

# FCIA SYLLABUS: READING LIST

## Finance, investments, and ERM track with banking option

### Exam F1FIE: Financial Products

The aim of this exam is for candidates to develop the following skills:

1. Understand different types of financial products and their uses.
2. Understand the main principles and techniques of pricing that are relevant to investments.
3. Apply these principles and techniques within the context of investing.
4. Understand how pricing links to wider business processes (e.g., business planning and capital setting).
5. Create and evaluate hypothetical scenarios, including using judgment to assess the implications of actions and to develop appropriate proposals or recommendations relating to investment products.

1. Principal terms	
1. Define principal terms used in financial products and securities. (A1)	
Reference	Source
McDonald RL. 2013. <i>Derivatives Markets</i> . 3rd ed. New York (NY): Pearson. Glossary.	<a href="https://www.pearson.com/en-ca/subject-catalog/p/derivatives-markets/P200000005976/9780137612864">https://www.pearson.com/en-ca/subject-catalog/p/derivatives-markets/P200000005976/9780137612864</a>

2. Mathematics, statistics, and stochastic calculus (15%)		
<ol style="list-style-type: none"> <li>1. Understand and apply concepts of probability and statistics important in mathematical finance. (C3)</li> <li>2. Understand the importance of the no-arbitrage condition in asset pricing. (B2)</li> <li>3. Apply the concept of martingale in asset pricing. (C3)</li> <li>4. Understand and apply Itô's integral and stochastic differential equations. (B3)</li> <li>5. Understand and apply Itô's lemma. (C3)</li> <li>6. Understand and apply Jensen's inequality. (C3)</li> <li>7. Assess mathematical considerations for analyzing financial time series. (C5)</li> <li>8. Understand the importance of the Feynman-Kac theorem to diffusion processes. (C3)</li> </ol>		
Reference	Source	
Hirsa A, Neftci SN. 2013. <i>An Introduction to the Mathematics of Financial Derivatives</i> . 3rd ed. Cambridge (MA): Academic Press. Chapters 1, 2, 3, 5, 6, 9, 10, 21.	<a href="https://shop.elsevier.com/books/an-introduction-to-the-mathematics-of-financial-derivatives/neftci/978-0-12-384682-2">https://shop.elsevier.com/books/an-introduction-to-the-mathematics-of-financial-derivatives/neftci/978-0-12-384682-2</a>	
Chin E, Nel D, Ólafsson S. 2014. <i>Stochastic Calculus</i> . Hoboken (NJ): Wiley. (Problems and Solutions in Mathematical Finance; vol. 1).	<a href="https://www.wiley.com/en-us/Problems+and+Solutions+in+Mathematical+Finance,+Volume+1:+Stochastic+Calculus-p-9781119965831">https://www.wiley.com/en-us/Problems+and+Solutions+in+Mathematical+Finance,+Volume+1:+Stochastic+Calculus-p-9781119965831</a>	
Candidates should study the following problems in <i>Stochastic Calculus</i> , Chin, Nel, and Ólafsson, alongside the matching chapters of <i>An Introduction to the Mathematics of Financial Derivatives</i> , Hirsa and Neftci, to reinforce the standard techniques used in stochastic calculus.		
Chin et al. chapter	Pages	Item
Corresponding Hirsa and Neftci chapter sections		

