2024

FRM® LEARNING OBJECTIVES

GARP®

FRM® | Financial Risk Manager

CONTENTS

2 FRM Learning Objectives Part I
3 Foundations of Risk Management
7 Quantitative Analysis
12 Financial Markets and Products
19 Valuation and Risk Models

25 FRM Learning Objectives Part II
26 Market Risk Measurement and Management
31 Credit Risk Measurement and Management
40 Operational Risk and Resilience
47 Liquidity and Treasury Risk Measurement and Management
52 Risk Management and Investment Management
56 Current Issues in Financial Markets

FRM
LEARNING OBJECTIVES
PART I

FOUNDATIONS OF RISK MANAGEMENT

QUANTITATIVE ANALYSIS

FINANCIAL MARKETS AND PRODUCTS

VALUATION AND RISK MODELS

FOUNDATIONS OF RISK MANAGEMENT

PART I EXAM WEIGHT | 20% (FRM)

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
- Enterprise risk management (ERM)

The readings that you should focus on for this section and the specific learning objectives to achieve with each reading are as follows.

Global Association of Risk Professionals. *Foundations of Risk Management*. New York, NY: Pearson, 2022.

Chapter 1. The Building Blocks of Risk Management [FRM–1]

After completing this reading, you should be able to:

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

Chapter 2. How Do Firms Manage Financial Risk? [FRM–2]

After completing this reading, you should be able to:

- Compare different strategies that a firm can use to manage its risk exposures and explain situations in which a firm would want to use each strategy.
- Explain the relationship between risk appetite and a firm's risk management decisions.
- Evaluate some advantages and disadvantages of hedging risk exposures and explain challenges that can arise when implementing a hedging strategy.
- Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.
- Assess the impact of risk management tools and instruments, including risk limits and derivatives.

Chapter 3. The Governance of Risk Management [FRM–3]

After completing this reading, you should be able to:

- Explain changes in regulations and corporate risk governance that occurred as a result of the 2007-2009 financial crisis.
- Describe best practices for the governance of a firm's risk management processes.
- Explain the risk management role and responsibilities of a firm's board of directors.
- Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
- 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.

Chapter 4. Credit Risk Transfer Mechanisms [FRM–4]

After completing this reading, you should be able to:

- Compare different types of credit derivatives, explain their applications, and describe their advantages.
- Explain different traditional approaches or mechanisms that firms can use to help mitigate credit risk.
- Evaluate the role of credit derivatives in the 2007-2009 financial crisis and explain changes in the credit derivative market that occurred as a result of the crisis.
- Explain the process of securitization, describe a special purpose vehicle (SPV), and assess the risk of different business models that banks can use for securitized products.

Chapter 5. Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM) [FRM–5]

After completing this reading, you should be able to:

- Explain Modern Portfolio Theory and interpret the Markowitz efficient frontier.
- Understand the derivation and components of the CAPM.
- Describe the assumptions underlying the CAPM.
- Interpret and compare the capital market line and the security 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.
- Calculate, compare, and interpret the following performance measures: the Sharpe performance index, the Treynor performance index, the Jensen performance index, the tracking error, information ratio, and Sortino ratio.

Chapter 6. The Arbitrage Pricing Theory and Multifactor Models of Risk and Return [FRM–6]

After completing this reading, you should be able to:

- Explain the Arbitrage Pricing Theory (APT), describe its assumptions, and compare the APT to the CAPM.
- Describe the inputs, including factor betas, to a multifactor model and explain the challenges of using multifactor models in hedging.
- Calculate the expected return of an asset using a single-factor and a multifactor model.
- Explain how to construct a portfolio to hedge exposure to multiple factors.
- Describe and apply the Fama-French three-factor model in estimating asset returns.

Chapter 7. Principles for Effective Data Aggregation and Risk Reporting [FRM–7]

After completing this reading, you should be able to:

- Explain the potential benefits of having effective risk data aggregation and reporting.
- Explain challenges to the implementation of a strong risk data aggregation and reporting process and the potential impacts of using poor-quality data.
- Describe key governance principles related to risk data aggregation and risk reporting.
- Describe characteristics of effective data architecture, IT infrastructure, and risk-reporting practices.

Chapter 8. Enterprise Risk Management and Future Trends [FRM–8]

After completing this reading, you should be able to:

- Describe Enterprise Risk Management (ERM) and compare an ERM program with a traditional silo-based risk management program.
- Describe the motivations for a firm to adopt an ERM initiative.
- Explain best practices for the governance and implementation of an ERM program.
- Describe risk culture, explain the characteristics of a strong corporate risk culture, and describe challenges to the establishment of a strong risk culture at a firm.
- Explain the role of scenario analysis in the implementation of an ERM program and describe its advantages and disadvantages.
- Explain the use of scenario analysis in stress testing programs and capital planning.

Chapter 9. Learning from Financial Disasters [FRM–9]

After completing this reading, you should be able to:

- Analyze the following factors that contributed to the given case studies of financial disasters and examine the key lessons learned from these case studies:
  - Interest rate risk, including the 1980s savings and loan crisis in the US.
  - Funding liquidity risk, including Lehman Brothers, Continental Illinois, and Northern Rock.
  - Constructing and implementing a hedging strategy, including the Metallgesellschaft case.
  - Model risk, including the Niederhoffer case, Long Term Capital Management, and the London Whale case.
  - Rogue trading and misleading reporting, including the Barings case.
  - Financial engineering, including Bankers Trust, the Orange County case, and Sachsen Landesbank.
  - Reputation risk, including the Volkswagen case.
  - Corporate governance, including the Enron case.
  - Cyber risk, including the SWIFT case.

Chapter 10. Anatomy of the Great Financial Crisis of 2007-2009 [FRM–10]

After completing this reading, you should be able to:

- Describe the historical background and provide an overview of the 2007-2009 financial crisis.
- Describe the build-up to the financial crisis and the factors that played an important role.
- Explain the role of subprime mortgages and collateralized debt obligations (CDOs) in the crisis.
- Compare the roles of different types of institutions in the financial crisis, including banks, financial intermediaries, mortgage brokers and lenders, and rating agencies.
- Describe trends in the short-term wholesale funding markets that contributed to the financial crisis, including their impact on systemic risk.
- Describe responses made by central banks in response to the crisis.

Chapter 11. GARP Code of Conduct* [FRM–11]

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.

* This reading is freely available on the GARP website.

QUANTITATIVE ANALYSIS

PART I EXAM WEIGHT | 20% (QA)

This area focuses on 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
- Machine learning

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

Global Association of Risk Professionals. *Quantitative Analysis*. New York, NY: Pearson, 2022.

Chapter 1: Fundamentals of Probability [QA–1]

After completing this reading, you should be able to:

- Describe an event and an event space.
- Describe independent events and mutually exclusive events.
- Explain the difference between independent events and conditionally independent events.
- Calculate the probability of an event for a discrete probability function.
- Define and calculate a conditional probability.
- Distinguish between conditional and unconditional probabilities.
- Explain and apply Bayes' rule.

Chapter 2: Random Variables [QA–2]

After completing this reading, you should be able to:

- Describe and distinguish a probability mass function from a cumulative distribution function and explain the relationship between these two.
- Understand and apply the concept of a mathematical expectation of a random variable.
- Describe the four common population moments.
- Explain the differences between a probability mass function and a probability density function.

- Characterize the quantile function and quantile-based estimators.
- Explain the effect of a linear transformation of a random variable on the mean, variance, standard deviation, skewness, kurtosis, median, and interquartile range.

Chapter 3: Common Univariate Random Variables [QA–3]

After completing this reading, you should be able to:

- Distinguish the key properties and identify the common occurrences of the following distributions: uniform distribution, Bernoulli distribution, binomial distribution, Poisson distribution, normal distribution, lognormal distribution, Chi-squared distribution, Student's t- and F-distributions.
- Describe a mixture distribution and explain the creation and characteristics of mixture distributions.

Chapter 4: Multivariate Random Variables [QA–4]

After completing this reading, you should be able to:

- Explain how a probability matrix can be used to express a probability mass function.
- Compute the marginal and conditional distributions of a discrete bivariate random variable.
- Explain how the expectation of a function is computed for a bivariate discrete random variable.
- Define covariance and explain what it measures.
- Explain the relationship between the covariance and correlation of two random variables, and how these are related to the independence of the two variables.
- Explain the effects of applying linear transformations on the covariance and correlation between two random variables.
- Compute the variance of a weighted sum of two random variables.
- Compute the conditional expectation of a component of a bivariate random variable.
- Describe the features of an independent and identically distributed (iid) sequence of random variables.
- Explain how the iid property is helpful in computing the mean and variance of a sum of iid random variables.

Chapter 5: Sample Moments [QA–5]

After completing this reading, you should be able to:

- Estimate the mean, variance, and standard deviation using sample data.
- Explain the difference between a population moment and a sample moment.
- Distinguish between an estimator and an estimate.
- Describe the bias of an estimator and explain what the bias measures.
- Explain what is meant by the statement that the mean estimator is BLUE.
- Describe the consistency of an estimator and explain the usefulness of this concept.
- Explain how the Law of Large Numbers (LLN) and Central Limit Theorem (CLT) apply to the sample mean.
- Estimate and interpret the skewness and kurtosis of a random variable.
- Use sample data to estimate quantiles, including the median.
- Estimate the mean of two variables and apply the CLT.
- Estimate the covariance and correlation between two random variables.
- Explain how coskewness and cokurtosis are related to skewness and kurtosis.

Chapter 6: Hypothesis Testing [QA–6]

After completing this reading, you should be able to:

- Construct an appropriate null hypothesis and alternative hypothesis and distinguish between the two.
- Differentiate between a one-sided and a two-sided test and identify when to use each test.
- Explain the difference between Type I and Type II errors and how these relate to the size and power of a test.

- Understand how a hypothesis test and a confidence interval are related.
- Explain what the p-value of a hypothesis test measures.
- Construct and apply confidence intervals for one-sided and two-sided hypothesis tests and interpret the results of hypothesis tests with a specific confidence level.
- Identify the steps to test a hypothesis about the difference between two population means.
- Explain the problem of multiple testing and how it can lead to biased results.

Chapter 7: Linear Regression [QA–7]

After completing this reading, you should be able to:

- Describe the models which can be estimated using linear regression and differentiate them from those which cannot.
- Interpret the results of an ordinary least squares (OLS) regression with a single explanatory variable.
- Describe the key assumptions of OLS parameter estimation.
- Characterize the properties of OLS estimators and their sampling distributions.
- Construct, apply, and interpret hypothesis tests and confidence intervals for a single regression coefficient in a regression.
- Explain the steps needed to perform a hypothesis test in a linear regression.
- Describe the relationship among a t-statistic, its p-value, and a confidence interval.
- Estimate the correlation coefficient from the R2 measure obtained in linear regressions with a single explanatory variable.

Chapter 8: Regression with Multiple Explanatory Variables [QA–8]

After completing this reading, you should be able to:

- Distinguish between the relative assumptions of single and multiple regression.
- Interpret regression coefficients in a multiple regression.
- Interpret goodness-of-fit measures for single and multiple regressions, including R2 and adjusted-R2.
- Construct, apply, and interpret joint hypothesis tests and confidence intervals for multiple coefficients in a regression.
- Calculate the regression R2 using the three components of the decomposed variation of the dependent variable data: the explained sum of squares, the total sum of squares, and the residual sum of squares.

Chapter 9: Regression Diagnostics [QA–9]

After completing this reading, you should be able to:

- Explain how to test whether a regression is affected by heteroskedasticity.
- Describe approaches to using heteroskedastic data.
- Characterize multicollinearity and its consequences, as well as distinguish between multicollinearity and perfect collinearity.
- Describe the consequences of excluding a relevant explanatory variable from a model and contrast those with the consequences of including an irrelevant regressor.
- Explain two model selection procedures and how these relate to the bias-variance trade-off.
- Describe the various methods of visualizing residuals and their relative strengths.
- Describe methods for identifying outliers and their impact.
- Determine the conditions under which OLS is the best linear unbiased estimator.

