

2020

FRM®

Learning Objectives



The Global Association of Risk Professionals (GARP®) created the Financial Risk Manager (FRM®) Learning Objectives document to provide a comprehensive resource for those interested in becoming Certified FRMs.

FRM LEARNING OBJECTIVES

The FRM is a comprehensive exam and you are expected to be familiar with a broad range of risk management concepts and techniques. Key concepts appear in the Study Guide as bullet points at the beginning of each section to help you identify the major themes and knowledge domains associated with the readings listed under each section. The Learning Objectives document builds upon the Study Guide and highlights more details around the recommended readings as well as specific learning objectives associated with each section of the knowledge domains covered by the Exam. Approximate weightings for each knowledge domain are assigned to help you navigate through the self-study process as these learning objectives form the backbone of the Exam itself; therefore, it is strongly suggested that you become familiar with these learning objectives as you review the readings.

FRM
LEARNING
OBJECTIVES
PART I



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

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

Global Association of Risk Professionals. *Foundations of Risk Management*. New York, NY: Pearson, 2019.

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.
- Describe elements, or building blocks, of the risk management process and identify problems and challenges that can arise in the risk management process.
- Evaluate and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative assessment and enterprise risk management.
- Distinguish between expected loss and unexpected loss and provide examples of each.
- Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management.
- Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.
- 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 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 corporate risk governance that occurred as a result of the 2007-2009 financial crisis.
- Compare and contrast best practices in corporate governance with those of risk management.
- Assess the role and responsibilities of the board of directors in risk governance.
- Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
- 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 how each one transfers credit risk and describe their advantages and disadvantages.
- 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 the capital market line.
- Apply the CAPM in calculating the expected return on an asset.
- Interpret beta and calculate the beta of a single asset or portfolio.
- 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.
- Calculate the expected return of an asset using a single-factor and a multifactor model.
- Explain models that account for correlations between asset returns in a multi-asset portfolio.
- Explain how to construct a portfolio to hedge exposure to multiple factors.
- Describe and apply the Fama-French three-factor model in estimating asset returns.

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.
- Describe the impact of data quality on model risk and the model development process.
- Describe key governance principles related to risk data aggregation and risk reporting practices.
- Identify the governance framework, risk data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices.
- Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another.
- Describe characteristics of effective risk reporting practices.
- Describe the role that supervisors play in the monitoring and implementation of the risk data aggregation and 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.
- Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative.
- Explain best practices for the governance and implementation of an ERM program.
- Describe important dimensions of an ERM program and relate ERM to strategic planning.
- Describe risk culture, explain 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 in capital planning.

Chapter 9. Learning From Financial Disasters [FRM-9]

After completing this reading you should be able to:

- Analyze the key factors that led to and derive the lessons learned from case studies involving the following risk factors:
 - Interest rate risk, including the 1980s savings and loan crisis in the US
 - Funding liquidity risk, including Lehman Brothers, Continental Illinois and Northern Rock
 - Implementing hedging strategies, 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 and complex derivatives, including Bankers Trust, the Orange County case, and Sachsen Landesbank
 - Reputational 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 taken 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 tests a candidate's knowledge of basic probability and statistics, regression and time series analysis and various quantitative techniques useful in risk management. The broad knowledge points covered in *Quantitative Analysis* include the following:

- Discrete and continuous probability distributions
- Estimating the parameters of distributions
- Population and sample statistics
- Bayesian analysis
- Statistical inference and hypothesis testing
- Measures of correlation
- Linear regression with single and multiple regressors
- Time series analysis and forecasting
- Simulation methods

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. *Quantitative Analysis*. New York, NY: Pearson, 2019.

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 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 level of confidence.
- Identify the steps to test a hypothesis about the difference between two population means.
- Explain the problem of multiple testing and how it can bias 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 between a t-statistic, its p-value and a confidence interval.

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 R^2 and adjusted- R^2 .
- Construct, apply and interpret joint hypothesis tests and confidence intervals for multiple coefficients in a regression.

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; 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; 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.

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.



Financial Markets and Products

PART I EXAM WEIGHT | 30% (FMP)

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

- Structures and functions of financial institutions
- 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 that should be achieved with each reading are:

Global Association of Risk Professionals. *Financial Markets and Products*. New York, NY: Pearson, 2019.

Chapter 1. Banks [FMP-1]

After completing this reading you should be able to:

- Identify the major risks faced by a bank and explain ways in which these risks can arise.
- Distinguish between economic capital and regulatory capital.
- Summarize 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 the conflict of interest problems.
- Describe the distinctions between the “banking book” and the “trading book” of a bank.
- Explain the originate-to-distribute model of a bank 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 payment for a policy holder.
- Distinguish between mortality risk and longevity risk and describe how to hedge these risks.
- Describe a defined benefit plan and a defined contribution plan for a pension fund and explain the differences between them.
- 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 the problems.
- 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.
- Calculate the net asset value (NAV) of an open-end mutual fund.
- 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 features and uses of derivatives and compare linear and non-linear derivatives.
- Describe the over-the-counter market, distinguish it from trading on an exchange and evaluate its advantages and disadvantages.
- Differentiate between options, forwards and futures contracts.
- Identify and calculate option and forward contract payoffs.
- 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.
- Calculate an arbitrage payoff and describe how arbitrage opportunities are temporary.
- Describe some of the risks that can arise from the use of derivatives.

Chapter 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.
- Describe netting and describe a netting process.
- Describe the implementation of a margining process and explain the determinants of initial and variation margin requirements.
- Compare exchange-traded and OTC markets and describe their uses.
- Identify the classes of derivative securities and explain the risk associated with them.
- Identify risks associated with OTC markets and explain how these risks can be mitigated.
- Describe the role of collateralization in the over-the-counter 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 and contrast bilateral markets to the use of novation and netting.
- 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 as well as non-members.