1	1 to 3	Definitions 1.1-1.7  (Note that statement (b) of Definition 1.7 involves integration using a measure-theoretic approach. An equally valid statement can be made using a Riemann-Stieltjes integral for continuous distributions or a sum for discrete distributions.)	5.2
	4 to 5	Q3-Q7	5.2
	18 to 19	Q7	15.4.1
	43 to 44	Q4	14.2.2
	43 to 44	Q5	Paragraph on p. 245 containing equations from 14.91-14.93
2	52	Definitions 2.1, 2.2	8.2.1
	52	Theorems 2.3, 2.4	5.8
	52	Definitions 2.5, 2.6	2.2.9, 6.2
	55 to 57	Q1-Q3	6.4.1
	57 to 68	Q4-Q13, except Q11	8.2.1
	68 to 71	Q1, Q2, Q3	No direct correspondence
	71	Q1	6.6.1
	72	Q2	6.6.2
3	96 to 97	Theorem 3.2	10.4
	97 to 98	Theorem 3.3	21.4
	99 to 100	Definition 3.6	10.4
	115	Q13	First part is different approach to part of Q12 on p. 64
	123 to 149	Q1-Q20	10.5
	155 to 158	Q1-Q3	10.7
	175 to 178	Q10	10.7
4	186 to 187	Definitions 4.1(a)-(f)	H&N introduces self-financing portfolios in 6.11.3 and goes into detail in 12.3
	189	Theorem 4.6	14.3
	192 to 194	Q1	6.11 and exercise 1 on p. 109
	192 to 194	Q2	6.11 and exercise 4 on p. 110
	194 to 197	Q1-Q3	14.3
	221 to 242	Q1-Q17	15
5	262 to 264	Q9-Q11	5.5.5, 8.2.2
	281 to 285	Q1, Q2	Chapter 11 section on pure jump framework

### 3. Introduction to option pricing theory (20%)

1. Understand and apply various techniques for analyzing conditional heteroscedastic models, including ARCH (autoregressive conditionally heteroscedastic) and GARCH (generalized autoregressive conditionally heteroscedastic). (C3)
2. Perform calculations and evaluate results of option-pricing techniques and theory for equity and interest rate derivatives. (C6)
3. Apply the basic concepts of currency markets (purchase-price parity, law of one price, etc.). (B3)
4. Identify differences and implications of real-world versus risk-neutral probability measures. (B4)
5. Understand and apply Girsanov's theorem in changing measures. (C3)
6. Understand and apply the Black-Scholes-Merton PDE (partial differential equation). (C3)
7. Identify limitations of the Black-Scholes pricing formula.
8. Describe and apply approaches for relaxing the assumptions used in the Black-Scholes formula. (C3)
9. Apply and assess alternatives to the Black-Scholes-Merton model or alternative techniques that can be used to deal with option-pricing technique limitations. (B6)
10. Demonstrate an understanding of interest rate models. (B2)
11. Understand and apply the concept of calibration and describe the issues related to calibration. (B6)
12. Understand and assess the Heath-Jarrow-Morton (HJM) model and the HJM no-arbitrage condition. (B6)

Reference	Source
Jorion P. 2007. <i>Value at Risk: The New Benchmark for Managing Financial Risk</i> . 3rd ed. New York (NY): McGraw Hill. Chapter 9.	<a href="https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html">https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html</a>
Choi JE. 2004. <i>Estimation of Stochastic Volatility Models by Simulated Maximum Likelihood Method</i> [research paper]. Waterloo, ON: University of Waterloo.	<a href="https://www.soa.org/globalassets/assets/files/static-pages/research/arch/2005/arch05v39n1_3.pdf">https://www.soa.org/globalassets/assets/files/static-pages/research/arch/2005/arch05v39n1_3.pdf</a>
Hirsa A, Neftci SN. 2013. <i>An Introduction to the Mathematics of Financial Derivatives</i> . 3rd ed. Cambridge (MA): Academic Press. Chapters 4, 11-20.	<a href="https://shop.elsevier.com/books/an-introduction-to-the-mathematics-of-financial-derivatives/neftci/978-0-12-384682-2">https://shop.elsevier.com/books/an-introduction-to-the-mathematics-of-financial-derivatives/neftci/978-0-12-384682-2</a>
Veronesi P. 2010. <i>Fixed Income Securities: Valuation, Risk, and Risk Management</i> . Hoboken (NJ): Wiley. Chapters 14, 15 (excluding appendix), 16 (including case study, excluding appendix), 17, 18 (excluding appendix), 19 (excluding appendix).	<a href="https://www.wiley.com/en-us/Fixed+Income+Securities%3A+Valuation%2C+Risk%2C+and+Risk+Management-p-9780470109106">https://www.wiley.com/en-us/Fixed+Income+Securities%3A+Valuation%2C+Risk%2C+and+Risk+Management-p-9780470109106</a>