Chapter 10: Stationary Time Series [QA–10]

After completing this reading, you should be able to:

- Describe the requirements for a series to be covariance stationary.
- Define the autocovariance function and the autocorrelation function.
- Define white noise and describe independent white noise and normal (Gaussian) white noise.

- Define and describe the properties of autoregressive (AR) processes.
- Define and describe the properties of moving average (MA) processes.
- Explain how a lag operator works.
- Explain mean reversion and calculate a mean-reverting level.
- Define and describe the properties of autoregressive moving average (ARMA) processes.
- Describe the application of AR, MA, and ARMA processes.
- Describe sample autocorrelation and partial autocorrelation.
- Describe the Box-Pierce Q statistic and the Ljung-Box Q statistic.
- Explain how forecasts are generated from ARMA models.
- Describe the role of mean reversion in long-horizon forecasts.
- Explain how seasonality is modeled in a covariance-stationary ARMA.

Chapter 11: Non-Stationary Time Series [QA–11]

After completing this reading, you should be able to:

- Describe linear and nonlinear time trends.
- Explain how to use regression analysis to model seasonality.
- Describe a random walk and a unit root.
- Explain the challenges of modeling time series containing unit roots.
- Describe how to test if a time series contains a unit root.
- Explain how to construct an h-step-ahead point forecast for a time series with seasonality.
- Calculate the estimated trend value and form an interval forecast for a time series.

Chapter 12: Measuring Returns, Volatility, and Correlation [QA–12]

After completing this reading, you should be able to:

- Calculate, distinguish, and convert between simple and continuously compounded returns.
- Define and distinguish between volatility, variance rate, and implied volatility.
- Describe how the first two moments may be insufficient to describe non-normal distributions.
- Explain how the Jarque-Bera test is used to determine whether returns are normally distributed.
- Describe the power law and its use for non-normal distributions.
- Define correlation and covariance and differentiate between correlation and dependence.
- Describe properties of correlations between normally distributed variables when using a one-factor model.
- Compare and contrast the different measures of correlation used to assess dependence.

Chapter 13: Simulation and Bootstrapping [QA–13]

After completing this reading, you should be able to:

- Describe the basic steps to conduct a Monte Carlo simulation.
- Describe ways to reduce Monte Carlo sampling error.
- Explain the use of antithetic and control variates in reducing Monte Carlo sampling error.
- Describe the bootstrapping method and its advantage over Monte Carlo simulation.
- Describe pseudo-random number generation.
- Describe situations where the bootstrapping method is ineffective.
- Describe the disadvantages of the simulation approach to financial problem solving.

Chapter 14: Machine Learning Methods [QA–14]

After completing this reading, you should be able to:

- Discuss the philosophical and practical differences between machine learning techniques and classical econometrics.
- Compare and apply the two methods utilized for rescaling variables in data preparation.
- Explain the differences among the training, validation, and test data sub-samples, and how each is used.
- Understand the differences between and consequences of underfitting and overfitting, andpropose potential remedies for each.
- Use principal components analysis to reduce the dimensionality of a set of features.
- Describe how the K-means algorithm separates a sample into clusters.
- Describe natural language processing and how it is used.
- Differentiate among unsupervised, supervised, and reinforcement learning models.
- Explain how reinforcement learning operates and how it is used in decision-making.

Chapter 15: Machine Learning and Prediction [QA–15]

After completing this reading, you should be able to:

- Explain the role of linear regression and logistic regression in prediction.
- Evaluate the predictive performance of logistic regression models.
- Understand how to encode categorical variables.
- Discuss why regularization is useful, and distinguish between the ridge regression and LASSO approaches.
- Show how a decision tree is constructed and interpreted.
- Describe how ensembles of learners are built.
- Explain the intuition and processes behind the K nearest neighbors and support vector machine methods for classification.
- Understand how neural networks are constructed and how their weights are determined.
- Compare the logistic regression and neural network classification approaches using a confusion matrix.

FINANCIAL MARKETS AND PRODUCTS

PART I EXAM WEIGHT | 30% (FMP)

This area focuses on financial products and the markets in which they trade, more specifically, the following knowledge areas:

- Structures and functions of financial institutions
- Structure 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

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

Global Association of Risk Professionals. *Financial Markets and Products*. New York, NY: Pearson, 2022.

Chapter 1. Banks [FMP–1]

After completing this reading, you should be able to:

- Identify the major risks faced by banks and explain how these risks can arise.
- Distinguish between economic capital and regulatory capital.
- Summarize the Basel committee regulations for regulatory capital and their motivations.
- Explain how deposit insurance gives rise to a moral hazard problem.
- Describe investment banking financing arrangements, including private placement, public offering, best efforts, firm commitment, and Dutch auction approaches.
- Describe the potential conflicts of interest among commercial banking, securities services, and investment banking divisions of a bank, and recommend solutions to these conflict of interest problems.
- Describe the distinctions between the banking book and the trading book of a bank.
- Explain the originate-to-distribute banking model and discuss its benefits and drawbacks.

Chapter 2. Insurance Companies and Pension Plans [FMP–2]

After completing this reading, you should be able to:

- Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies.
- Describe the use of mortality tables and calculate the premium payments for a policy holder.
- Distinguish between mortality risk and longevity risk and describe how to hedge these risks.
- Describe defined benefit plans and defined contribution plans and explain the differences between them.
- Compare the various types of life insurance policies.

- Calculate and interpret loss ratio, expense ratio, combined ratio, and operating ratio for a property-casualty insurance company.
- Describe moral hazard and adverse selection risks facing insurance companies, provide examples of each, and describe how to overcome these risks.
- Evaluate the capital requirements for life insurance and property-casualty insurance companies.
- Compare the guaranty system and the regulatory requirements for insurance companies with those for banks.

Chapter 3. Fund Management [FMP–3]

After completing this reading, you should be able to:

- Differentiate among open-end mutual funds, closed-end mutual funds, and exchange-traded funds (ETFs).
- Identify and describe potential undesirable trading behaviors at mutual funds.
- Explain the concept of net asset value (NAV) of an open-end mutual fund and how it relates to share price.
- Explain the key differences between hedge funds and mutual funds.
- Calculate the return on a hedge fund investment and explain the incentive fee structure of a hedge fund including the terms hurdle rate, high-water mark, and clawback.
- Describe various hedge fund strategies including long-short equity, dedicated short, distressed securities, merger arbitrage, convertible arbitrage, fixed income arbitrage, emerging markets, global macro, and managed futures, and identify the risks faced by hedge funds.
- Describe characteristics of mutual fund and hedge fund performance and explain the effect of measurement biases on performance measurement.

Chapter 4. Introduction to Derivatives [FMP–4]

After completing this reading, you should be able to:

- Define derivatives, describe the features and uses of derivatives, and compare linear and non-linear derivatives.
- Describe the specifics of exchange-traded and over-the-counter markets, and evaluate the advantages and disadvantages of each.
- Differentiate between options, forwards, and futures contracts.
- Identify and calculate option and forward contract payoffs.
- Differentiate among the broad categories of traders: hedgers, speculators, and arbitrageurs.
- 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.
- Describe arbitrageurs' strategy and calculate an arbitrage payoff.
- Describe some of the risks that can arise from the use of derivatives.

Chapter 5. Exchanges and OTC Markets [FMP–5]

After completing this reading, you should be able to:

- Describe how exchanges can be used to alleviate counterparty risk.
- Explain the developments in clearing that reduce risk.
- Define netting and describe a netting process.
- Describe the implementation of a margining process, explain the determinants of and calculate initial and variation margin requirements.
- Describe the process of buying stock on margin without using CCP and calculate margin requirements.
- Compare exchange-traded and OTC markets and describe their uses.
- Identify risks associated with OTC markets and explain how these risks can be mitigated.
- Describe the role of collateralization in the OTC market and compare it to the margining system.
- Explain the use of special purpose vehicles (SPVs) in the OTC derivatives market.

Chapter 6. Central Clearing [FMP–6]

After completing this reading, you should be able to:

- Provide examples of the mechanics of a central counterparty (CCP).
- Describe the role of CCPs and distinguish between bilateral and centralized clearing.
- Describe advantages and disadvantages of central clearing of OTC derivatives.
- Explain regulatory initiatives for the OTC derivatives market and their impact on central clearing.
- Compare margin requirements in centrally cleared and bilateral markets and explain how margin can mitigate risk.
- Compare netting in bilateral markets vs centrally cleared markets.
- Assess the impact of central clearing on the broader financial markets.
- Identify and explain the types of risks faced by CCPs.
- Identify and distinguish between the risks to clearing members and to non-members.

Chapter 7. Futures Markets [FMP–7]

After completing this reading, you should be able to:

- Define and describe the key features and specifications of a futures contract, including the underlying asset, the contract price and size, trading volume, open interest, delivery, and limits.
- Explain the convergence of futures and spot prices.
- Describe the role of an exchange in futures transactions.
- Explain the differences between a normal and an inverted futures market.
- Describe the mechanics of the delivery process and contrast it with cash settlement.
- Describe and compare different trading order types.
- Describe the application of marking to market and hedge accounting for futures.
- Compare and contrast forward and futures contracts.

Chapter 8. Using Futures for Hedging [FMP–8]

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 and calculate the basis, discuss various sources of basis risk, and explain how basis risks arise when hedging with futures.
- Define cross hedging and compute and interpret the hedge ratio and hedge effectiveness.
- Calculate the profit and loss on a short or a long hedge.
- 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 how to create a long-term hedge using a stack-and-roll strategy and describe some of the risks that arise from this strategy.

Chapter 9. Foreign Exchange Markets [FMP–9]

After completing this reading, you should be able to:

- Explain and describe the mechanics of spot quotes, forward quotes, and futures quotes in the foreign exchange markets distinguish between bid and ask exchange rates.
- Calculate a bid-ask spread and explain why the bid-ask spread for spot quotes may be different from the bid-ask spread for forward quotes.
- Compare outright (forward) and swap transactions.

- Define, compare, and contrast transaction risk, translation risk, and economic risk.
- Describe examples of transaction, translation, and economic risks and explain how to hedge these risks.
- Describe the rationale for multi-currency hedging using options.
- Identify and explain the factors that determine exchange rates.
- Calculate and explain the effect of an appreciation/depreciation of one currency relative to another.
- Explain the purchasing power parity theorem and use this theorem to calculate the appreciation or depreciation of a foreign currency.
- Describe the relationship between nominal and real interest rates.
- 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.
- Distinguish between covered and uncovered interest rate parity conditions.

Chapter 10. Pricing Financial Forwards and Futures [FMP–10]

After completing this reading, you should be able to:

- Define and describe financial 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.
- Distinguish between the forward price and the value of a forward contract.
- Calculate the value of a forward contract on a financial asset that does or does not provide income or yield.
- Explain the relationship between forward and futures prices.
- Calculate the value of a stock index futures contract and explain the concept of index arbitrage.

Chapter 11. Commodity Forwards and Futures [FMP–11]

After completing this reading, you should be able to:

- Explain the key differences between commodities and financial assets.
- Define and apply commodity concepts such as storage costs, carry markets, lease rate, and convenience yield.
- Identify factors that impact prices on agricultural commodities, metals, energy, and weather derivatives.
- Explain the 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.
- Describe the cost of carry model and determine 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.
- 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.
- Explain the impact of systematic and nonsystematic risk on current futures prices and expected future spot prices.
- Define and interpret normal backwardation and contango.

Chapter 12. Options Markets [FMP–12]

After completing this reading, you should be able to:

- Describe the various types and uses of options, define moneyness.
- Explain the payoff function and calculate the profit and loss from an options position.
- Explain how dividends and stock splits can impact the terms of a stock option.

- Describe the application of commissions, margin requirements, and exercise procedures to exchange-traded options, and explain the trading characteristics of these options.
- Define and describe warrants, convertible bonds, and employee stock options.