Chapter 7. Futures Markets [FMP-7]

After completing this reading you should be able to:

- Define and describe the key features 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 rationale for margin requirements and explain how they work.
- Describe the role of an exchange in futures and over-the-counter market transactions.
- Identify the differences between a normal and inverted futures market.
- Explain the different market quotes.
- Describe the mechanics of the delivery process and contrast it with cash settlement.
- Evaluate the impact of 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 the basis and explain the various sources of basis risk and explain how basis risks arise when hedging with futures.
- Define cross hedging and compute and interpret the minimum variance hedge ratio and hedge effectiveness.
- Compute the optimal number of futures contracts needed to hedge an exposure and explain and calculate the “tailing the hedge” adjustment.
- Explain how to use stock index futures contracts to change a stock portfolio’s beta.
- Explain 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 and distinguish between bid and ask exchange rates.
- Calculate 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 a currency relative to a foreign currency.
- 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:

- Differentiate between investment and consumption assets.
- Define short-selling and calculate the net profit of a short sale of a dividend-paying stock.
- Describe the differences between forward and futures contracts and explain the relationship between forward and spot prices.
- Calculate the forward price given the underlying asset's spot price and describe an arbitrage argument between spot and forward prices.
- 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 a forward foreign exchange rate using the interest rate parity relationship.
- 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 basic equilibrium formula for pricing commodity forwards.
- Describe an arbitrage transaction in commodity forwards and compute the potential arbitrage profit.
- Define the lease rate and explain how it determines the no-arbitrage values for commodity forwards and futures.
- Describe the cost of carry model and illustrate the impact of storage costs and convenience yields on commodity forward prices and no-arbitrage bounds.
- Compute the forward price of a commodity with storage costs.
- Compare the lease rate with the convenience yield.
- 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 relationship between current futures prices and expected future spot prices, including the impact of systematic and nonsystematic risk.
- Define and interpret normal backwardation and contango.

Chapter 12. Options Markets [FMP-12]

After completing this reading you should be able to:

- Describe the types, position variations, payoffs and profits and typical underlying assets of options.
- Explain the specification of exchange-traded stock option contracts, including that of nonstandard products.
- Explain how dividends and stock splits can impact the terms of a stock option.
- Describe how trading, commissions, margin requirements and exercise typically work for exchange-traded 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 a PPN.
- 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 factors 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 structure of the following exotic options: gap, forward start, compound, chooser, barrier, binary, lookback, Asian, exchange and basket options.
- Describe and contrast volatility and variance swaps.
- Explain the basic premise of static option replication and how it can be applied to hedging exotic options.

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 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 yield.
- 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 in corporate bonds.
- Describe the different classifications of bonds characterized by issuer, maturity, interest rate, and collateral.
- Describe the mechanisms by which corporate bonds can be retired before maturity.
- Define recovery rate and default rate, differentiate between an issue default rate and a dollar default rate and describe the relationship between recovery rates and seniority.
- 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.
- Describe the mortgage prepayment option and the factors that influence prepayments.
- Summarize the securitization process of mortgage-backed securities (MBS), particularly formation of mortgage pools including specific pools and to-be-announceds (TBAs).
- Calculate 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 of 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.
- Explain prepayment modeling and its four components: refinancing, turnover, defaults and curtailments.
- Describe the steps in valuing an MBS using Monte Carlo simulation.
- Define Option Adjusted Spread (OAS) and explain its challenges and its uses.

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 US Treasury bill.
- Differentiate between the clean and dirty price for a US Treasury bond; calculate the accrued interest and dirty price on a US Treasury bond.
- Explain and calculate a US Treasury bond futures contract conversion factor.
- Calculate the cost of delivering a bond into a Treasury bond futures contract.
- Describe the impact of the level and shape of the yield curve on the cheapest-to-deliver Treasury bond decision.
- Calculate the theoretical futures price for a Treasury bond futures contract.
- Calculate the final contract price on a Eurodollar futures contract and compare Eurodollar futures to FRAs.
- Describe and compute the Eurodollar futures contract convexity adjustment.
- Explain how Eurodollar futures can be used to extend the LIBOR zero curve.
- Calculate the duration-based hedge ratio and create a duration-based hedging strategy using interest rate futures.
- Explain the limitations of using a duration-based hedging strategy.

Chapter 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 the mechanics of a currency swap and compute its cash flows.
- Explain how a currency swap can be used to transform an asset or liability and calculate the resulting cash flows.
- Calculate the value of a currency swap based on two simultaneous bond positions.
- Calculate the value of a currency swap based on a sequence of 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 will test a candidate's knowledge of valuation techniques and risk models. The broad knowledge points covered in *Valuation and Risk Models* include the following:

- Value-at-Risk (VaR)
- Expected shortfall (ES)
- Estimating volatility and correlation
- Economic and regulatory capital
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation
- Hedging
- Country and sovereign risk models and management
- External and internal credit ratings
- Expected and unexpected losses
- Operational risk

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. *Valuation and Risk Models*. New York, NY: Pearson, 2019.

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.
- Explain the limitations of the mean-variance framework with respect to assumptions about return distributions.
- 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 period 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.
- Describe spectral risk measures and explain how VaR and ES are special cases of spectral risk measures.

