvia Hudgins, *Bank Management & Financial Services, 9th Edition* (New York, NY: McGraw-Hill, 2013).**
    - Chapter 7. Risk Management for Changing Interest Rates: Asset-Liability Management and Duration Techniques

61. **Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York, NY: Oxford University Press, 2014)**
    - Chapter 13. Illiquid Assets

Risk Management and Investment Management

PART II EXAM WEIGHT | 15%

Topics and Readings

This area focuses on risk management techniques applied to the investment management process. The broad knowledge points covered in *Risk Management and Investment Management* include the following:

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

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 62 introduces the factor theory of investing, in which asset and portfolio returns and risk premiums are explained by their exposure to specific factors. The first chapter describes the theory of factor risk by starting with the basic single-factor risk premium theory — the CAPM — and then examining multifactor models. The second chapter explains factors that drive risk premiums and compares two types of factors: fundamental-based factors and investment-style factors. The third chapter explores how the sets of factors used to construct a benchmark can affect portfolio alpha.

Reading 63 introduces ways to construct an optimal portfolio given investment constraints.

VaR is an important tool in portfolio management, as it explicitly accounts for leverage and portfolio diversification while providing a single measure of portfolio risk. The first chapter of Reading 64 explains how managers can measure and manage portfolio VaR. The second chapter details some benefits of using VaR in investment management and introduces the process of risk budgeting.

As risk capital is a scarce resource, controls should exist to ensure that risk capital is used in a manner consistent with the firm's risk budget. Reading 65 explains how managers can develop a risk plan, provides tools for risk budgeting and introduces guidelines for monitoring portfolio risk.

Standardized measurements are helpful for investors in comparing the performance of asset managers. Reading 66 introduces various measures to evaluate portfolio manager performance.

Hedge funds are private investment vehicles that are not open to the general investing public. Reading 67 gives a general introduction to hedge fund styles, and Reading 68 describes the process of performing due diligence on funds and fund managers.

Finally, Reading 69 analyzes the predictability of investment fraud through US Securities and Exchange Commission (SEC) filings and explains the efficacy of mandatory disclosures in avoiding fraud.

Readings for Risk Management and Investment Management

62. **Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York, NY: Oxford University Press, 2014).**
    - Chapter 6. Factor Theory
    - Chapter 7. Factors
    - Chapter 10. Alpha (and the Low-Risk Anomaly)

63. **Richard Grinold and Ronald Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, 2nd Edition* (New York, NY: McGraw-Hill, 2000).**
    - Chapter 14. Portfolio Construction

64. **Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York, NY: McGraw Hill, 2007).**
    - Chapter 7. Portfolio Risk: Analytical Methods
    - Chapter 17. VaR and Risk Budgeting in Investment Management

65. **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

66. **Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 12th Edition* (New York, NY: McGraw-Hill, 2020).**
    - Chapter 24. Portfolio Performance Evaluation

67. **G. Constantinides, M. Harris and R. Stulz, eds., *Handbook of the Economics of Finance, Volume 2B* (Oxford, UK: Elsevier, 2013).**
    - Chapter 17. Hedge Funds

68. **Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2016).**
    - Chapter 12. Performing Due Diligence on Specific Managers and Funds

69. **Stephen G. Dimmock and William C. Gerken: *Predicting Fraud by Investment Managers* (2012).**

Current Issues in Financial Markets

PART II EXAM WEIGHT | 10%

Topics and Readings

This area focuses on current issues that have a strong impact on financial markets. The broad knowledge points covered in *Current Issues in Financial Markets* include the following:

- Artificial intelligence (AI), machine learning (ML), and big data
- Risk management implications of COVID-19
- Phasing out of LIBOR/reference rates

- Climate risk
- Cyber resiliency in the wider financial system
- Digital currencies

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2022 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows. Readings 70 and 71 discuss the use of AI and ML in risk management. Reading 70 summarizes some core AI/ML techniques and then analyzes the application of these techniques in different risk management fields. Reading 71 discusses risks financial firms face in formulating their AI/ML strategies and the need for appropriate AI/ML governance frameworks.

Readings 72 and 73 address the COVID-19 pandemic as a historic challenge that has had significant impacts in financial markets. Reading 72 discusses the increased exposure of financial firms to cyber risk following the onset of the COVID-19 pandemic. Reading 73 examines the possible channels that caused market stress during the first few months of the pandemic and public sector responses.

The transition from a reference rate regime centered on interbank offered rates (IBORs) to one based on a new set of overnight risk-free rates (RFRs) is an important paradigm shift for markets. Reading 74 examines risks to market fairness and effectiveness that may arise during the transition from a LIBOR reference rate regime to a risk-free rate regime and considers how market participants might address these risks. Reading 75 provides an overview of RFR benchmarks and compares some of their key characteristics with those of existing benchmarks.

The projected increase in the frequency and severity of disasters due to climate change is a potential threat to financial stability. Reading 76 explores how climate-related financial risks can arise and impact banks individually and the banking system as a whole.

Cyber attacks pose a significant threat to financial systems. Reading 72 discusses the increased exposure of financial firms to cyber risk following the onset of the COVID-19 pandemic.

Reading 77 explores how the banking sector could be altered by the adoption of digital money, while discussing the benefits and risks of an acceleration in e-money adoption.

Readings for Current Issues in Financial Markets

70. **Aziz, Saqib and Dowling, Michael M., "AI and Machine Learning for Risk Management," (July 14, 2018). Published as: Aziz, S. and M. Dowling (2019). "Machine Learning and AI for Risk Management", in T. Lynn, G. Mooney, P. Rosati, and M. Cummins (eds.), Disrupting Finance: FinTech and Strategy in the 21st Century, Palgrave, 2019), (pages 33-50 only).**

71. **"Artificial Intelligence Risk & Governance," Artificial Intelligence/Machine Learning Risk & Security Working Group (AIRS).**

72. **"Covid-19 and cyber risk in the financial sector," BIS Bulletin No 37, January 2021.[†]**

73. **"Holistic Review of the March Market Turmoil," Chapters 1-4, FSB, November 17, 2020.**

74. **"LIBOR transition Case studies for navigating conduct risks," FMSB, June 2020.**

75. **Schrimpf and Sushko, "Beyond LIBOR: a primer on the new benchmark rates," (BIS Quarterly Review, March 5, 2019).**

76. **"Climate-related risk drivers and their transmission channels," BIS, April 2021.**

77. **Tobias Adrian and Tommaso Mancini-Griffoli, *"The Rise of digital money,"* IMF, July 2019**

[†] The reading covers two topic areas – "Risk management implications of COVID-19" and "Cyber resiliency in the wider financial system".

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