Chapter 13. Properties of Options [FMP–13]

After completing this reading, you should be able to:

- Identify the six factors that affect an option's price.
- 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, with dividends and without dividends, and express it in terms of forward prices.
- Explain and assess potential rationales for using the early exercise features of American call and put options.

Chapter 14. Trading Strategies [FMP–14]

After completing this reading, you should be able to:

- Explain the motivation to initiate a covered call or a protective put strategy.
- Describe principal protected notes (PPNs) and explain necessary conditions to create them.
- Describe the use and calculate the payoffs of various spread strategies.
- Describe the use and explain the payoff functions of combination strategies.

Chapter 15. Exotic Options [FMP–15]

After completing this reading, you should be able to:

- Define and contrast exotic derivatives and plain vanilla derivatives.
- Describe some of the reasons that drive the development of exotic derivative 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 payoff structures of the following exotic options: gap, forward start, compound, chooser, barrier, binary, lookback, Asian, exchange, and basket options.
- Describe and contrast volatility swaps and variance swaps.
- Explain the basic premise of static option replication and how it can be applied to hedging exotic options.

Chapter 16. Properties of Interest Rates [FMP–16]

After completing this reading, you should be able to:

- Describe Treasury rates, LIBOR, Secured Overnight Financing Rate (SOFR), 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.
- Calculate the Macaulay 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.
- Derive forward interest rates from a set of spot rates.
- Derive the value of the cash flows from a forward rate agreement (FRA).
- Calculate zero-coupon rates using the bootstrap method.
- Compare and contrast the major theories of the term structure of interest rates.

Chapter 17. Corporate Bonds [FMP–17]

After completing this reading, you should be able to:

- Describe features of bond trading and explain the behavior of bond yields.
- Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.
- Define high-yield bonds and describe types of high-yield bond issuers and some of the payment features unique to high-yield bonds.
- Differentiate between credit default risk and credit spread risk.
- Describe event risk and explain what may cause it to manifest in corporate bonds.
- Describe different characteristics of bonds such as issuer, maturity, interest rate, and collateral.
- Describe the mechanisms by which corporate bonds can be retired before maturity.
- Define recovery rate and default rate, and differentiate between an issue default rate and a dollar default rate.
- Evaluate the expected return from a bond investment and identify the components of the bond's expected return.

Chapter 18. 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.
- Summarize the securitization process of mortgage-backed securities (MBS), particularly the formation of mortgage pools, including specific pools and to-be-announced (TBAs).
- Calculate the weighted average coupon, weighted average maturity, single monthly mortality rate (SMM), and conditional prepayment rate (CPR) for a mortgage pool.
- Describe the process of trading pass-through agency MBS.
- Explain the mechanics of different types of agency MBS products, including collateralized mortgage obligations (CMOs), interest-only securities (IOs), and principal-only securities (POs).
- Describe a dollar roll transaction and how to value a dollar roll.
- Describe the mortgage prepayment option and factors that affect it; 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 uses and challenges.

Chapter 19. Interest Rate Futures [FMP–19]

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 U.S. Treasury bill.
- Differentiate between the clean and dirty price for a U.S. Treasury bond; calculate the accrued interest and dirty price on a U.S. Treasury bond.
- Explain and calculate a U.S. 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 and compare Eurodollar futures to FRAs.
- Describe and compute the Eurodollar futures contract convexity adjustment.
- 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 20. Swaps [FMP–20]

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 FRAs.
- 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 forward exchange rates.
- Identify and describe other types of swaps, including commodity, volatility, credit default, and exotic swaps.
- Describe the credit risk exposure in a swap position.

VALUATION AND RISK MODELS

PART I EXAM WEIGHT | 30% (VRM)

This area focuses on 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

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

Global Association of Risk Professionals. *Valuation and Risk Models*. New York, NY: Pearson, 2022.

Chapter 1. Measures of Financial Risk [VRM–1]

After completing this reading, you should be able to:

- Describe the mean-variance framework and the efficient frontier.
- Compare the normal distribution with the typical distribution of returns of risky financial assets such as equities.
- Define the VaR measure of risk, describe assumptions about return distributions and holding periods, and explain the limitations of VaR.
- Explain and calculate ES and compare and contrast VaR and ES.
- Define the properties of a coherent risk measure and explain the meaning of each property.
- Explain why VaR is not a coherent risk measure.

Chapter 2. Calculating and Applying VaR [VRM–2]

After completing this reading, you should be able to:

- Explain and give examples of linear and non-linear portfolios.
- Describe and explain the historical simulation approach for computing VaR and ES.
- Describe the delta-normal approach and use it to calculate VaR for non-linear derivatives.
- Describe and calculate VaR for linear derivatives.

- Describe the limitations of the delta-normal method.
- Explain the Monte Carlo simulation method for computing VaR and ES and identify its strengths and weaknesses.
- Describe the implications of correlation breakdown for a VaR or ES analysis.
- Describe worst-case scenario analysis and compare it to VaR.

Chapter 3. Measuring and Monitoring Volatility [VRM–3]

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 and describe regime switching.
- Compare and contrast different approaches for estimating conditional volatility.
- Apply the exponentially weighted moving average (EWMA) approach to estimate volatility, and describe alternative approaches to weighting historical return data.
- Apply the GARCH (1,1) model to estimate volatility.
- Explain and apply approaches to estimate long horizon volatility/VaR and describe the process of mean reversion according to a GARCH (1,1) model.
- Evaluate implied volatility as a predictor of future volatility and its shortcomings.
- Describe an example of updating correlation estimates.

Chapter 4. External and Internal Credit Ratings [VRM–4]

After completing this reading, you should be able to:

- Describe external rating scales, the rating process, and the link between ratings and default.
- Define conditional and unconditional default probabilities and explain the distinction between the two.
- Define hazard rate and use it to calculate the unconditional default probability of a credit asset.
- Define recovery rate and calculate the expected loss from a loan.
- Explain and compare the through-the-cycle and point-in-time ratings approaches.
- Describe alternative methods to credit ratings produced by rating agencies.
- Compare external and internal ratings approaches.
- Describe and interpret a rating transition matrix and explain its uses.
- Describe the relationships between changes in credit ratings and changes in stock prices, bond prices, and credit default swap spreads.
- Explain historical failures and potential challenges to the use of credit ratings in making investment decisions.

Chapter 5. Country Risk: Determinants, Measures, and Implications [VRM–5]

After completing this reading, you should be able to:

- Explain how a country's economic growth rates, political risk, legal risk, and economic structure relate to its risk exposure.
- Evaluate composite measures of risk that incorporate multiple components of country risk.
- Compare instances of sovereign default in both foreign currency debt and local currency debt and explain common causes of sovereign defaults.
- Describe the consequences of sovereign default.
- Describe factors that influence the level of sovereign default risk; explain and assess how rating agencies measure sovereign default risks.
- Describe the characteristics of sovereign credit spreads and sovereign credit default swaps (CDS) and compare the use of sovereign spreads to credit ratings.

Chapter 6. Measuring Credit Risk [VRM–6]

After completing this reading, you should be able to:

- Explain the distinctions between economic capital and regulatory capital and describe how economic capital is derived.
- Describe the degree of dependence typically observed among the loan defaults in a bank's loan portfolio, and explain the implications for the portfolio's default rate.
- Define and calculate expected loss (EL).
- Define and explain unexpected loss (UL).
- Estimate the mean and standard deviation of credit losses assuming a binomial distribution.
- Describe the Gaussian copula model and its application.
- Describe and apply the Vasicek model to estimate default rate and credit risk capital for a bank.
- Describe the CreditMetrics model and explain how it is applied in estimating economic capital.
- Describe and use Euler's theorem to determine the contribution of a loan to the overall risk of a portfolio.
- Explain why it is more difficult to calculate credit risk capital for derivatives than for loans.
- Describe challenges to quantifying credit risk.

Chapter 7. Operational Risk [VRM–7]

After completing this reading, you should be able to:

- Describe the different categories of operational risk and explain how each type of risk can arise.
- Compare the basic indicator approach, the standardized approach, and the advanced measurement approach for calculating operational risk regulatory capital.
- Describe the standardized measurement approach and explain the reasons for its introduction by the Basel Committee.
- Explain how a loss distribution is derived from an appropriate loss frequency distribution and loss severity distribution using Monte Carlo simulation.
- 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 are scarce.
- Describe how to identify causal relationships and how to use Risk and Control Self-Assessment (RCSA), Key Risk Indicators (KRIs), and education to understand and manage operational risks.
- Describe the allocation of operational risk capital to business units.
- Explain how to use the power law to measure operational risk.
- Explain how the moral hazard and adverse selection problems faced by insurance companies relate to insurance against operational risk.

Chapter 8. Stress Testing [VRM–8]

After completing this reading, you should be able to:

- Describe the rationale for the use of stress testing as a risk management tool.
- Describe the relationship between stress testing and other risk measures, particularly in enterprise-wide stress testing.
- Describe stressed VaR and stressed ES, including their advantages and disadvantages, and compare the process of determining stressed VaR and ES to that of traditional VaR and ES.
- Explain key considerations and challenges related to developing stress testing scenarios and building stress testing models.
- Describe reverse stress testing and describe an example of regulatory stress testing.
- Describe the responsibilities of the board of directors, senior management, and the internal audit function in stress testing governance.
- Describe the role of policies and procedures, validation, and independent review in stress testing governance.
- Describe the Basel stress testing principles for banks regarding the implementation of stress testing.

Chapter 9. Pricing Conventions, Discounting, 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 arbitrage opportunities for fixed-income securities with certain cash flows.
- Identify the components of a U.S. Treasury coupon bond and compare 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.
- 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 to compute interest on a fixed-income security.

Chapter 10. Interest 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.
- Define spot rate and compute discount factors given spot rates.
- Interpret the forward rate and compute forward rates given spot rates.
- Define par rate and describe how to determine the par rate of a bond.
- Interpret the relationship between spot, forward, and par rates.
- Assess the impact of a change in time to maturity on the price of a bond.
- Define the "flattening" and "steepening" of rate curves and describe a trade to reflect expectations that a curve will flatten or steepen.
- Describe a swap transaction and explain how a swap market defines par rates.

Chapter 11. Bond Yields and Return Calculations [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.
- Explain how to compute a bond's YTM given its 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 the profit and loss (P&L) for a bond position or portfolio into separate factors including carry roll-down, rate change, and spread change effects.
- Describe the common assumptions made about interest rates when calculating carry roll-down, and calculate carry roll-down under these assumptions.

Chapter 12. Applying Duration, Convexity, and DV01 [VRM–12]

After completing this reading, you should be able to:

- Describe a one-factor interest rate model and identify common examples of interest rate factors.
- Define and compute the DV01 of a fixed-income security given a change in rates and the resulting change in price.

- Calculate the face amount of bonds required to hedge an interest rate-sensitive position given the DV01 of each.
- Define, compute, and interpret the effective duration of a fixed-income security given a change in rates 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 rates and the resulting change in price.
- Calculate the DV01, duration, and convexity of a portfolio of fixed-income securities.
- Explain the hedging of a position based on effective duration and convexity.
- Construct a barbell portfolio to match the cost and duration of a given bullet investment and explain the advantages and disadvantages of bullet and barbell portfolios.

Chapter 13. Modeling Non-Parallel Term Structure Shifts and Hedging [VRM–13]

After completing this reading, you should be able to:

- Describe principal components analysis and explain its use in understanding term structure movements.
- Describe key rate shift analysis and define key rate 01 (KR01).
- Calculate the KR01s of a portfolio given a set of key rates.
- Compute the positions in hedging instruments necessary to hedge the key rate risks of a portfolio.
- Apply key rate analysis and principal components analysis to estimating portfolio volatility.
- Describe an interest rate bucketing approach, define forward bucket 01, and compare forward bucket 01s to KR01s.
- Calculate the corresponding duration measure given a KR01 or forward bucket 01.