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

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.
- Describe the implications of regime switching on quantifying volatility.
- Evaluate the various approaches for estimating VaR.
- Compare and contrast different parametric and non-parametric approaches for estimating conditional volatility.
- Calculate conditional volatility using parametric and non-parametric approaches.
- Evaluate implied volatility as a predictor of future volatility and its shortcomings.
- Apply the exponentially weighted moving average (EWMA) approach and 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.
- Calculate conditional volatility with and without mean reversion.
- Describe the impact of mean reversion on long horizon conditional volatility estimation.
- 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.
- Describe the impact of time horizon, economic cycle, industry and geography on external ratings.
- Define and use the hazard rate to calculate 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 at-the-point internal ratings approaches.
- Describe alternative methods to credit ratings produced by rating agencies.
- Compare external and internal ratings approaches.
- Describe and interpret a ratings transition matrix and explain its uses.
- Explain the potential impact of ratings changes on bond and stock prices.
- 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:

- Identify sources of country risk.
- Explain how a country's position in the economic growth life cycle, political risk, legal risk and economic structure affect its risk exposure.
- Evaluate composite measures of risk that incorporate all major types 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 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:

- Evaluate a bank's economic capital relative to its level of credit risk.
- Explain the distinctions between economic capital and regulatory capital and describe how economic capital is derived. 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 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 the 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 simulations.
- Describe the common data issues that can introduce inaccuracies and biases in the estimation of loss frequency and severity distributions.
- Describe how to use scenario analysis in instances when data is scarce.
- Describe how to identify causal relationships and how to use Risk and Control Self-assessment (RCSA), Key Risk Indicators (KRIs) and education to measure and manage operational risks.
- Describe the allocation of operational risk capital to business units.
- Explain how to use the power law to measure operational risk.
- Explain the risks of moral hazard and adverse selection when using insurance to mitigate operational risks.

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.
- Identify key aspects of stress testing governance, including choice of scenarios, regulatory specifications, model building, stress-testing coverage, capital and liquidity stress testing and reverse stress testing.
- Describe the relationship between stress testing and other risk measures, particularly in enterprise-wide stress testing.
- Explain the importance of stressed inputs and their importance in stressed VaR and stressed ES.
- Identify the advantages and disadvantages of stressed risk metrics.
- Describe the key elements of effective governance over stress testing.
- Describe the responsibilities of the board of directors and senior management in stress testing activities.
- Identify elements of clear and comprehensive policies, procedures and documentations for stress testing.
- Identify areas of validation and independent review for stress tests that require attention from a governance perspective.
- Describe the important role of the internal audit in stress testing governance and control.
- 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 US 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 in bond pricing.

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 spot rates given discount factors.
- Interpret the forward rate and compute forward rates given spot rates.
- Define par rate and describe the equation for the par rate of a bond.
- Interpret the relationship between spot, forward and par rates.
- Assess the impact of maturity on the price of a bond and the returns generated by bonds.
- Define the “flattening” and “steepening” of rate curves and describe a trade to reflect expectations that a curve will flatten or steepen.
- Describe a swap transaction and explain how a swap market defines par rates.
- Describe overnight indexed swap (OIS) and distinguish OIS rates from LIBOR swap 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.
- Compute a bond's YTM given a bond structure and price.
- Calculate the price of an annuity and a perpetuity.
- Explain the relationship between spot rates and YTM.
- Define the coupon effect and explain the relationship between coupon rate, YTM and bond prices.
- Explain the decomposition of 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.
- Explain the following four common assumptions in carry roll-down scenarios: realized forwards, unchanged term structure, unchanged yields and realized expectations of short-term rates; 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 yield and the resulting change in price.
- Calculate the face amount of bonds required to hedge an option position given the DV01 of each.
- Define, compute and interpret the effective duration of a fixed income security given a change in yield and the resulting change in price.
- Compare and contrast DV01 and effective duration as measures of price sensitivity.
- Define, compute and interpret the convexity of a fixed income security given a change in yield and the resulting change in price.
- Explain the process of calculating the effective duration and convexity of a portfolio of fixed income securities.
- Describe an example of hedging 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 versus barbell portfolios.

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

After completing this reading you should be able to:

- Describe and assess the major weakness attributable to single-factor approaches when hedging portfolios or implementing asset liability techniques.
- Describe the principal components analysis and explain its use in understanding term structure movements.
- Define key rate exposures and know the characteristics of key rate exposure factors including partial '01s and forward-bucket '01s.
- Describe key-rate shift analysis.
- Define, calculate and interpret key rate '01 and key rate duration.
- Describe the key rate exposure technique in multi-factor hedging applications; summarize its advantages and disadvantages.
- Calculate the key rate exposures for a given security and compute the appropriate hedging positions given a specific key rate exposure profile.
- Relate key rates, partial '01s and forward-bucket '01s and calculate the forward-bucket '01 for a shift in rates in one or more buckets.
- Apply key rate and multi-factor analysis to estimating portfolio volatility.

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 using the Black-Scholes-Merton model on a non-dividend-paying stock.
- Define implied volatilities and describe how to compute implied volatilities from market prices of options using the Black-Scholes-Merton model.
- Explain how dividends affect the decision to exercise early for American call and put options.
- Compute the value of a European option using the Black-Scholes-Merton model on a dividend-paying stock, futures and exchange rates.
- 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.
- Describe delta hedging for an option, forward and futures contracts.
- Compute the delta of an option.
- Describe the dynamic aspects of delta hedging and distinguish between dynamic hedging and hedge-and-forget strategy.
- Define and calculate the delta of a portfolio.
- Define and describe theta, gamma, vega and rho for option positions and calculate the gamma and vega for a portfolio.
- Explain how to implement and maintain a delta-neutral and a gamma-neutral position.
- Describe the relationship between delta, theta, gamma and vega.
- Describe how portfolio insurance can be created through option instruments and stock index futures.

FRM
LEARNING
OBJECTIVES
PART II



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

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

Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, 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.
- Define coherent risk measures.
- 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 generalized extreme value and POT.
- Evaluate the tradeoffs involved in setting the threshold level when applying the generalized Pareto (GP) distribution.
- Explain the importance of multivariate EVT for risk management.