### 4. Introduction to credit and liquidity risk (20%)

1. Understand events and causes of the 2008 global credit crisis relating to mortgage-backed securities (MBS) and credit-default swaps (CDS). (B2)
2. Understand the basic concepts of credit risk modelling such as probability of default, loss given default, exposure at default, and expected loss. (B3)
3. Apply and assess credit-valuation models. (B6)
4. Apply and assess the Merton asset-value models in the context of credit risk. (B6)
5. Understand and apply credit-default swaps. (C3)
6. Apply and assess mortgage-default models in the valuation of mortgage-backed securities. (B6)
7. Measure and perform marking-to-market counterparty credit risk in credit derivatives. (C5)
8. Understand the rationale, markets, and risks of structured finance. (B4)
9. Compare the use of credit-spread measures in portfolio construction. (C2)
10. Describe risk considerations in investment-grade versus high-yield bond portfolios. (C2)
11. Understand the concept of liquidity risk and the threat it represents to financial intermediaries and markets. (B2)

12. Measure and monitor liquidity risk, using various liquidity-measurement tools and ratios. (C5)
13. Understand liability-termination provisions such as book-value surrender and the impact on a company's overall liquidity risk. (B3)
14. Apply liquidity risk models, including modelling cash flow of various types of assets under various scenario analysis and time horizons. (D6)
15. Create liquidity risk management plans and procedures, including addressing appropriate product design and investment guidelines and reporting given a desired liquidity risk level. (C6)
16. Be familiar with rating agency expectations for liquidity and the implications for company ratings. (D4)

Reference	Source
Bluhm C, Overbeck L, Wagner C. 2010. <i>Introduction to Credit Risk Modeling</i> . 2nd ed. Chapters 1, 2 (Sections 2.1-2.7), 3, 6.	<a href="https://www.routledge.com/Introduction-to-Credit-Risk-Modeling/Bluhm-Overbeck-Wagner/p/book/9781584889922">https://www.routledge.com/Introduction-to-Credit-Risk-Modeling/Bluhm-Overbeck-Wagner/p/book/9781584889922</a>
Gregory J. 2020. <i>The xVA Challenge: Counterparty Risk, Funding, Collateral, Capital and Initial Margin</i> . 4th ed. London (UK): Chapman & Hall. Chapters 1, 2, 3, 12.	<a href="https://www.wiley.com/en-us/The+xVA+Challenge%3A+Counterparty+Risk%2C+Funding%2C+Collateral%2C+Capital+and+Initial+Margin%2C+4th+Edition-p-9781119509004">https://www.wiley.com/en-us/The+xVA+Challenge%3A+Counterparty+Risk%2C+Funding%2C+Collateral%2C+Capital+and+Initial+Margin%2C+4th+Edition-p-9781119509004</a>
American Academy of Actuaries. 2000. <i>Report of the Life Liquidity Work Group of the American Academy of Actuaries to the Life Liquidity Risk Working Group of the NAIC</i> . Dallas (TX): American Academy of Actuaries.	<a href="https://www.actuary.org/sites/default/files/pdf/naic/lifeliq_0900.pdf">https://www.actuary.org/sites/default/files/pdf/naic/lifeliq_0900.pdf</a>
Shin HS. 2009. "Reflections on Northern Rock: The bank run that heralded the global financial crisis." <i>J Econ Perspect</i> . 23(1): 101-119.	<a href="https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.23.1.101">https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.23.1.101</a>
Chief Risk Officer (CRO) Forum. 2008. <i>Liquidity Risk Management: Best Risk Management Practices</i> . [place unknown]: CRO Forum.	<a href="https://www.thecroforum.org/wp-content/uploads/2012/10/croforumbrmliquidityriskmanagement_oct08-2.pdf">https://www.thecroforum.org/wp-content/uploads/2012/10/croforumbrmliquidityriskmanagement_oct08-2.pdf</a>