Chapter 14. Binomial Trees [VRM–14]

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.
- Define and calculate delta of a stock option.
- 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–15]

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 on a non-dividend-paying stock using the Black-Scholes-Merton model.
- Define implied volatilities and describe how to compute implied volatilities from market prices of options using the Black-Scholes-Merton model.
- Explain how dividends affect the decision to exercise early for American call and put options.
- Compute the value of a European option on a dividend-paying stock, futures, or foreign currency using the Black-Scholes-Merton model.
- Describe warrants, calculate the value of a warrant, and calculate the dilution cost of the warrant to existing shareholders.

Chapter 16. Option Sensitivity Measures: The "Greeks" [VRM–16]

After completing this reading, you should be able to:

- Describe and assess the risks associated with naked and covered option positions.
- Describe the use of a stop-loss hedging strategy, including its advantages and disadvantages, and explain how this strategy can generate naked and covered option positions.
- Compute the delta of an option.
- Explain delta hedging for an option position, including its dynamic aspects.
- Define and describe vega, gamma, theta, and rho for option positions and calculate the gamma and vega of an option.
- Explain how to implement and maintain a delta-neutral and gamma-neutral position.
- Describe the relationship between delta, theta, gamma, and vega.
- Calculate the delta, gamma, and vega of a portfolio.
- Describe how to implement portfolio insurance and how this strategy compares with delta hedging.

FRM
LEARNING OBJECTIVES PART II

MARKET RISK MEASUREMENT AND MANAGEMENT

CREDIT RISK MEASUREMENT AND MANAGEMENT

OPERATIONAL RISK AND RESILIENCE

LIQUIDITY AND TREASURY RISK MEASUREMENT AND MANAGEMENT

RISK MANAGEMENT AND INVESTMENT MANAGEMENT

CURRENT ISSUES IN FINANCIAL MARKETS

MARKET RISK MEASUREMENT AND MANAGEMENT

PART II EXAM WEIGHT | 20% (MR)

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
  - Expected shortfall (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)

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

Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).
Chapter 3. Estimating Market Risk Measures: An Introduction and Overview [MR–1]

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

- Explain the importance and challenges of extreme values in risk management.
- Describe extreme value theory (EVT) and its use in risk management.
- Describe the peaks-over-threshold (POT) approach.
- Compare and contrast the generalized extreme value (GEV) and POT approaches to estimating extreme risks.
- Discuss the application of the generalized Pareto (GP) distribution in the POT approach.
- Explain the multivariate EVT for risk management.

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

Chapter 6. Backtesting VaR [MR–4]

After completing this reading, you should be able to:

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

Chapter 11. VaR Mapping [MR–5]

After completing this reading, you should be able to:

- Explain the principles underlying VaR mapping and describe the mapping process.
- Explain and demonstrate how the mapping process captures general and specific risks.
- Differentiate among the three methods for 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 computed and used relative to 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, January 2011. [MR–6]

After completing this reading, you should be able to:

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

Gunter Meissner, *Correlation Risk Modeling and Management, 2nd Edition* (Risk Books, 2019).

Chapter 1. Correlation Basics: Definitions, Applications, and 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 2007-2009.
- Describe how correlation impacts the price of quanto options as well as other multi-asset exotic options.
- Describe the structure, uses, and payoffs of a correlation swap.
- Estimate the impact of different correlations between assets in the trading book on the VaR capital charge.
- Explain the role of correlation risk in market risk and credit risk.
- Relate correlation risk to systemic and concentration risk.

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

After completing this reading, you should be able to:

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

Chapter 5. Financial Correlation Modeling — Bottom-Up Approaches (pages 126-134 only) [MR–9]

After completing this reading, you should be able to:

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

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

Chapter 6. Empirical Approaches to Risk Metrics and Hedging [MR–10]

After completing this reading, you should be able to:

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

Chapter 7. The Science of Term Structure Models [MR–11]

After completing this reading, you should be able to:

- Calculate the expected discounted value of a zero-coupon security using a binomial tree.
- Construct and apply an arbitrage argument to price a call option on a zero-coupon security using replicating portfolios.
- Define risk-neutral pricing and apply it to option pricing.
- Distinguish between true and risk-neutral probabilities and apply this difference to interest rate drift.
- Explain how the principles of arbitrage pricing of derivatives on fixed-income securities can be extended over multiple periods.
- Define option-adjusted spread (OAS) and apply it to security pricing.

- Describe the rationale behind the use of recombining trees in option pricing.
- Calculate the value of a constant-maturity Treasury swap, given an interest rate tree and the risk-neutral probabilities.
- Evaluate the advantages and disadvantages of reducing the size of the time steps on the pricing of derivatives on fixed-income securities.
- Evaluate the appropriateness of the Black-Scholes-Merton model when valuing derivatives on fixed-income securities.

Chapter 8. The Evolution of Short Rates and the Shape of the Term Structure [MR–12]

After completing this reading, you should be able to:

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

Chapter 9. The Art of Term Structure Models: Drift [MR–13]

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–14]

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 C. Hull, *Options, Futures, and Other Derivatives, 10th Edition* (New York, NY: Pearson, 2017).
Chapter 20. Volatility Smiles [MR–15]

After completing this reading, you should be able to:

- Describe a 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 an option's Greek letter risk measures.
- Explain the impact of a single asset price jump on a volatility smile.

John C. Hull, *Risk Management and Financial Institutions 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018). Chapter 18. Fundamental Review of the Trading Book [MR-16]

After completing this reading, you should be able to:

- Describe the changes to the Basel framework for calculating market risk capital under the Fundamental Review of the Trading Book (FRTB) and the motivations for these changes.
- Compare the various liquidity horizons proposed by the FRTB for different asset classes and explain how a bank can calculate its expected shortfall using the various horizons.
- Explain the FRTB revisions to Basel regulations in the following areas:
  - Classification of positions in the trading book compared to the banking book.
  - Backtesting, profit and loss attribution, credit risk, and securitizations.

CREDIT RISK MEASUREMENT AND MANAGEMENT

PART II EXAM WEIGHT | 20% (CR)

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

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

Sylvain Bouteille and Diane Coogan-Pushner, *The Handbook of Credit Risk Management: Originating, Assessing, and Managing Credit Exposures, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2022).

Chapter 1. Fundamentals of Credit Risk [CR–1]

After completing this reading, you should be able to:

- Define credit risk and explain how it arises using examples.
- Explain the distinctions between insolvency, default, and bankruptcy.
- Identify and describe transactions that generate credit risk.
- Describe the entities that are exposed to credit risk and explain circumstances under which exposure occurs.
- Discuss the motivations for managing or taking on credit risk.

Chapter 2. Governance [CR–2]

After completing this reading, you should be able to:

- Define risk management responsibilities in an organization and explain the three lines of defense framework for effective risk management and control.
- Explain the processes that lead to risk taking including credit origination, credit risk assessment, and credit approval processes.
- Discuss the following key principles underlying best practice for the governance system of credit risk: Guidelines, Skills, Limits, and Oversight.
- Describe the most common parameters of a credit-sensitive transaction.
- Describe the roles of the credit committee in an organization.

Hennie van Greuning and Sonja Brajovic Bratanovic, *Analyzing Banking Risk, Fourth Edition* (World Bank Group, 2020).

Chapter 7. Credit Risk Management [CR–3]

After completing this reading, you should be able to:

- Describe key elements of an effective lending or financing policy.
- Explain the importance and challenges of setting exposure and concentration limits.
- Describe the scope and allocation processes of a bank's credit facility and explain bank-specific policies and actions to reduce credit risk.
- Discuss factors that should be considered during the credit asset classification process.
- Describe and explain loan loss provisions and loan loss reserves.
- Identify and explain the components of expected loss and distinguish between expected loss and unexpected loss.
- Explain the requirements for estimating expected loss under IFRS 9.
- Describe a workout procedure for loss assets and compare the following two approaches used to manage loss assets: retaining loss assets and writing off loss assets.
- Explain the components of credit risk analysis.
- Explain the components of credit risk management capacity, and outline key questions that the board of directors of a bank should ask.

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) [CR–4]

After completing this reading, you should be able to:

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

Michalis Doumpos, Christos Lemonakis, Dimitrios Niklis, and Constantin Zopounidis, *Analytical Techniques in the Assessment of Credit Risk: An Overview of Methodologies and Applications* (Springer, 2019).

Chapter 1. Introduction to Credit Risk Modeling and Assessment [CR–5]

After completing this reading, you should be able to:

- Explain the capital adequacy, asset quality, management, earnings, and liquidity (CAMEL) system used for evaluating the financial condition of a bank.
- Describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss, and time horizon.
- Estimate capital adequacy ratio of a financial institution.
- Describe the judgmental approaches, empirical models, and financial models to predict default.
- Apply the Merton model to calculate default probability and the distance to default and describe the limitations of using the Merton model.

- Compare and contrast different approaches to credit risk modeling, such as those related to the Merton model, Credit Risk Plus (CreditRisk+), CreditMetrics, and the Moody's-KMV model.
- Apply risk-adjusted return on capital (RAROC) to measure the performance of a loan.

Chapter 2. Credit Scoring and Rating [CR–6]

After completing this reading, you should be able to:

- Compare the credit scoring system to the credit rating system in assessing credit quality and describe the different types of each system.
- Distinguish between through-the-cycle and point-in-time credit rating systems.
- Describe the process for developing credit risk scoring and rating models.
- Describe rating agencies' assignment methodologies for issue and issuer ratings, and identify the main criticisms of the credit rating agencies' ratings.

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 [CR–7]

After completing this reading, you should be able to:

- Analyze the credit risks and other risks generated by retail banking.
- Explain the differences between retail credit risk and corporate credit risk.
- Discuss the "dark side" of retail credit risk and the measures that attempt to address the problem.
- Define and describe credit risk scoring model types, key variables, and applications.
- Discuss the key variables in a mortgage credit assessment and describe the use of cutoff scores, default rates, and loss rates in a credit scoring model.
- Discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.
- Describe the customer relationship cycle and discuss the trade-off between creditworthiness and profitability.
- Discuss the benefits of risk-based pricing of financial services.

Aswath Damodaran, *Country Risk: Determinants, Measures, and Implications – The 2022 Edition* (2022) [CR–8]

After completing this reading, you should be able to:

- Identify and explain the different sources of country risk.
- Evaluate the methods for measuring country risk and discuss the limitations of using those methods.
- Compare and contrast foreign currency defaults and local currency defaults.
- Explain the consequences of a country's default.
- Discuss measures of sovereign default risk and describe components of a sovereign rating.
- Describe the shortcomings of the sovereign rating systems of rating agencies.
- Compare the use of credit ratings, market-based credit default spreads, and CDS spreads in predicting default.

John C. Hull, *Risk Management and Financial Institutions, Sixth Edition* (John Wiley & Sons, 2023).

Chapter 17. Estimating Default Probabilities [CR–9]

After completing this reading, you should be able to:

- Compare agencies' ratings to internal credit rating systems.
- Describe linear discriminant analysis (LDA), define the Altman's Z-score and its usage, and apply LDA to classify a sample of firms by credit quality.
- Describe the relationship between borrower rating and probability of default.

- Describe a rating migration matrix and calculate the probability of default, cumulative probability of default, and marginal probability of default.
- Define the hazard rate and use it to define probability functions for default time as well as to calculate conditional and unconditional default probabilities.
- Describe recovery rates and their dependencies on default rates.
- Define a credit default swap (CDS) and explain its mechanics including the obligations of both the default protection buyer and the default protection seller.
- Describe CDS spreads and explain how CDS spreads can be used to estimate hazard rates.
- Define and explain CDS-bond basis.
- Compare default probabilities calculated from historical data with those calculated from credit yield spreads.
- Describe the difference between real-world and risk-neutral default probabilities and determine which one to use in the analysis of credit risk.
- Using the Merton model, calculate the value of a firm's debt and equity, the volatility of firm value, and the volatility of firm equity.
- Using the Merton model, calculate distance to default and default probability.
- Assess the quality of the default probabilities produced by the Merton model, the Moody's KMV model, and the Kamakura model.