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

Chapter 6. Backtesting VaR [MR-4]

After completing this reading you should be able to:

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

Chapter 11. VaR Mapping [MR-5]

After completing this reading you should be able to:

- Explain the principles underlying VaR mapping and describe the mapping process.
- Explain how the mapping process captures general and specific risks.
- Differentiate among the three methods of mapping portfolios of fixed income securities.
- Summarize how to map a fixed income portfolio into positions of standard instruments.
- Describe how mapping of risk factors can support stress testing.
- Explain how VaR can be used as a performance benchmark.
- Describe the method of mapping forwards, forward rate agreements, interest rate swaps and options.

“Messages from the academic literature on risk measurement for the trading book,” Basel Committee on Banking Supervision, Working Paper, No. 19, Jan 2011. [MR-6]

After completing this reading you should be able to:

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

Gunter Meissner, *Correlation Risk Modeling and Management, 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 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 the translation of the copula equation.
- Describe the Gaussian copula and explain how to use it to derive the joint probability of default of two assets.
- Summarize the process of finding the default time of an asset correlated to all other assets in a portfolio using the Gaussian copula.

Bruce Tuckman and Angel Serrat, *Fixed Income Securities: 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:

- Define volatility smile and volatility skew.
- Explain the implications of put-call parity on the implied volatility of call and put options.
- Compare the shape of the volatility smile (or skew) to the shape of the implied distribution of the underlying asset price and to the pricing of options on the underlying asset.
- Describe characteristics of foreign exchange rate distributions and their implications on option prices and implied volatility.
- Describe the volatility smile for equity options and foreign currency options and provide possible explanations for its shape.
- Describe alternative ways of characterizing the volatility smile.
- Describe volatility term structures and volatility surfaces and how they may be used to price options.
- Explain the impact of the volatility smile on the calculation of "the Greeks".
- Explain the impact of a single asset price jump on a volatility smile.

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 focus 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 that should be achieved with each reading are:

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

Chapter 1. The Credit Decision [CR-1]

After completing this reading you should be able to:

- Define credit risk and explain how it arises using examples.
- Explain the components of credit risk evaluation.
- Describe, compare and contrast various credit risk mitigants and their role in credit analysis.
- Compare and contrast quantitative and qualitative techniques of credit risk evaluation.
- Compare the credit analysis of consumers, corporations, financial institutions and sovereigns.
- Describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss and time horizon.
- Compare bank failure and bank insolvency.

Chapter 2. The Credit Analyst [CR-2]

After completing this reading you should be able to:

- Describe the quantitative, qualitative and research skills a banking credit analyst is expected to have.
- Assess the quality of various sources of information used by a credit analyst.
- Explain the CAMEL system used for evaluating the financial condition of a bank.

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-3]

After completing this reading you should be able to:

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

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

Chapter 3. Rating Assignment Methodologies [CR-4]

After completing this reading you should be able to:

- Explain the key features of a good rating system.
- Describe the experts-based approaches, statistical-based models and numerical approaches to predicting default.
- Describe a rating migration matrix and calculate the probability of default, cumulative probability of default, marginal probability of default and annualized default rate.
- Describe rating agencies' assignment methodologies for issue and issuer ratings.
- Describe the relationship between borrower rating and probability of default.
- Compare agencies' ratings to internal experts-based rating systems.
- Distinguish between the structural approaches and the reduced-form approaches to predicting default.
- Apply the Merton model to calculate default probability and the distance to default and describe the limitations of using the Merton model.
- Describe linear discriminant analysis (LDA), define the Z-score and its usage and apply LDA to classify a sample of firms by credit quality.
- Describe the application of a logistic regression model to estimate default probability.
- Define and interpret cluster analysis and principal component analysis.
- Describe the use of a cash flow simulation model in assigning rating and default probability and explain the limitations of the model.
- Describe the application of heuristic approaches, numeric approaches and artificial neural networks in modeling default risk and define their strengths and weaknesses.
- Describe the role and management of qualitative information in assessing probability of default.

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

Chapter 18. Credit Risks and Credit Derivatives [CR-5]

After completing this reading you should be able to:

- Using the Merton model, calculate the value of a firm's debt and equity and the volatility of firm value.
- Explain the relationship between credit spreads, time to maturity and interest rates and calculate credit spread.
- Explain the differences between valuing senior and subordinated debt using a contingent claim approach.
- Explain, from a contingent claim perspective, the impact of stochastic interest rates on the valuation of risky bonds, equity and the risk of default.
- Compare and contrast different approaches to credit risk modeling, such as those related to the Merton model, CreditRisk+, CreditMetrics and the KMV model.
- Assess the credit risks of derivatives.
- Describe a credit derivative, credit default swap and total return swap.
- Explain how to account for credit risk exposure in valuing a swap.

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

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

After completing this reading you should be able to:

- Compare the different ways of representing credit spreads.
- Compute one credit spread given others when possible.
- Define and compute the Spread '01.
- Explain how default risk for a single company can be modeled as a Bernoulli trial.
- Explain the relationship between exponential and Poisson distributions.
- Define the hazard rate and use it to define probability functions for default time and conditional default probabilities.
- Calculate the unconditional default probability and the conditional default probability given the hazard rate.
- Distinguish between cumulative and marginal default probabilities.
- Calculate risk-neutral default rates from spreads.
- Describe advantages of using the CDS market to estimate hazard rates.
- Explain how a CDS spread can be used to derive a hazard rate curve.
- Explain how the default distribution is affected by the sloping of the spread curve.
- Define spread risk and its measurement using the mark-to-market and spread volatility.