## 5. Derivatives and hedging (10%)

1. Compare and contrast the various kinds of volatility. (C4)
2. Compare and contrast various approaches for setting volatility assumptions in hedging. (C4)
3. Compare and contrast different approaches to hedging. (C4)
4. Perform delta hedging and understand the interplay between hedging assumptions and hedging outcomes. (B3)
5. Describe and understand economic scenarios where hedging strategies may be ineffective for certain portfolios. (B2)
6. Demonstrate how interest rate swaps, forwards, and futures can be used to modify a portfolio's risk and return. (C3)
7. Utilize derivatives to achieve targeted equity and interest rate risk exposures. (C3)
8. Discuss methods of forecasting volatility and understand the applications of volatility and variance swaps. (C5)

Reference	Source
Derman E, Miller MB, Park D. 2016. <i>The Volatility Smile</i> . Hoboken (NJ): Wiley. Chapters 1, 2, 3, 4, 6, 7.	<a href="https://www.wiley.com/en-us/The+Volatility+Smile-p-9781118959183">https://www.wiley.com/en-us/The+Volatility+Smile-p-9781118959183</a>
Veronesi P. 2010. <i>Fixed Income Securities: Valuation, Risk, and Risk Management</i> . Hoboken (NJ): Wiley. Chapter 5 (Sections 5.1-5.7, excluding case study), 6 (including appendix).	<a href="https://www.wiley.com/en-us/Fixed+Income+Securities%3A+Valuation%2C+Risk%2C+and+Risk+Management-p-9780470109106">https://www.wiley.com/en-us/Fixed+Income+Securities%3A+Valuation%2C+Risk%2C+and+Risk+Management-p-9780470109106</a>

## 6. Fixed-income securities (20%)

1. Explain the cash-flow characteristics and pricing of government securities. (B2)
2. Analyze par yield curves, spot curves, and forward curves and their relationship to traded security prices. (B4)
3. Analyze the different characteristics of securities issued by government agencies. (B4)
4. Evaluate features of provincial and municipal bonds, and the role of rating agencies in pricing them. (C5)
5. Describe the cash flow of various corporate bonds considering underlying risks such as interest rate, credit, and event risks. (A2)
6. Analyze cash-flow patterns and underlying drivers and risks of mortgage-backed securities and collateralized mortgage obligations. (D4)
7. Construct portfolios of fixed-income securities using the following broad categories: (D6)
  - a. Managing funds against a target return; and
  - b. Evaluate strategies for managing funds and immunizing funds against single and multiple liabilities.
8. Understand and discuss approaches to setting expectations for fixed-income returns. (D5)
9. Evaluate the effects of capital markets expectations on the yield curve. (C5)
10. Perform calculations of modified duration, convexity, and duration times spread (DTS) and its applications towards various fixed-income strategies. (D5)
11. Apply the model to price common interest sensitive instruments, including callable bonds, bond options, caps, floors and swaptions. (C3)

Reference	Source
Fabozzi FJ, Mann SV, Fabozzi F, editors. 2021. <i>The Handbook of Fixed Income Securities</i> . 9th ed. New York (NY): McGraw Hill. Chapters 1, 2, 7 are background only; Chapters 10, 11, 15, 18, 21, 25, 30, 60, 65.	<a href="https://www.mheducation.ca/the-handbook-of-fixed-income-securities-ninth-edition-9781260473896-can">https://www.mheducation.ca/the-handbook-of-fixed-income-securities-ninth-edition-9781260473896-can</a>
Maginn JL, Tuttle DL, Pinto JE, McLeavey DW, editors. 2007. <i>Managing Investment Portfolios: A Dynamic Process</i> . 3rd ed. Hoboken (NJ): Wiley. Chapter 6.	<a href="https://www.actexamdriver.com/orderselection.aspx?id=453147610">https://www.actexamdriver.com/orderselection.aspx?id=453147610</a>