Chapter 19. Credit Value at Risk [CR–10]

After completing this reading, you should be able to:

- Compare market risk value at risk (VaR) with credit VaR in terms of definition, time horizon, and tools for measuring them.
- Define and calculate credit VaR.
- Describe the use of rating transition matrices for calculating credit VaR.
- Describe the application of the Vasicek model to estimate capital requirements under the Basel II internal-ratings-based (IRB) approach.
- Interpret the Vasicek's model, Credit Risk Plus (CreditRisk+) model, and the CreditMetrics ways of estimating the probability distribution of losses arising from defaults as well as modeling the default correlation.
- Define credit spread risk and assess its impact on calculating credit VaR.

Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).
Chapter 8. Portfolio Credit Risk (Sections 8.1, 8.2, 8.3 only) [CR–11]

After completing this reading, you should be able to:

- Define and calculate default correlation for credit portfolios.
- Identify drawbacks in using the correlation-based credit portfolio framework.
- Assess the impact of correlation on a credit portfolio and its Credit VaR.
- Describe the use of a single factor model to measure portfolio credit risk, including the impact of correlation.
- Define beta and calculate the asset return correlation of any pair of firms using the single factor model.
- Using the single factor model, estimate the probability of a joint default of any pair of credits and the default correlation between any pair of credits.
- Describe how Credit VaR can be calculated using a simulation of joint defaults.
- Assess the effect of granularity on Credit VaR.

Chapter 9. Structured Credit Risk [CR–22]

After completing this reading, you should be able to:

- Describe common types of structured products.
- Describe tranching and the distribution of credit losses in a securitization.
- Describe a waterfall structure in a securitization.
- Identify the key participants in the securitization process and describe conflicts of interest that can arise in the process.
- Compute and evaluate one or two iterations of interim cashflows in a three-tiered securitization structure.
- Describe the treatment of excess spread in a securitization structure and estimate the value of the overcollateralization account at the end of each year.
- Explain the tests on the excess spread that a custodian must go through at the end of each year to determine the cash flow to the overcollateralization account and to the equity noteholders.
- 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.

John C. Hull, *Options, Futures, and Other Derivatives, 11th Edition* (Pearson, 2022).

Chapter 24. Credit Risk [CR–12]

After completing this reading, you should be able to:

- Assess the credit risks of derivatives.
- Define credit valuation adjustment (CVA) and debt valuation adjustment (DVA).
- Calculate the probability of default using credit spreads.
- Describe, compare, and contrast various credit risk mitigants and their role in credit analysis.
- Describe the significance of estimating default correlation for credit portfolios and distinguish between reduced form and structural default correlation models.
- Describe the Gaussian copula model for time to default and calculate the probability of default using the one-factor Gaussian copula model.
- Describe how to estimate credit VaR using the Gaussian copula and the CreditMetrics approach.

Chapter 25. Credit Derivatives [CR–13]

After completing this reading, you should be able to:

- Describe a credit derivative, credit default swap (CDS), total return swap, and collateralized debt obligation (CDO).
- Explain how to account for credit risk exposure in valuing a CDS.
- Identify the default probabilities used to value a CDS.
- Evaluate the use of credit indices and fixed coupons in pricing CDS transactions.
- Define CDS forwards and CDS options.
- Describe the process of valuing a synthetic CDO using the spread payments approach and the Gaussian copula model of time to default approach.
- Define the two measures of implied correlation: compound (tranche) correlation and base correlation.
- Discuss alternative approaches used to estimate default correlation.

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital* (West Sussex, UK: John Wiley & Sons, 2020).

Chapter 2. Derivatives [CR–14]

After completing this reading, you should be able to:

- Define derivatives and explain how derivative transactions create counterparty credit risk.
- Compare and contrast exchange-traded derivatives and over-the-counter (OTC) derivatives, and discuss the features of their markets.
- Describe the process of clearing a derivative transaction.
- Identify the participants and describe the use of collateralization in the derivatives market.
- Define the International Swaps and Derivatives Association (ISDA) Master Agreement, the risk-mitigating features it provides, and the default events it covers.
- Describe the features and use of credit derivatives and discuss potential risks they may create.
- Describe central clearing of OTC derivatives and discuss the roles, mandate, advantages, and disadvantages of the central counterparty (CCP).
- Explain the margin requirements for both centrally-cleared and non-centrally-cleared derivatives.
- Define special purpose vehicles (SPVs), derivatives product companies (DPCs), monolines, and credit derivatives product companies (CDPCs) and describe the limitations of using them as risk mitigating methods.
- Describe the approaches used and the challenges faced in modeling derivatives risk.

Chapter 3. Counterparty Risk and Beyond [CR–15]

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.
- Describe credit value adjustment (CVA) and compare the use of CVA and credit limits in evaluating and mitigating counterparty risk.
- Identify and describe the different ways institutions can quantify, manage, and mitigate counterparty risk.
- Identify and explain the costs of an OTC derivative.
- Explain the components of the X-Value Adjustment (xVA) term.

Chapter 6. Netting, Close-out and Related Aspects [CR–16]

After completing this reading, you should be able to:

- Explain the purpose of an International Swaps and Derivatives Association (ISDA) master agreement.
- Summarize netting and close-out procedures (including multilateral netting), explain their advantages and disadvantages, and describe how they fit into the framework of the ISDA master agreement.
- Describe the effectiveness of netting in reducing credit exposure under various scenarios.
- Describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.
- Provide examples of trade compression of derivative positions, calculate net notional exposure amount, and identify the party holding the net contract position in a trade compression.
- Identify and describe termination events and discuss their potential effects on parties to a transaction.

Chapter 7. Margin (Collateral) and Settlement [CR–17]

After completing this reading, you should be able to:

- Describe the rationale for collateral management.
- Describe the terms of a collateral agreement and features of a credit support annex (CSA) within the ISDA Master Agreement including threshold, initial margin, minimum transfer amount and rounding, haircuts, credit quality, and credit support amount.
- Calculate the credit support amount (margin) under various scenarios.
- Describe the role of a valuation agent.
- Describe the mechanics of collateral and the 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 aspects of collateral including funding, rehypothecation, and segregation.
- Explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.
- Describe the various regulatory capital requirements.

Chapter 8. Central Clearing [CR–18]

After completing this reading, you should be able to:

- Define a central counterparty (CCP) and describe the mechanics of central clearing.
- Explain the concept of novation under central clearing.
- Define netting, multilateral offset, and compression and provide examples of each.
- Describe the application and estimation of margin and default funds under central clearing.
- Discuss the risks faced by a CCP and the ways it manages its exposures.
- Provide examples of a loss waterfall.
- Explain the different methods of managing the default of one or more members of a CCP.
- Compare bilateral and central clearing.
- Compare initial margin and default fund requirements for clearing members in relation to loss coverage, cost of clearing, and moral hazard.
- Describe the advantages and disadvantages of central clearing.

Chapter 11. Future Value and Exposure [CR–19]

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 expected positive 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 general impact of aggregation on exposure, and the impact of aggregation on exposure when there is correlation between transaction values.
- Describe the differences between funding exposure and credit exposure.

- Explain the impact of collateralization on exposure and assess the risk associated with the remargining period, threshold, and minimum transfer amount.
- Assess the impact of collateral on counterparty risk and funding, with and without segregation or rehypothecation.

Chapter 17. CVA [CR–20]

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 CVA as a spread with no wrong-way risk, netting, or collateralization.
- Evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.
- Describe debt value adjustment (DVA) and bilateral CVA (BCVA).
- Explain the distinctions between unilateral CVA (UCVA) and BCVA, and between unilateral DVA (UDVA) and BCVA.
- Calculate DVA, BCVA, and BCVA as a spread.
- 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, including the impact of margin period of risk, thresholds, and initial margins.
- Describe wrong-way risk and contrast it with right-way risk.
- Identify examples of wrong-way risk and examples of right-way risk.
- Discuss the impact of collateral on wrong-way risk.
- Identify examples of wrong-way collateral.
- Discuss the impact of wrong-way risk on central counterparties (CCPs).
- Describe the various wrong-way modeling methods including hazard rate approaches, structural approaches, parametric approaches, and jump approaches.
- Explain the implications of central clearing on wrong-way risk.

***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 [CR–21]

After completing this reading, you should be able to:

- Differentiate among current exposure, peak exposure, expected exposure, and expected positive exposure.
- Explain the treatment of counterparty credit risk (CCR) both as a credit risk and as a market risk and describe its implications for trading activities and risk management for a financial institution.
- Describe a stress test that can be performed on a loan portfolio and on a derivative portfolio.
- Differentiate between stressed expected loss and stress loss of a credit portfolio, and calculate the stress loss on a loan portfolio and the stress loss on a derivative portfolio.
- Describe a stress test that can be performed on CVA.
- Calculate the stressed CVA and the stress loss on CVA.
- Calculate the DVA and explain how stressing DVA enters into aggregating stress tests of CCR.
- Describe the common pitfalls in stress testing CCR.

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

Chapter 12. An Introduction to Securitisation [CR–23]

After completing this reading, you should be able to:

- Define securitization, describe the securitization process, and explain the roles of participants in the process.
- Explain the terms over-collateralization, first-loss piece, equity piece, and cash waterfall within the securitization process.
- Analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose vehicle (SPV) and distinguish between the three main SPV structures: amortizing, revolving, and master trust.
- Explain the reasons for and the benefits of undertaking securitization.
- Describe and assess the various types of credit enhancements.
- Explain the various performance analysis tools for securitized structures and identify the asset classes they are most applicable to.
- Define and calculate the delinquency ratio, default ratio, monthly payment rate (MPR), debt service coverage ratio (DSCR), the weighted average coupon (WAC), the weighted average maturity (WAM), and the weighted average life (WAL) for relevant securitized structures.
- Explain the prepayment forecasting methodologies and calculate the constant prepayment rate (CPR) and the Public Securities Association (PSA) rate.

OPERATIONAL RISK AND RESILIENCE

PART II EXAM WEIGHT | 20% (ORR)

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 Resilience include the following:

- Governance of operational risk management frameworks
- Identification, classification, and reporting of operational risks
- Measurement and assessment of operational risks
- Mitigation of operational risks
- Cyber-resilience and operational resilience
- Risks related to money laundering, financing of terrorism, financial crime, and fraud
- Third-party outsourcing risk
- Model risk and model validation
- Stress testing banks
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital planning
- 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:

Global Association of Risk Professionals. *Operational Risk and Resilience* (New York, NY: Pearson, 2022).
Chapter 1. Introduction to Operational Risk and Resilience [ORR–1]

After completing this reading, you should be able to:

- Describe an operational risk management framework and assess the types of risks that can fall within the scope of such a framework.
- Describe the seven Basel II event risk categories and identify examples of operational risk events in each category.
- Explain characteristics of operational risk exposures and operational loss events, and challenges that can arise in managing operational risk due to these characteristics.
- Describe operational resilience, identify the elements of an operational resilience framework, and summarize regulatory expectations for operational resilience.

Chapter 2. Risk Governance [ORR–2]

After completing this reading, you should be able to:

- Explain the Basel regulatory expectations for the governance of an operational risk management framework.
- Describe and compare the roles of different committees and the board of directors in operational risk governance.

- Describe the "three lines of defense" model for operational risk governance and compare roles and responsibilities for each line of defense.
- Explain best practices and regulatory expectations for the development of a risk appetite for operational risk and for a strong risk culture.

Chapter 3. Risk Identification [ORR–3]

After completing this reading, you should be able to:

- Compare different top-down and bottom-up approaches and tools for identifying operational risks.
- Describe best practices in the process of scenario analysis for operational risk.
- Describe and apply an operational risk taxonomy and give examples of different taxonomies of operational risks.
- Describe and apply the Level 1, 2, and 3 categories in the Basel operational risk taxonomy.