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

After completing this reading you should be able to:

- Define 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 and calculate Credit VaR.
- 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-8]

After completing this reading you should be able to:

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

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital*, 3rd Edition (West Sussex, UK: John Wiley & Sons, 2015).

Chapter 4. Counterparty Risk [CR-9]

After completing this reading you should be able to:

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

Chapter 5. Netting, Close-out and Related Aspects [CR-10]

After completing this reading you should be able to:

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

Chapter 6. Collateral [CR-11]

After completing this reading you should be able to:

- Describe the rationale for collateral management.
- Describe the terms of a collateral 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.
- 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.

Chapter 7. Credit Exposure and Funding [CR-12]

After completing this reading you should be able to:

- Describe and calculate the following metrics for credit exposure: expected mark-to-market, expected exposure, potential future exposure, expected positive exposure and negative exposure, effective exposure and maximum exposure.
- Compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.
- Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.
- Identify typical credit exposure profiles for various derivative contracts and combination profiles.
- Explain how payment frequencies and exercise dates affect the exposure profile of various securities.
- Explain the impact of netting on exposure, the benefit of correlation, and calculate the netting factor.
- Explain the impact of collateralization on exposure and assess the risk associated with the remargining period, threshold and minimum transfer amount.
- Assess the impact of collateral on counterparty risk and funding, with and without segregation or rehypothecation.

Chapter 9. Counterparty Risk Intermediation [CR-13]

After completing this reading you should be able to:

- Identify counterparty risk intermediaries including central counterparties (CCPs), derivative product companies (DPCs), special purpose vehicles (SPVs) and monoline insurance companies (monolines) and describe their roles.
- Describe the risk management process of a CCP and explain the loss waterfall structure of a CCP.
- Compare bilateral and centrally cleared over-the-counter (OTC) derivative markets.
- Assess the capital requirements for a qualifying CCP and discuss the advantages and disadvantages of CCPs.
- Discuss the impact of central clearing on credit value adjustment (CVA), funding value adjustment (FVA), capital value adjustment (KVA) and margin value adjustment (MVA).

Chapter 14. Credit and Debt Value Adjustments [CR-14]

After completing this reading you should be able to:

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

Chapter 17. Wrong-way Risk [CR-15]

After completing this reading you should be able to:

- Describe wrong-way risk and contrast it with right-way risk.
- Identify examples of wrong-way risk and examples of right-way risk.
- Discuss the impact of collateral on wrong-way risk.
- Discuss the impact of wrong-way risk on central counterparties.

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-16]

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.
- Calculate the stressed expected loss, the stress loss for the 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.

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-17]

After completing this reading you should be able to:

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

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

After completing this reading you should be able to:

- Discuss the flaws in the securitization of subprime mortgages prior to the financial crisis of 2007.
- Identify and explain the different techniques used to mitigate credit risk and describe how some of these techniques are changing the bank credit function.
- Describe the originate-to-distribute model of credit risk transfer and discuss the two ways of managing a bank credit portfolio.
- Describe the different types and structures of credit derivatives including credit default swaps (CDS), first-to-default puts, total return swaps (TRS), asset-backed credit-linked notes (CLN) and their applications.

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-19]

After completing this reading you should be able to:

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

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

After completing this reading you should be able to:

- Explain the subprime mortgage credit securitization process in the United States.
- Identify and describe key frictions in subprime mortgage securitization and assess the relative contribution of each factor to the subprime mortgage problems.
- Compare predatory lending and borrowing.



Operational Risk and Resiliency

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 Resiliency* include the following:

- Principles for sound operational risk management
- Risk appetite frameworks and enterprise risk management (ERM)
- Risk culture and conduct
- Analyzing and reporting operational loss data
- Model risk and model validation
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital planning
- Stress testing banks
- Third-party outsourcing risk
- Risks related to money laundering and financing of terrorism
- Regulation and the Basel Accords
- Cyber risk and cyber resilience
- Operational resilience

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

“Principles for the Sound Management of Operational Risk,” (Basel Committee on Banking Supervision Publication, June 2011). [ORR-1]

After completing this reading you should be able to:

- Describe the three “lines of defense” in the Basel model for operational risk governance.
- Summarize the fundamental principles of operational risk management as suggested by the Basel Committee.
- Explain guidelines for strong governance of operational risk and evaluate the role of the board of directors and senior management in implementing an effective operational risk framework.
- Describe tools and processes that can be used to identify and assess operational risk.
- Describe features of an effective control environment and identify specific controls that should be in place to address operational risk.
- Explain the Basel Committee’s suggestions for managing technology risk and outsourcing risk.

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

After completing this reading you should be able to:

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

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

Chapter 4. What is ERM? [ORR-3]

After completing this reading you should be able to:

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

“Implementing Robust Risk Appetite Frameworks to Strengthen Financial Institutions,” *Institute of International Finance*, June 2011. [ORR-4]

After completing this reading you should be able to:

- Describe best practices for the implementation and communication of a risk appetite framework (RAF) at a firm.
- Explain the relationship between a firm’s RAF and its risk culture and between the RAF and a firm’s strategy and business planning process.
- Explain key challenges to the implementation of an RAF and describe ways that a firm can overcome each challenge.
- Assess the role of stress testing within an RAF and describe challenges in aggregating firm-wide risk exposures.
- Explain lessons learned in the implementation of a RAF through the presented case studies.

