CREDIT RISK MEASUREMENT AND MANAGEMENT

PART II EXAM WEIGHT | 20% (CR)

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

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

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

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

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

After completing this reading, you should be able to:

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

Chapter 2. Governance [CR–2]

After completing this reading, you should be able to:

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

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

Chapter 7. Credit Risk Management [CR–3]

After completing this reading, you should be able to:

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

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

Chapter 5. Capital Structure in Banks (pages 170-186 only) [CR–4]

After completing this reading, you should be able to:

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

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

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

After completing this reading, you should be able to:

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

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

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

After completing this reading, you should be able to:

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

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

Chapter 9. Credit Scoring and Retail Credit Risk Management [CR–7]

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

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

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

Chapter 17. Estimating Default Probabilities [CR–9]

After completing this reading, you should be able to:

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

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

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

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

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

Chapter 9. Structured Credit Risk [CR–22]

After completing this reading, you should be able to:

- Describe common types of structured products.
- Describe tranching and the distribution of credit losses in a securitization.
- Describe a waterfall structure in a securitization.
- Identify the key participants in the securitization process and describe conflicts of interest that can arise in the process.
- Compute and evaluate one or two iterations of interim cashflows in a three-tiered securitization structure.
- Describe the treatment of excess spread in a securitization structure and estimate the value of the overcollateralization account at the end of each year.
- Explain the tests on the excess spread that a custodian must go through at the end of each year to determine the cash flow to the overcollateralization account and to the equity noteholders.
- Describe a simulation approach to calculating credit losses for different tranches in a securitization.
- Explain how the default probabilities and default correlations affect the credit risk in a securitization.
- Explain how default sensitivities for tranches are measured.
- Describe risk factors that impact structured products.
- Define implied correlation and describe how it can be measured.
- Identify the motivations for using structured credit products.

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

Chapter 24. Credit Risk [CR–12]

After completing this reading, you should be able to:

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

Chapter 25. Credit Derivatives [CR–13]

After completing this reading, you should be able to:

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

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

Chapter 2. Derivatives [CR–14]

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

- Describe counterparty risk and differentiate it from lending risk.
- Describe transactions that carry counterparty risk and explain how counterparty risk can arise in each transaction.
- Identify and describe institutions that take on significant counterparty risk.
- Describe credit exposure, credit migration, recovery, mark-to-market, replacement cost, default probability, loss given default, and the recovery rate.
- Describe credit value adjustment (CVA) and compare the use of CVA and credit limits in evaluating and mitigating counterparty risk.
- Identify and describe the different ways institutions can quantify, manage, and mitigate counterparty risk.
- Identify and explain the costs of an OTC derivative.
- Explain the components of the X-Value Adjustment (xVA) term.

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

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

- Describe the rationale for collateral management.
- Describe the terms of a collateral agreement and features of a credit support annex (CSA) within the ISDA Master Agreement including threshold, initial margin, minimum transfer amount and rounding, haircuts, credit quality, and credit support amount.
- Calculate the credit support amount (margin) under various scenarios.
- Describe the role of a valuation agent.
- Describe the mechanics of collateral and the types of collateral that are typically used.
- Explain the process for the reconciliation of collateral disputes.
- Explain the features of a collateralization agreement.
- Differentiate between a two-way and one-way CSA agreement and describe how collateral parameters can be linked to credit quality.
- Explain aspects of collateral including funding, rehypothecation, and segregation.
- Explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.
- Describe the various regulatory capital requirements.

Chapter 8. Central Clearing [CR–18]

After completing this reading, you should be able to:

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

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

After completing this reading, you should be able to:

- Describe and calculate the following metrics for credit exposure: expected mark-to-market, expected exposure, potential future exposure, expected positive exposure and negative exposure, effective expected positive exposure, and maximum exposure.
- Compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.
- Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.
- Identify typical credit exposure profiles for various derivative contracts and combination profiles.
- Explain how payment frequencies and exercise dates affect the exposure profile of various securities.
- Explain the general impact of aggregation on exposure, and the impact of aggregation on exposure when there is correlation between transaction values.
- Describe the differences between funding exposure and credit exposure.

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

Chapter 17. CVA [CR–20]

After completing this reading, you should be able to:

- Explain the motivation for and the challenges of pricing counterparty risk.
- Describe credit value adjustment (CVA).
- Calculate CVA and CVA as a spread with no wrong-way risk, netting, or collateralization.
- Evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.
- Describe debt value adjustment (DVA) and bilateral CVA (BCVA).
- Explain the distinctions between unilateral CVA (UCVA) and BCVA, and between unilateral DVA (UDVA) and BCVA.
- Calculate DVA, BCVA, and BCVA as a spread.
- Explain how netting can be incorporated into the CVA calculation.
- Define and calculate incremental CVA and marginal CVA and explain how to convert CVA into a running spread.
- Explain the impact of incorporating collateralization into the CVA calculation, including the impact of margin period of risk, thresholds, and initial margins.
- Describe wrong-way risk and contrast it with right-way risk.
- Identify examples of wrong-way risk and examples of right-way risk.
- Discuss the impact of collateral on wrong-way risk.
- Identify examples of wrong-way collateral.
- Discuss the impact of wrong-way risk on central counterparties (CCPs).
- Describe the various wrong-way modeling methods including hazard rate approaches, structural approaches, parametric approaches, and jump approaches.
- Explain the implications of central clearing on wrong-way risk.

***Stress Testing: Approaches, Methods, and Applications*, edited by Akhtar Siddique and Iftekhar Hasan (London, UK: Risk Books, 2013).**

Chapter 4. The Evolution of Stress Testing Counterparty Exposures [CR–21]

After completing this reading, you should be able to:

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

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

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

After completing this reading, you should be able to:

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