Chapter 4. Risk Measurement and Assessment [ORR–4]

After completing this reading, you should be able to:

- Explain best practices for the collection of operational loss data and reporting of operational loss incidents, including regulatory expectations.
- Explain operational risk-assessment processes and tools, including risk control self-assessments (RCSAs), likelihood assessment scales, and heatmaps.
- Describe the differences among key risk indicators (KRIs), key performance indicators (KPIs), and key control indicators (KCIs).
- Describe the use of factor-based models that quantitatively assess operational risk, and explain the application of the Swiss cheese model and the bowtie tool.
- Estimate operational risk exposures based on the fault tree model given probability assumptions.
- Describe approaches used to determine the level of operational risk capital for economic capital purposes, including their application and limitations.
- Describe and explain the steps to ensure a strong level of operational resilience, and to test the operational resilience of important business services.

Chapter 5. Risk Mitigation [ORR–5]

After completing this reading, you should be able to:

- Explain and compare different ways firms address their operational risk exposures.
- Compare different types of internal controls and provide examples of each type of internal control.
- Describe control automation, internal control design, and control testing, including risks and challenges that arise in these processes and ways to make them more effective.
- Describe methods to improve the quality of an operational process and reduce the potential for human error.
- Explain how operational risk can arise with new products, new business initiatives, or mergers and acquisitions, and describe ways to mitigate these risks.
- Identify and describe approaches firms should use to mitigate the impact of operational risk events.
- Describe methods for the transfer of operational risks and the management of reputational risk, and assess their effectiveness in different situations.

Chapter 6. Risk Reporting [ORR–6]

After completing this reading, you should be able to:

- Identify roles and responsibilities of different organizational committees, and explain how risk reports should be developed for each committee or business function.

- Describe components of operational risk reports and explain best practices in operational risk reporting.
- Describe challenges to reporting operational risks, including characteristics of operational loss data, and explain ways to overcome these challenges.
- Explain best practices for reporting risk exposures to regulators and external stakeholders.

Chapter 7: Integrated Risk Management [ORR–7]

After completing this reading, you should be able to:

- Describe the role of risk governance, risk appetite, and risk culture in the context of an enterprise risk management (ERM) framework.
- Summarize the role of Basel regulatory capital and the process of determining internal economic capital.
- Describe elements of a stress-testing framework for financial institutions and explain best practices for stress testing.
- Explain challenges and considerations when developing and implementing models used in stress testing operational risk.

Cyber-resilience: Range of practices (Basel Committee on Banking Supervision Publication, December 2018). [ORR–8]

After completing this reading, you should be able to:

- Define cyber-resilience and compare recent regulatory initiatives in the area of cyber-resilience.
- Describe current practices by banks and supervisors in the governance of a cyber-risk management framework, including roles and responsibilities.
- Explain methods for supervising cyber-resilience, testing and incident response approaches, and cybersecurity and resilience metrics.
- Explain and assess current practices for the sharing of cybersecurity information between different types of institutions.
- Describe practices for the governance of risks of interconnected third-party service providers.

Global Association of Risk Professionals. *Operational Risk and Resilience* (New York, NY: Pearson, 2022).
Chapter 9. Case Study: Cyberthreats and Information Security Risks [ORR–9]

After completing this reading, you should be able to:

- Provide examples of cyber threats and information security risks, and describe frameworks and best practices for managing cyber risks.
- Describe lessons learned from the Equifax case study.

Sound Management of Risks related to Money Laundering and Financing of Terrorism (Basel Committee on Banking Supervision, January 2014, revised July 2020). (through p.16, para. 83) [ORR–10]

After completing this reading, you should be able to:

- Explain best practices recommended by the Basel committee for the assessment, management, mitigation, and monitoring of money laundering and financing of terrorism (ML/FT) risks.
- Describe recommended practices for the acceptance, verification, and identification of customers at a bank.
- Explain practices for managing ML/FT risks in a group-wide and cross-border context.

Global Association of Risk Professionals. *Operational Risk and Resilience* (New York, NY: Pearson, 2022).
Chapter 11. Case Study: Financial Crime and Fraud [ORR–11]

After completing this reading, you should be able to:

- Describe elements of a control framework to manage financial fraud risk and money laundering risk.
- Summarize the regulatory findings and describe the lessons learned from the USAA case study.

Guidance on Managing Outsourcing Risk (Board of Governors of the Federal Reserve System, December 2013). [ORR-12]

After completing this reading, you should be able to:

- Explain how risks can arise through outsourcing activities to third-party service providers and describe elements of an effective program to manage outsourcing risk.
- Explain how financial institutions should perform due diligence on third-party service providers.
- Describe topics and provisions that should be addressed in a contract with a third-party service provider.

Global Association of Risk Professionals. *Operational Risk and Resilience* (New York, NY: Pearson, 2022). Chapter 13. Case Study: Third–Party Risk Management [ORR–13]

After completing this reading, you should be able to:

- Explain how risks related to the use of third parties can arise and describe characteristics of an effective third-party risk management framework.
- Describe the lessons learned from the presented case studies.

Chapter 14. Case Study: Investor Protection and Compliance Risks in Investment Activities [ORR–14]

After completing this reading, you should be able to:

- Summarize important regulations designed to protect investors in financial instruments, including MiFiD, MiFiD II, and Dodd-Frank.
- Describe and provide lessons learned from the case studies involving violations of investor protection or compliance regulations.

Supervisory Guidance on Model Risk Management (Federal Deposit Insurance Corporation, June 7, 2017). [ORR-15]

After completing this reading, you should be able to:

- Describe model risk and explain how it can arise in the implementation of a model.
- Describe elements of an effective model risk management process.
- Explain best practices for the development and implementation of models.
- Describe elements of a strong model validation process and challenges to an effective validation process.

Global Association of Risk Professionals. *Operational Risk and Resilience* (New York, NY: Pearson, 2022). Chapter 16. Case Study: Model Risk and Model Validation [ORR–16]

After completing this reading, you should be able to:

- Define a model and describe different ways that financial institutions can become exposed to model risk.
- Describe the role of the model risk management function and explain best practices in the model risk management and validation processes.
- Describe lessons learned from the three case studies involving model risk.

Stress Testing Banks (Til Schuermann, *International Journal of Forecasting* 30, no. 3, 2014): 717–728. [ORR–17]

After completing this reading, you should be able to:

- Describe the evolution of the stress testing process and compare the methodologies of historical European Banking Association (EBA), Comprehensive Capital Analysis and Review (CCAR), and Supervisory Capital Assessment Program (SCAP) stress tests.
- Explain challenges in designing stress test scenarios, including the problem of coherence in modeling risk factors.
- Explain challenges in modeling a bank's revenues, losses, and its balance sheet over a stress test horizon period.

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 [ORR–18]

After completing this reading, you should be able to:

- Define, compare, and contrast risk capital, economic capital, and regulatory capital and explain methods and motivations for using economic capital approaches to allocate risk capital.
- Describe the RAROC (risk-adjusted return on capital) methodology and its use in capital budgeting.
- Compute and interpret the RAROC for a project, loan, or loan portfolio and use RAROC to compare business unit performance.
- Explain challenges that arise when using RAROC for performance measurement, including choosing a time horizon, measuring default probability, and choosing a confidence level.
- Calculate the hurdle rate and apply this rate in making business decisions using RAROC.
- Compute the adjusted RAROC for a project to determine its viability.
- Explain challenges in modeling diversification benefits, including aggregating a firm's risk capital and allocating economic capital to different business lines.
- Explain best practices in implementing an approach that uses RAROC to allocate economic capital.

Range of practices and issues in economic capital frameworks (Basel Committee on Banking Supervision Publication, March 2009). [ORR–19]

After completing this reading, you should be able to:

- Within the economic capital implementation framework, describe the challenges that appear in:
  - Defining and calculating 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 recommendations by the Bank for International Settlements (BIS) that supervisors should consider to make effective use of internal risk measures, such as economic capital, that are not designed for regulatory purposes.
- Explain benefits and impacts of using an economic capital framework within the following areas:
  - Credit portfolio management
  - Risk-based pricing
  - Customer profitability analysis
  - Management incentives
- Describe best practices and assess key concerns for the governance of an economic capital framework.

Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice (Board of Governors of the Federal Reserve System, August 2013). [ORR–20]

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 (BHCs) subject to the Capital Plan Rule.
- Describe practices that 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 risk-weighted asset (RWA) and balance sheet projections

Mark Carey, Capital Regulation Before the Global Financial Crisis (GARP Risk Institute, April 2019). [ORR-21]

After completing this reading, you should be able to:

- Explain the motivations for introducing the Basel regulations, including key risk exposures addressed, and explain the reasons for revisions to Basel regulations over time.
- Explain the calculation of risk-weighted assets and the capital requirement per the original Basel I guidelines.
- Describe measures introduced in the 1995 and 1996 amendments, including guidelines for netting of credit exposures and methods for calculating market risk capital for assets in the trading book.
- Describe changes to the Basel regulations made as part of Basel II, including the three pillars.
- Compare the standardized internal ratings-based (IRB) approach, the foundation IRB approach, and the advanced IRB approach for the calculation of credit risk capital under Basel II.
- Calculate credit risk capital under Basel II utilizing the IRB approach.
- Compare the basic indicator approach, the standardized approach, and the advanced measurement approach for the calculation of operational risk capital under Basel II.
- Summarize elements of the Solvency II capital framework for insurance companies.

Mark Carey, Solvency, Liquidity, and Other Regulation After the Global Financial Crisis (GARP Risk Institute, April 2019). [ORR-22]

After completing this reading, you should be able to:

- Describe and calculate the stressed VaR 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 (CR) capital charge for portfolios of positions that 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, including special rules for globally systemically important banks (G-SIBs).
- 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.
- Provide examples of legislative and regulatory reforms that were introduced after the 2007-2009 financial crisis.

High-level summary of Basel III reforms (Basel Committee on Banking Supervision Publication, December 2017). [ORR-23]

After completing this reading, you should be able to:

- Explain the motivations for revising the Basel III framework and the goals and impacts of the December 2017 reforms to the Basel III framework.
- Summarize the December 2017 revisions to the Basel III framework in the following areas:
  - The standardized approach to credit risk
  - The internal ratings-based (IRB) approaches for credit risk
  - The CVA risk framework

- The operational risk framework
- The leverage ratio framework

- Describe the revised output floor introduced as part of the Basel III reforms and approaches to be used when calculating the output floor.

Basel III: Finalising post-crisis reforms (Basel Committee on Banking Supervision Publication, December 2017): 128-136. [ORR-24]

After completing this reading, you should be able to:

- Explain the elements of the new standardized approach to measure operational risk capital, including the business indicator, internal loss multiplier, and loss component, and calculate the operational risk capital requirement for a bank using this approach.
- Compare the Standardized Measurement Approach (SMA) to earlier methods of calculating operational risk capital, including the Advanced Measurement Approaches (AMA).
- Describe general and specific criteria recommended by the Basel Committee for the identification, collection, and treatment of operational loss data.

LIQUIDITY AND TREASURY RISK MEASUREMENT AND MANAGEMENT

PART II EXAM WEIGHT | 15% (LTR)

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

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

John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).
Chapter 24. Liquidity Risk [LTR–1]

After completing this reading, you should be able to:

- Explain and calculate liquidity trading risk via cost of liquidation and liquidity-adjusted VaR (LVaR).
- Identify liquidity funding risk, funding sources, and lessons learned from real cases: Northern Rock, Ashanti Goldfields, and Metallgesellschaft.
- Evaluate Basel III liquidity risk ratios and BIS principles for sound liquidity risk management.
- Explain liquidity black holes and identify the causes of positive feedback trading.

Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).
Chapter 12. Liquidity and Leverage [LTR–2]

After completing this reading, you should be able to:

- Differentiate between sources of liquidity risk and describe specific challenges faced by different types of financial institutions in managing liquidity risk.
- Summarize the asset-liability management process at a fractional reserve bank, including the process of liquidity transformation.
- Compare transactions used in the collateral market and explain risks that can arise through collateral market transactions.

- Describe the relationship between leverage and a firm's return profile (including the leverage effect) and distinguish the impact of different types of transactions on a firm's leverage and balance sheet.
- Distinguish methods to measure and manage funding liquidity risk and transactions liquidity risk.
- Calculate the expected transactions cost and the spread risk factor for a transaction and calculate the liquidity adjustment to VaR for a position to be liquidated over a number of trading days.
- Discuss interactions between different types of liquidity risk and explain how liquidity risk events can increase systemic risk.