“Banking Conduct and Culture: A Permanent Mindset Change,” G30 Working Group, 2018. (Introduction through Lessons Learned only) [ORR-5]

After completing this reading you should be able to:

- Describe challenges faced by banks with respect to conduct and culture and explain motivations for banks to improve their conduct and culture.
- Explain methods by which a bank can improve its corporate culture and assess progress made by banks in this area.
- Explain how a bank can structure performance incentives and make staff development decisions to encourage a strong corporate culture.
- Summarize expectations by different national regulators for banks’ conduct and culture.
- Describe best practices and lessons learned in managing a bank’s corporate culture.

Alessandro Carretta, Franco Fiordelisi and Paola Schwizer, Risk Culture in Banking (Palgrave Macmillan, 2017).

Chapter 2: Risk Culture [ORR-6]

After completing this reading you should be able to:

- Compare risk culture and corporate culture and explain how they interact.
- Explain factors that influence a firm’s corporate culture and its risk culture.
- Describe methods by which corporate culture and risk culture can be measured.
- Describe characteristics of a strong risk culture and challenges to the implementation of an effective risk culture.
- Assess the relationship between risk culture and business performance.

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

Chapter 2: OpRisk Data and Governance [OR-7]

After completing this reading you should be able to:

- Describe the seven Basel II event risk categories and identify examples of operational risk events in each category.
- Summarize the process of collecting and reporting internal operational loss data, including the selection of thresholds, the timeframe for recoveries and reporting expected operational losses.
- Explain the use of a risk control self-assessment (RCSA) and key risk indicators (KRIs) in identifying, controlling and assessing operational risk exposures.
- Describe and assess the use of scenario analysis in managing operational risk and identify biases and challenges that can arise when using scenario analysis.
- Compare the typical operational risk profiles of firms in different financial sectors.
- Explain the role of operational risk governance and explain how a firm’s organizational structure can impact risk governance.

“Supervisory Guidance on Model Risk Management,” Federal Deposit Insurance Corporation, June 7, 2017. [ORR-8]

After completing this reading you should be able to:

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

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

Chapter 3. Information Risk and Data Quality Management [ORR-9]

After completing this reading you should be able to:

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

Giacomo De Laurentis, Renato Maino, Luca Molteni, Developing, Validating and Using Internal Ratings (Hoboken, NJ: John Wiley & Sons, 2010).

Chapter 5. Validating Rating Models [ORR-10]

After completing this reading you should be able to:

- Explain the process of model validation and describe best practices for the roles of internal organizational units in the validation process.
- Compare qualitative and quantitative processes to validate internal ratings and describe elements of each process.
- Describe challenges related to data quality and explain steps that can be taken to validate a model's data quality.
- Explain how to validate the calibration and the discriminatory power of a rating model.

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

Chapter 11. Assessing the Quality of Risk Measures [OR-11]

After completing this reading you should be able to:

- Describe ways that errors can be introduced into models.
- Explain how model risk and variability can arise through the implementation of VaR models and the mapping of risk factors to portfolio positions.
- Identify reasons for the failure of the long-equity tranche, short-mezzanine credit trade in 2005 and describe how such modeling errors could have been avoided.
- Explain major defects in model assumptions that led to the underestimation of systematic risk for residential mortgage backed securities (RMBS) during the 2007-2009 financial downturn.

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-12]

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-13]

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 BIS recommendations 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-14]

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

“Stress Testing Banks,” Til Schuermann, *International Journal of Forecasting* 30, no. 3, (2014): 717-728 [ORR-15]

After completing this reading you should be able to:

- Describe the historical evolution of the stress testing process and compare 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.

“Guidance on Managing Outsourcing Risk,” Board of Governors of the Federal Reserve System, December 2013. [ORR-16]

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.

Mark Carey “Management of Risks Associated with Money Laundering and Financing of Terrorism,” GARP Risk Institute, February 2019. [ORR-17]

After completing this reading you should be able to:

- Explain best practices recommended for the assessment, management, mitigation and monitoring of money laundering and financial terrorism (ML/FT) risks.

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

Chapter 17. Regulation of the OTC Derivatives Market [ORR-18]

After completing this reading you should be able to:

- Summarize the clearing process in OTC derivative markets.
- Describe changes to the regulation of OTC derivatives which took place after the 2007-2009 financial crisis and explain the impact of these changes.

Mark Carey, “Capital Regulation Before the Global Financial Crisis,” GARP Risk Institute, April 2019. [ORR-19]

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 to calculate 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 IRB approach, the Foundation Internal Ratings-Based (IRB) approach and the advanced IRB approach for the calculation of credit risk capital under Basel II.
- 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-20]

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.
- Explain motivations for “gold plating” of regulations and 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-21]

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-22]

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.

Andrew Coburn, Eireann Leverett, and Gordon Woo, Solving Cyber Risk: Protecting Your Company and Society (Hoboken, NJ: Wiley, 2019).

Chapter 8: The Cyber-Resilient Organization [ORR-23]

After completing this reading you should be able to:

- Describe elements of an effective cyber-resilience framework and explain ways that an organization can become more cyber-resilient.
- Explain resilient security approaches that can be used to increase a firm’s cyber resilience and describe challenges to their implementation.
- Explain methods that can be used to assess the financial impact of a potential cyber attack and explain ways to increase a firm’s financial resilience.

“Cyber-resilience: Range of practices,” (Basel Committee on Banking Supervision Publication, December 2018). [ORR-24]

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.

“Building the UK financial sector’s operational resilience,” (Bank of England, July 2018). (Exclude Section 3, Include only Annex 1) [ORR-25]

After completing this reading you should be able to:

- Describe operational resilience and describe threats and challenges to the operational resilience of a financial institution.
- Explain recommended principles, including tools and metrics, for maintaining strong operational resilience at financial institutions.
- Describe potential consequences of business disruptions, including potential systemic risk impacts.
- Define impact tolerance; explain best practices and potential benefits for establishing the impact tolerance for a firm or a business process.