## 7. Guaranteed investment products and annuities (15%)

1. Identify and evaluate the impact of embedded options in liabilities, specifically variable annuities guaranteed riders (guaranteed minimum accumulation benefit [GMAB], guaranteed minimum death benefit [GMDB], guaranteed minimum withdrawal benefit [GMWB], and guaranteed minimum income benefit [GMIB]). (C5)
2. Understand risks associated with guaranteed riders, including market, insurance, policyholder behaviour, basis, credit, regulatory, and accounting. (B2)
3. Perform risk management and dynamic hedging for existing GMxB and its embedded options. (D6)
4. Analyze hedgeable components that are equity, interest rate, volatility, and cross Greeks. (C4)
5. Analyze partially hedgeable or unhedgeable components that are policyholder behaviour, mortality and lapse, basis risk, counterparty exposure, foreign bonds and equities, correlation, and operation failures. (C2)
6. Compare and contrast static vs. dynamic hedging. (C4)
7. Analyze how differences between modeled and actual outcomes for guarantees affect financial results over time. (D4)

Reference	Source
Marceau E, Veilleux PA. 2017. "On the impact of stochastic volatility, interest rates and mortality on the hedge efficiency of GLWB guarantees." SSRN.	<a href="https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3015806">https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3015806</a>
Morrison S, Tadowski L. 2013. <i>Guarantees and Target Volatility Funds</i> . New York (NY): Moody's Analytics.	<a href="https://www.moodysanalytics.com/-/media/whitepaper/2013/2013-04-10-Guarantees-and-Target-Volatility-Funds.pdf">https://www.moodysanalytics.com/-/media/whitepaper/2013/2013-04-10-Guarantees-and-Target-Volatility-Funds.pdf</a>
Augustyniak M, Boudreault M. 2016 [last revised 2017 Aug 31]. "Mitigating interest rate risk in variable annuities: An analysis of hedging effectiveness under model risk." <i>N Am Actuar J</i> . SSRN.	<a href="https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2769927">https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2769927</a>
Ramachandran R, Sarfatti A. 2017. <i>Variable Annuity Volatility Management: An Era of Risk-Control</i> . New York (NY): Oliver Wyman.	<a href="https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2017/dec/Oliver%20Wyman%20-%20Variable%20Annuity%20Volatility%20Management.pdf">https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2017/dec/Oliver%20Wyman%20-%20Variable%20Annuity%20Volatility%20Management.pdf</a>
Derman E, Miller MB, Park D. 2016. <i>The Volatility Smile</i> . Hoboken (NJ): Wiley. Chapter 3.	<a href="https://www.wiley.com/en-us/The+Volatility+Smile-p-9781118959183">https://www.wiley.com/en-us/The+Volatility+Smile-p-9781118959183</a>
CIA Educational Note: <i>IFRS 17 Market Consistent Valuation of Financial Guarantees for Life and Health Insurance Contracts</i> .	<a href="https://www.cia-ica.ca/publications/publication-details/222073">https://www.cia-ica.ca/publications/publication-details/222073</a>
Hardy M. 2003. <i>Investment Guarantees: Modeling and Risk Management for Equity-Linked Life Insurance</i> . Hoboken (NJ): Wiley. Chapters 6, 7, 8, 9, 12, 13.	<a href="https://www.wiley.com/en-us/Investment+Guarantees%3A+Modeling+and+Risk+Management+for+Equity+Linked+Life+Insurance-p-9780471460121">https://www.wiley.com/en-us/Investment+Guarantees%3A+Modeling+and+Risk+Management+for+Equity+Linked+Life+Insurance-p-9780471460121</a>

## Exam F2FIE: Valuation and Financial Considerations

The aim of the Valuation and Financial Considerations exam is to develop a candidate's expertise to a level that allows for analysis in major areas of the investment practice. It builds on material covered in the Financial Products exam and earlier subjects and seeks to equip a student with the skills and broad working understanding of financial and investment markets.