Shyam Venkat, Stephen Baird, *Liquidity Risk Management: A Practitioner's Perspective* (Hoboken, NJ: John Wiley & Sons, 2016).

Chapter 6. Early Warning Indicators [LTR–3]

After completing this reading, you should be able to:

- Evaluate the characteristics of sound Early Warning Indicators (EWI) measures.
- Identify EWI guidelines from banking regulators and supervisors (OCC, BCBS, Federal Reserve).
- Discuss the applications of EWIs in the context of the liquidity risk management process.

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 [LTR–4]

After completing this reading, you should be able to:

- Compare various money market and capital market instruments and discuss their advantages and disadvantages.
- Identify and discuss various factors that affect the choice of investment securities by a bank.
- Apply investment maturity strategies and maturity management tools based on the yield curve and duration.

Chapter 11. Liquidity and Reserves Management: Strategies and Policies [LTR–5]

After completing this reading, you should be able to:

- Calculate a bank's net liquidity position and explain factors that affect the supply and demand of liquidity at a bank.
- Compare strategies that a bank can use to meet demands for additional liquidity.
- Estimate a bank's liquidity needs through three methods (sources and uses of funds, structure of funds, and liquidity indicators).
- Summarize the process taken by a U.S. bank to calculate its legal reserves.
- Differentiate between factors that affect the choice among alternate sources of reserves.

Shyam Venkat, Stephen Baird, *Liquidity Risk Management: A Practitioner's Perspective* (Hoboken, NJ: John Wiley & Sons, 2016).

Chapter 4. Intraday Liquidity Risk Management [LTR–6]

After completing this reading, you should be able to:

- Identify and explain the uses and sources of intraday liquidity.
- Discuss the governance structure of intraday liquidity risk management.
- Differentiate between methods for tracking intraday flows and monitoring risk levels.

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

Chapter 6. Monitoring Liquidity [LTR–7]

After completing this reading, you should be able to:

- Distinguish between deterministic and stochastic cash flows and provide examples of each.
- Describe and provide examples of liquidity options and explain the impact of liquidity options on a bank's liquidity position and its liquidity management process.
- Describe and apply the concepts of liquidity risk, funding cost risk, liquidity generation capacity, expected liquidity, and cash flow at risk.
- Interpret the term structure of expected cash flows and cumulative cash flows.
- Discuss the impact of available asset transactions on cash flows and liquidity generation capacity.

Darrell Duffie, 2010. The Failure Mechanics of Dealer Banks (*Journal of Economic Perspectives* 24:1, 51-72). [LTR–8]

After completing this reading, you should be able to:

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

Shyam Venkat, Stephen Baird, *Liquidity Risk Management: A Practitioner's Perspective* (Hoboken, NJ: John Wiley & Sons, 2016).

Chapter 3. Liquidity Stress Testing [LTR–9]

After completing this reading, you should be able to:

- Differentiate between various types of liquidity, including funding, operational, strategic, contingent, and restricted liquidity.
- Estimate contingent liquidity via the liquid asset buffer.
- Discuss liquidity stress test design issues such as scope, scenario development, assumptions, outputs, governance, and integration with other risk models.

Moorad Choudhry, *The Principles of Banking* (Singapore: John Wiley & Sons, 2012).

Chapter 14. Liquidity Risk Reporting and Stress Testing [LTR–10]

After completing this reading, you should be able to:

- Identify best practices for the reporting of a bank's liquidity position.
- Compare and interpret different types of liquidity risk reports.
- Explain the process of reporting a liquidity stress test and interpret a liquidity stress test report.

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

Chapter 7. Contingency Funding Planning [LTR–11]

After completing this reading, you should be able to:

- Discuss the relationship between contingency funding planning and liquidity stress testing.
- Evaluate the key design considerations of a sound contingency funding plan.
- Assess the key components of a contingency funding plan (governance and oversight, scenarios and liquidity gap analysis, contingent actions, monitoring and escalation, and data and reporting).

Peter Rose, Sylvia Hudgins, *Bank Management & Financial Services, 9th Edition* (New York, NY: McGraw-Hill, 2013).

Chapter 12. Managing and Pricing Deposit Services [LTR–12]

After completing this reading, you should be able to:

- Differentiate between the various transaction and non-transaction deposit types.
- Compare the different methods used to determine the pricing of deposits and calculate the price of a deposit account using cost-plus, marginal cost, and conditional pricing formulas.
- Explain challenges faced by banks that offer deposit accounts, including deposit insurance, disclosures, overdraft protection, and basic (lifeline) banking.

Chapter 13. Managing Non-deposit Liabilities [LTR–13]

After completing this reading, you should be able to:

- Distinguish between the various sources of non-deposit liabilities at a bank.
- Describe and calculate the available funds gap.
- Discuss factors affecting the choice of non-deposit funding sources.
- Calculate overall cost of funds using both the historical average cost approach and the pooled-funds approach.

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 [LTR–14]

After completing this reading, you should be able to:

- Describe the mechanics of repurchase agreements (repos) and calculate the settlement for a repo transaction.
- Discuss common motivations for entering into repos, including their use in cash management and liquidity management.
- Discuss 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 2007-2009 financial crisis.
- Compare the use of general and special collateral in repo transactions.
- Identify the characteristics of special spreads and explain the typical behavior of U.S. Treasury special spreads over an auction cycle.
- Calculate the financing advantage of a bond trading special when used in a repo transaction.

Joel Grant, 2011. Liquidity Transfer Pricing: A Guide to Better Practice (Occasional Paper, Financial Stability Board, Bank for International Settlements). [LTR–15]

After completing this reading, you should be able to:

- Discuss the process of liquidity transfer pricing (LTP) and identify best practices for the governance and implementation of an LTP process.
- Discuss challenges that may arise for banks during the implementation of LTP.
- Compare the various approaches to liquidity transfer pricing (zero cost, average cost, and matched-maturity marginal cost).
- Describe the contingent liquidity risk pricing process and calculate the cost of contingent liquidity risk.

Patrick McGuire, Goetz von Peter. The US Dollar Shortage in Global Banking and the International Policy Response. (BIS Working Papers, Bank for International Settlements, 2009). [LTR-16]

After completing this reading, you should be able to:

- Identify the causes of the U.S. dollar shortage during the Great Financial Crisis.
- Evaluate the importance of assessing maturity/currency mismatch across the balance sheets of consolidated entities.
- Discuss how central bank swap agreements overcame challenges commonly associated with international lenders of last resort.

Claudio Borio, Robert McCauley, Patrick McGuire, Vladyslav Sushko. Covered Interest Parity Lost: Understanding the Cross-Currency Basis. (BIS Quarterly Review, 2016). [LTR–17]

After completing this reading, you should be able to:

- Differentiate between the mechanics of foreign exchange (FX) swaps and cross-currency swaps.
- Identify key factors that affect the cross-currency swap basis.
- Assess the causes of covered interest rate parity violations after the financial crisis of 2008.

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 [LTR–18]

After completing this reading, you should be able to:

- Discuss how asset-liability management strategies can help a bank hedge against interest rate risk.
- Describe interest-sensitive gap management and apply this strategy to maximize a bank's net interest margin.
- Describe duration gap management and apply this strategy to protect a bank's net worth.
- Discuss the limitations of interest-sensitive gap management and duration gap management.

Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York, NY: Oxford University Press, 2014).
Chapter 13. Illiquid Assets [LTR–19]

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.
- Explain the unsmoothing of returns and its properties.
- Compare illiquidity risk premiums across and within asset categories.
- Evaluate portfolio choice decisions on the inclusion of illiquid assets.

RISK MANAGEMENT AND INVESTMENT MANAGEMENT

PART II EXAM WEIGHT | 15% (IM)

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

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

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

Chapter 6. Factor Theory [IM–1]

After completing this reading, you should be able to:

- Provide examples of factors that impact asset prices and explain the theory of factor risk premiums.
- Discuss the capital asset pricing model (CAPM) including its assumptions and explain how factor risk is addressed in the CAPM.
- Explain the implications of using the CAPM to value assets, including equilibrium and optimal holdings, exposure to factor risk, its treatment of diversification benefits, and shortcomings of the CAPM.
- Describe multifactor models and compare and contrast multifactor models to the CAPM.
- Explain how stochastic discount factors are created and apply them in the valuation of assets.
- Describe efficient market theory and explain how markets can be inefficient.

Chapter 7. Factors [IM–2]

After completing this reading, you should be able to:

- Describe the process of value investing and explain why a value premium may exist.
- Explain how different macroeconomic risk factors, including economic growth, inflation, and volatility, affect asset returns and risk premiums.
- Assess methods of mitigating volatility risk in a portfolio and describe challenges that arise when managing volatility risk.
- Explain how dynamic risk factors can be used in a multifactor model of asset returns, using the Fama-French model as an example.
- Compare value and momentum investment strategies, including their return and risk profiles.

Chapter 10. Alpha (and the Low-Risk Anomaly) [IM–3]

After completing this reading, you should be able to:

- Describe and evaluate the low-risk anomaly of asset returns.
- Define and calculate alpha, tracking error, the information ratio, and the Sharpe ratio.
- Explain the impact of benchmark choice on alpha and describe characteristics of an effective benchmark to measure alpha.
- Describe Grinold's fundamental law of active management, including its assumptions and limitations, and calculate the information ratio using this law.
- Apply a factor regression to construct a benchmark with multiple factors, measure a portfolio's sensitivity to those factors, and measure alpha against that benchmark.
- Explain how to use style analysis to handle time-varying factor exposures.
- Describe issues that arise when measuring alphas for nonlinear strategies.
- Compare the volatility anomaly and the beta anomaly and analyze evidence of each anomaly.
- Describe potential explanations for the risk anomaly.

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 [IM–4]

After completing this reading, you should be able to:

- Distinguish among the inputs to the portfolio construction process.
- Evaluate the motivation for and the methods used for refining alphas in the implementation process.
- Describe neutralization and the different approaches used for refining alphas to be neutral.
- Describe the implications of transaction costs on portfolio construction.
- Describe practical issues in portfolio construction, including the determination of an appropriate risk aversion, aversions to specific risks, and proper alpha coverage.
- Describe portfolio revisions and rebalancing, and analyze 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, NY: McGraw-Hill, 2007).

Chapter 7. Portfolio Risk: Analytical Methods [IM–5]

After completing this reading, you should be able to:

- Define, calculate, and distinguish between the following portfolio VaR measures: diversified and undiversified portfolio VaR, individual VaR, incremental VaR, marginal VaR, and component VaR.
- Explain the impact of correlation on portfolio risk.
- Apply the concept of marginal VaR in making portfolio management decisions.
- Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio.
- Explain the difference between risk management and portfolio management and describe how to use marginal VaR in portfolio management.

Chapter 17. VaR and Risk Budgeting in Investment Management [IM–6]

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.
- Explain the use of VaR to check manager compliance and monitor risk.
- Explain how VaR can be used in the development of investment guidelines and for improving the investment process.
- Describe the risk budgeting process and calculate risk budgets across asset classes and active managers.

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

Chapter 17. Risk Monitoring and Performance Measurement [IM–7]

After completing this reading, you should be able to:

- Describe the three fundamental dimensions behind risk management, and their relation to VaR and tracking error.
- 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.
- Describe the Liquidity Duration Statistic and how it can be used to measure liquidity.
- Describe the objectives of performance measurement tools.
- Describe the use of alpha, benchmarks, and peer groups as inputs in performance measurement tools.