“Striving for Operational Resilience: The Questions Boards and Senior Management Should Ask,” Oliver Wyman, 2019. [ORR-26]

After completing this reading you should be able to:

- Compare operational resilience to traditional business continuity and disaster recovery approaches.
- Describe elements of an effective operational resilience framework and its potential benefits.



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 that should be achieved 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 US 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.
- Define liquidity risk, funding cost risk, liquidity generation capacity, expected liquidity, 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 plan 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, 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 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 Nondeposit Liabilities [LTR-13]

After completing this reading you should be able to:

- Distinguish 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) credit crisis.
- Compare the use of general and special collateral in repo transactions.
- Identify the characteristics of special spreads and explain the typical behavior of US Treasury special spreads over an auction cycle.
- Calculate the financing advantage of a bond trading special when used in a repo transaction.

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, matched maturity marginal cost).
- Describe the contingent liquidity risk pricing process and calculate the cost of contingent liquidity risk.

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

After completing this reading you should be able to:

- Identify the causes of the US 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, 2016. “Covered Interest Parity Lost: Understanding the Cross-Currency Basis,” BIS Quarterly Review. [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 that should be achieved 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.
- Describe the capital asset pricing model (CAPM) including its assumptions and explain how factor risk is addressed in the CAPM.
- Explain 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 reasons why a value premium may exist.
- Explain how different macroeconomic risk factors, including economic growth, inflation and volatility affect risk premiums and asset returns.
- 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 risk and return 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 measure time-varying factor exposures and their use in style analysis.
- Describe issues that arise when measuring alphas for nonlinear strategies.
- Compare the volatility anomaly and 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 methods and motivation for refining alphas in the implementation process.
- Describe neutralization and methods for refining alphas to be neutral.
- Describe the implications of transaction costs on portfolio construction.
- Assess the impact of practical issues in portfolio construction, such as determination of risk aversion, incorporation of specific risk aversion and proper alpha coverage.
- Describe portfolio revisions and rebalancing and evaluate the tradeoffs between alpha, risk, transaction costs and time horizon.
- Determine the optimal no-trade region for rebalancing with transaction costs.
- Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming and quadratic programming.
- Describe dispersion, explain its causes and describe methods for controlling forms of dispersion.

Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York, 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: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR and diversified portfolio VaR.
- Explain the role of correlation on portfolio risk.
- Describe the challenges associated with VaR measurement as portfolio size increases.
- Apply the concept of marginal VaR to guide decisions about portfolio VaR.
- Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio.
- Explain the difference between risk management and portfolio management and describe how to use marginal VaR in portfolio management.

Chapter 17. VaR and Risk Budgeting in Investment Management [IM-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.
- Apply VaR to check compliance, monitor risk budgets and reverse engineer sources of risk.
- Explain how VaR can be used in the investment process and the development of investment guidelines.
- Describe the risk budgeting process and calculate risk budgets across asset classes and active managers.

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

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

After completing this reading you should be able to:

- Define, compare and contrast VaR and tracking error as risk measures.
- Describe risk planning, including its objectives, effects and the participants in its development.
- Describe risk budgeting and the role of quantitative methods in risk budgeting.
- Describe risk monitoring and its role in an internal control environment.
- Identify sources of risk consciousness within an organization.
- Describe the objectives and actions of a risk management unit in an investment management firm.
- Describe how risk monitoring can confirm that investment activities are consistent with expectations.
- Describe Liquidity Duration Statistic and how it can be used to measure liquidity.
- Describe the use of alpha, benchmark and peer group as inputs in performance measurement tools.
- Describe the objectives of performance measurement.

Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 11th Edition* (New York, NY: McGraw-Hill, 2017).

Chapter 24. Portfolio Performance Evaluation [IM-8]

After completing this reading you should be able to:

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

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:

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

Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 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 funds in the past.
- Explain elements of the due diligence process used to assess investment managers.
- Identify themes and questions investors can consider when evaluating a manager.
- Describe criteria that can be evaluated in assessing a fund's risk management process.
- Explain how due diligence can be performed on a fund's operational environment.
- Explain how a fund's business model risk and its fraud risk can be assessed.
- Describe elements that can be included as part of a due diligence questionnaire.



Current Issues in Financial Markets

PART II EXAM WEIGHT | 10% (CI)

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:

- Blockchain
- Fintech revolution
- Artificial intelligence (AI), machine learning and “big data”
- Climate change and financial risk
- Reference rates

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

“The Impact of Blockchain Technology on Finance: A Catalyst for Change,” International Center for Monetary and Banking Studies, 2018. (Section 1-Section 3 only) [CI-1]

After completing this reading you should be able to:

- Describe the challenges blockchain technology faces in gaining widespread adoption in economic applications.
- Explain and assess the questions to be considered prior to implementing a blockchain solution to any economic activity.
- Explain the concept of cost of trust when speaking about legacy financial systems and blockchain technology.
- Describe the current regulatory concerns surrounding crypto-finance and assess the steps taken by regulators to address these issues.

“FinTech and market structure in financial services: Market developments and potential financial stability implications,” Financial Stability Board, February 14, 2019. [CI-2]

After completing this reading you should be able to:

- Differentiate between the potential changes to market structure (lending, payments, insurance, trading) and financial stability risks resulting from financial innovation through traditional providers, Fintech providers, Big Tech and third-party tech servicers.
- Discuss the impact and risks of technological developments in the areas of APIs, mobile banking and cloud computing on payment systems along with the scope of the EU’s Payment Services Directive.
- Analyze the market structure impact and risks of China’s NPI’s online MMFs in the areas of same day cash availability, deposit guarantee mechanisms and concentration risk along with the effort of Chinese authorities to address these risks.

Stijn Claessens, Jon Frost, Grant Turner, and Feng Zhu, “Fintech credit markets around the world: size, drivers and policy issues,” BIS Quarterly Review, September 23, 2018. [CI-3]

After completing this reading you should be able to:

- Describe the difficulties involved in measuring the size of the global fintech credit market.
- Describe the factors that have driven the recent growth of the fintech credit market.
- Examine the potential benefits and risks inherent in the fintech credit market.
- Compare and evaluate how different jurisdictions have crafted policy and regulatory responses to the fintech credit market.

“Sound Practices: Implications of fintech developments for banks and bank supervisors,” Bank for International Settlements (BIS), February 2018. [CI-4]

After completing this reading you should be able to:

- Differentiate between the five Basel fintech scenarios and the roles participants (incumbent banks, new banks, Big Tech, fintech firms and service providers) perform and risks they are subject to in each.
- Discuss the Basel disintermediated bank scenario and its impact on incumbent banks’ present business models. Identify areas of existing product and funding risks.
- Distinguish practical instances of Basel Committee’s Principles for sound management of operational risk (PSMOR) as applied to fintech.
- Distinguish the implications for bank supervisors on regulatory frameworks as a result of fintech along with existing licensing regimes and regulatory responses.

Tobias Adrian and Tommaso Mancini-Griffoli, “The Rise of Digital Money,” International Monetary Fund (IMF), July 2019. [CI-5]

After completing this reading you should be able to:

- Describe the characteristics of e-money that could propel a rapid global adoption of this type of money.
- Describe the risks faced by the banking sector as e-money adoption increases.
- Evaluate regulatory and policy actions that could be implemented in response to risks arising from increased adoption of e-money.

Hal Varian, “Big Data: New Tricks for Econometrics,” Journal of Economic Perspectives (Spring 2014): 28(2), 3-28. [CI-6]

After completing this reading you should be able to:

- Describe the issues unique to big datasets.
- Explain and assess different tools and techniques for manipulating and analyzing big data.
- Examine the areas for collaboration between econometrics and machine learning.

Bart van Liebergen, “Machine Learning: A Revolution in Risk Management and Compliance?” Institute of International Finance, April 2017. [CI-7]

After completing this reading you should be able to:

- Describe the process of machine learning and compare machine learning approaches.
- Describe the application of machine learning approaches within the financial services sector and the types of problems to which they can be applied.
- Analyze the application of machine learning in three use cases:
 - Credit risk and revenue modeling
 - Fraud
 - Surveillance of conduct and market abuse in trading

“Artificial intelligence and machine learning in financial services,” Financial Stability Board, Nov. 1, 2017. [CI-8]

After completing this reading you should be able to:

- Describe the drivers that have contributed to the growing use of FinTech and the supply and demand factors that have spurred adoption of AI and machine learning in financial services.
- Describe the use of AI and machine learning in the following cases:
 - (i) customer-focused uses
 - (ii) operations-focused uses
 - (iii) trading and portfolio management in financial markets
 - (iv) uses for regulatory compliance
- Describe the possible effects and potential benefits and risks of AI and machine learning on financial markets and how they may affect financial stability.

Hugues Chenet, “Climate Change and Financial Risk,” Social Science Research Network, June 25, 2019. [CI-9]

After completing this reading you should be able to:

- Discuss the history of climate change related risks for the financial sector including the Paris Agreement (2015) and distinguish the significance of Article 2.1 c as it pertains to the financial system.
- Distinguish the causes of potential mispricing of climate change risk and the impact of relevant history and data, non-normal probability distributions, kurtoses, skew, “black swan” events, and risk materialization time horizons on pricing as compared to traditional investment risk analysis.
- Discuss recent reporting and disclosure requirements under Article 173 of the French Energy Transition Act and the impact of The European Commission Sustainable Finance Action Plan on the allocation of capital towards sustainable investments and inclusion of climate and environmental factors in financial institutions’ risk management policies.

Andreas Schrimpf and Vladyslav Sushko, “Beyond LIBOR: a primer on the new benchmark rates,” BIS Quarterly Review, March 5, 2019. [CI-10]

After completing this reading you should be able to:

- Describe the features comprising an ideal benchmark.
- Examine the issues that led to the replacement of LIBOR as the reference rate.
- Examine the risks inherent in basing risk-free rates (RFR’s) on transactions in the repo market.



Creating a culture of risk awareness®

garp.org

ABOUT GARP | The Global Association of Risk Professionals is a non-partisan, not-for-profit membership organization. GARP offers risk certification — the Financial Risk Manager and Energy Risk Professional — and educational programs for professionals at financial institutions, government agencies, central banks, academia and corporations. Through the GARP Benchmarking Initiative and GARP Risk Institute, GARP sponsors research in risk management and promotes collaboration among practitioners, academics and regulators to promote a culture of risk awareness.

Founded in 1996, governed by a Board of Trustees, GARP is headquartered in Jersey City, NJ, with offices in London, Washington, D.C., Beijing and Hong Kong.

HEADQUARTERS

111 Town Square Place
14th Floor
Jersey City, New Jersey
07310 USA
+1 (201) 719.7210

LONDON

17 Devonshire Square
4th Floor
London, EC2M 4SQ UK
+44 (0) 20 7397.9630

WASHINGTON, D.C.

1001 19th Street North, #1200
Arlington, Virginia
22209 USA
+1 (703) 420.0920

BEIJING

Unit 1010 Financial
Street Centre
No. 9A, Financial Street,
Xicheng District
Beijing 100033 China
+86 (010) 5737.9835

HONG KONG

The Center
99 Queen's Road Central
Office No. 5510
55th Floor
Central, Hong Kong SAR, China
+852 3168.1532