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

Chapter 24. Portfolio Performance Evaluation [IM–8]

After completing this reading, you should be able to:

- Differentiate between the time-weighted and dollar-weighted returns of a portfolio and describe their appropriate uses.
- Describe risk-adjusted performance measures, such as Sharpe's measure, Treynor's measure, Jensen's measure (Jensen's alpha), and the information ratio and identify the circumstances under which the use of each measure is most relevant.
- 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.
- Describe style analysis.
- Explain the difficulties in measuring the performance of actively managed portfolios.
- Describe performance manipulation and the problems associated with using conventional performance measures.
- Describe techniques to measure the market timing ability of fund managers with a regression and with a call option model and compute return due to market timing.
- Describe and apply performance attribution procedures, including the asset allocation decision, sector and security selection decision, and the aggregate contribution.

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

Chapter 17. Hedge Funds [IM–9]

After completing this reading, you should be able to:

- Explain biases that are commonly found in databases of hedge funds.
- Explain the evolution of the hedge fund industry and describe landmark events that precipitated major changes in the development of the 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.
- 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 trends of hedge funds compared to those of equity indices.
- Describe market events that resulted in a convergence of risk factors for different hedge fund strategies and explain the impact of such convergences on portfolio diversification strategies.
- Describe the problem of risk sharing asymmetry between principals and agents in the hedge fund industry.

Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 2nd Edition* (Hoboken, NJ: Wiley Finance, 2016).

Chapter 12. Performing Due Diligence on Specific Managers and Funds [IM–10]

After completing this reading, you should be able to:

- Identify reasons for the failures of hedge 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 hedge fund manager.
- Describe criteria that can be evaluated in assessing a hedge fund's risk management process.
- Explain how due diligence can be performed on a hedge fund's operational environment.
- Explain how a hedge 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.

Stephen G. Dimmock and William C. Gerken, *Finding Bernie Madoff: Predicting Fraud by Investment Managers*, (2012) [IM–11]

After completing this reading, you should be able to:

- Explain the use and efficacy of information disclosures made by investment advisors in predicting fraud.
- Describe the barriers and the costs incurred in implementing fraud prediction methods.
- Discuss ways to improve investors' ability to use disclosed data to predict fraud.

CURRENT ISSUES IN FINANCIAL MARKETS

PART II EXAM WEIGHT | 10% (CI)

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:

- 2023 Bank Failures
- Artificial Intelligence
- Climate Risk
- Blockchain, cryptocurrency, and decentralized finance
- Digital Resilience

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

Review of the Federal Reserve's Supervision and Regulation of Silicon Valley Bank (through page 66, Board of Governors of the Federal Reserve System). [CI-1]

After completing this reading, you should be able to:

- Describe the events leading up to the failure of Silicon Valley Bank.
- Describe shortfalls and deficiencies in the Federal Reserve's supervisory oversight of Silicon Valley Bank during the period that the bank transitioned from the Fed's Regional Banking Organization (RBO) portfolio to its Large and Foreign Banking Organization (LFBO) portfolio.
- Identify Silicon Valley Bank's specific risk issues which led to and accelerated its failure including deposit concentration, type of deposits, held-to-maturity securities, available-for-sale securities, the bank's contingent funding plan and capacity, and its capital raising efforts.
- Identify and describe the failures and shortfalls of Silicon Valley Bank in the areas of governance and risk management including those related to the CRO position and the bank's internal audit function.
- Identify the scope of Silicon Valley Bank's liquidity risk management deficiencies and shortfalls, including its modeling and stress testing of its 30-day liquidity buffer, as well as the actions that management and regulators considered to address these specific liquidity issues.
- Describe the deficiencies in Silicon Valley Bank's interest rate risk management process, including its modelling process, and explain how proper use of metrics such as net interest income (NII) at risk and economic value of equity (EVE) could have improved its management of interest rate risk.

The Credit Suisse CoCo Wipeout: Facts, Misperceptions, and Lessons for Financial Regulation (*Journal of Applied Corporate Finance*, June 2023) [CI-2]

After completing this reading, you should be able to:

- Describe the features and mechanics of contingent convertible bonds (CoCos) and explain the rationale for banks to issue them.
- Explain the rescue of Credit Suisse by Swiss regulators in 2023 and compare it to the rescue of Bear Stearns by U.S. regulators during the financial crisis in 2008.
- Explain the rationale for the write-down of Credit Suisse CoCos that was engineered by regulators during the rescue of Credit Suisse and its takeover by UBS.
- Describe the reactions by market participants to the write-down of the CoCos, and explain and evaluate different arguments and lessons learned related to the decision to write down the CoCos.

Artificial Intelligence and Bank Supervision (Federal Reserve Bank of Richmond, Second Quarter 2023). [CI-3]

After completing this reading, you should be able to:

- Describe historical evolution and common types of AI-based applications used in the financial sector.
- Explain the advantages of implementing AI-based applications to the banking services companies and their customers.
- Discuss the disadvantages and difficulties for financial companies using AI.
- Clarify the specific issues faced by banks and regulators arising from utilizing AI in modeling and valuation.

Financial Risk Management and Explainable, Trustworthy, Responsible AI, Fritz-Morgenthal S, Hein B and Papenbrock J (*Frontiers in Artificial Intelligence*). [CI-4]

After completing this reading, you should be able to:

- Describe the challenge posed by potential model bias and the ethical and responsible considerations surrounding the implementation of AI-driven solutions in financial risk management.
- Analyze the potential benefits and challenges of utilizing AI while maintaining fairness and preventing biases in risk assessment and decision-making.
- Explain the proposed considerations for the technical validation of decision-making algorithms to check for potential unfairness.
- Describe the approaches and technologies that should be considered in the implementation and assessment of Trustworthy AI.
- Examine the application of Explainable AI (XAI) in the field of credit risk management as presented in the use case of a European insurance group.

Artificial Intelligence Risk Management Framework (*National Institute of Standards and Technology*). [CI-5]

After completing this reading, you should be able to:

- Describe how organizations can frame the risks related to AI and explain the challenges that should be considered in AI risk management.
- Identify AI actors across the AI lifecycle dimensions and describe how these actors work together to manage risks and achieve the goals of trustworthy and responsible AI.
- Describe the characteristics of trustworthy AI and analyze the proposed guidance to address them.
- Explain the potential benefits of periodically evaluating AI risk management effectiveness.
- Describe specific functions applied to help organizations address the risks of AI systems in practice.

Climate-related risk drivers and their transmission channels (Basel Committee on Banking Supervision Publication, April 2021). [CI-6]

After completing this reading, you should be able to:

- Describe climate-related risk drivers and explain how those drivers give rise to different types of risks for banks.
- Compare physical and transition risk drivers related to climate change.
- Assess the potential impact of different microeconomic and macroeconomic drivers of climate risk.
- Describe and assess factors that can amplify the impact of climate-related risks on banks as well as potential mitigants for these risks.

Climate-related financial risks – measurement methodologies (Basel Committee on Banking Supervision Publication, April 2021). [CI-7]

After completing this reading, you should be able to:

- Describe main issues in identifying and measuring climate-related financial risks.
- Identify unique data needs inherent in the climate-related risks and describe candidate methodologies that could be used to analyze these types of data.
- Describe current and developing methodologies for measuring climate-related financial risks employed by banks and supervisors.
- Compare and contrast climate-measuring methodologies utilized by banks, regulators, and third- party providers.
- Identify strengths and weaknesses of the main types of measurement approaches.
- Assess gaps and challenges in designing a modeling framework to capture climate-related financial risk.

Principles for the effective management and supervision of climate-related financial risks (Basel Committee on Banking Supervision Publication, June 2022). [CI-8]

After completing this reading, you should be able to:

- Describe the principles for managing climate-related financial risks related to corporate governance and internal control framework.
- Describe the principles for managing climate-related financial risks related to capital and liquidity adequacy and the risk management process.
- Describe the principles for the management of climate-related financial risks related to management, monitoring, and reporting, comprehensive management of credit risk and other risks, and scenario analysis.
- Describe the principles for the supervision of climate-related financial risks related to prudential regulatory and supervisory requirements for banks and responsibilities, powers, and functions of supervisors.

The Crypto Ecosystem: Key Elements and Risks (Basel Committee on Banking Supervision Publication, July 2023). [CI-9]

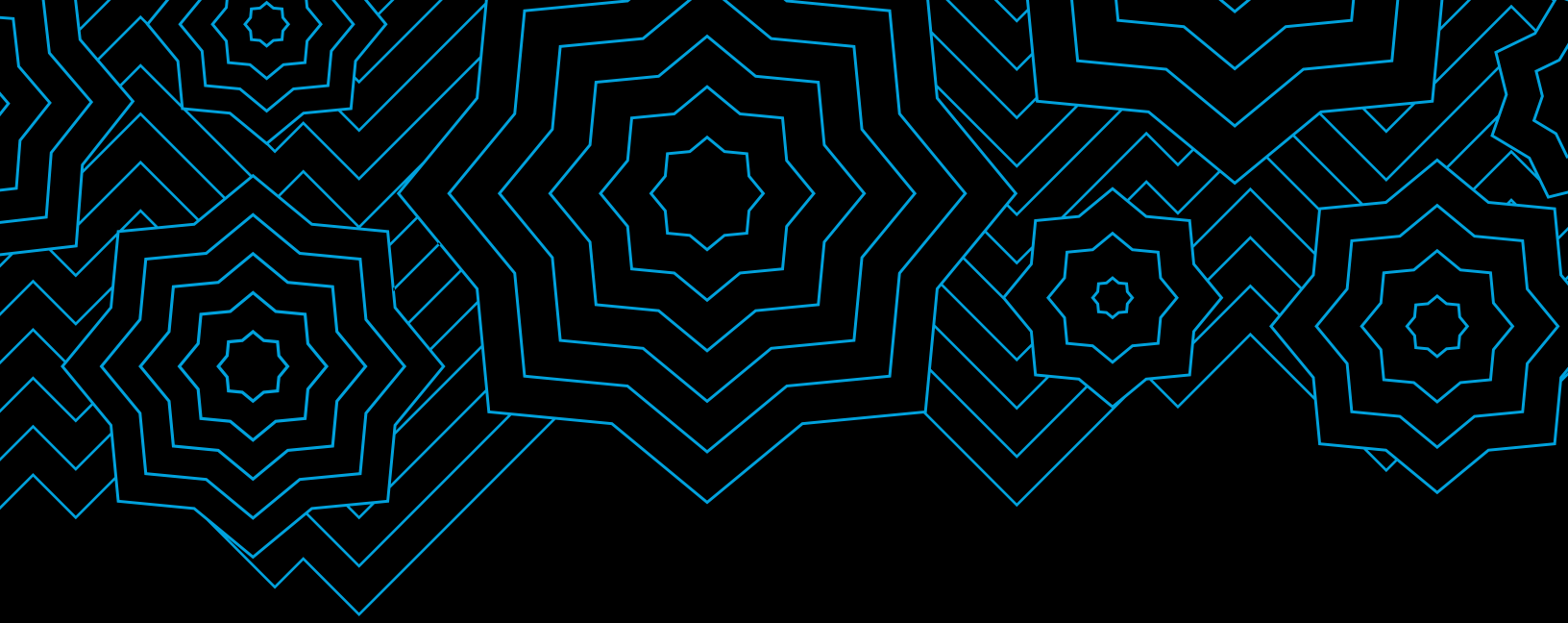
After completing this reading, you should be able to:

- Describe the key elements of the crypto ecosystem, including unbacked crypto, stablecoins, smart contracts, and DeFi services.
- Describe the structural flaws inherent in various elements of the crypto ecosystem.
- Describe the risks crypto poses to parties including crypto investors, governments, regulators, and traditional financial institutions; and identify potential policy actions that can be taken to mitigate these risks.

Digital Resilience and Financial Stability. The Quest for Policy Tools in The Financial Sector (April 13, 2023). Jose Ramon Martinez, Banco de Espana. [CI-10]

After completing this reading, you should be able to:

- Describe characteristics of cyber risks and information/communication technology (ICT) risks faced by financial institutions.
- Assess the interactions between cyber and ICT risks and financial risks and explain how cyber and ICT risk events at financial institutions can lead to systemic financial risk.
- Describe potential macroprudential tools and policy measures that can be used to address cyber risks and ICT risks and explain challenges to the adoption of each one.



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