1. Principal terms	
1. Define principal terms used in the investment and financial reporting environments. (A1)	
Reference	Source
Office of the Superintendent of Financial Institutions (OSFI). 2023. Ottawa (ON): OSFI. "Glossary of terms." [updated 2017 Sep 25]. (As background.)	<a href="https://www.osfi-bsif.gc.ca/eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/dti30e00.aspx">https://www.osfi-bsif.gc.ca/eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/dti30e00.aspx</a>

2. Investment policy and governance (10%)
<ol style="list-style-type: none"><li>1. Compare and differentiate the interests of key stakeholders. (B4)</li><li>2. Identify and analyze principal versus agent conflict. (B4)</li><li>3. Describe and analyze sources of unethical conduct and explain the role of a fiduciary. (B4)</li><li>4. Describe and evaluate governance mechanisms that attempt to address these conflicts. (B5)</li><li>5. Understand and evaluate the importance of an organization's culture in effectuating governance. (B5)</li><li>6. Explain and demonstrate how governance may be structured to gain competitive advantages and efficiencies. (C5)</li><li>7. Understand how ethics relate to business decision-making and relate ethics in business to personal ethics. (D5)</li><li>8. Demonstrate an understanding of the concept of investment beliefs, including their application, in the following areas: (D5)<ol style="list-style-type: none"><li>a. Establishment of an investment policy.</li><li>b. Diversification and rebalancing.</li><li>c. Strategic vs. tactical allocation.</li><li>d. Geographic and sector allocation.</li><li>e. Currency management.</li><li>f. Liquidity management.</li><li>g. Credit policy.</li><li>h. Active vs. passive management.</li><li>i. Alternatives and derivatives limits.</li></ol></li><li>9. Demonstrate understanding of regulators' guidance and context for different approaches to responsible investment and specifically, the integration of environmental, social, and governance (ESG) factors in the investment process. (C3)</li><li>10. Demonstrate an understanding of and analyze the underlying issues that constitute factors within each of the ESG areas. (C4)</li><li>11. Demonstrate an understanding of and evaluate the ESG market: relevance, size, scope, key drivers and challenges, and risks and opportunities. (C5)</li></ol>

Reference	Source
Peck S. 2010. <i>Investment Ethics</i> . Hoboken (NJ): Wiley. Chapters 1-3, 7, 9.	<a href="https://www.wiley.com/en-ca/Investment+Ethics-p-9780470434536">https://www.wiley.com/en-ca/Investment+Ethics-p-9780470434536</a>
Whelan T, Atz U, Van Holt T, Clark C. 2021. <i>ESG and Financial Performance: Uncovering the Relationship by Aggregating Evidence from 1,000 Plus Studies Published between 2105-2020</i> . New York (NY): Rockefeller Asset Management and NYU Stern Center for Sustainable Business.	<a href="https://www.stern.nyu.edu/sites/default/files/assets/documents/ESG%20Paper%20Aug%202021.pdf">https://www.stern.nyu.edu/sites/default/files/assets/documents/ESG%20Paper%20Aug%202021.pdf</a>

### 3. Asset allocation (15%)

1. Explain the impact of asset allocation relative to various investor goals and constraints, including the impact due to liability calculation, funding rules and regulations, and their results on the investor goals and attractiveness of different asset classes. (C2)
2. Propose and critique asset-allocation strategies. (D5)
3. Evaluate the significance of liabilities in the allocation of assets. (D5)
4. Explain the purpose and impact of financing and leverage in the allocation of assets. (C2)
5. Incorporate risk management principles in investment policy and strategy, including asset allocation. (C6)
6. Discuss strategic-implementation choices in asset allocation, including passive/active choices and vehicles for implementing passive and active mandates. (C3)
7. Discuss strategic considerations in rebalancing asset allocations. (D5)
8. Describe and critique the use of mean-variance optimization in asset allocation. (D5)

Reference	Source
Maginn JL, Tuttle DL, Pinto JE, McLeavey DW, editors. 2007. <i>Managing Investment Portfolios: A Dynamic Process</i> . 3rd ed. Hoboken (NJ): Wiley. Chapters 5, 11.	<a href="https://www.actexamdriver.com/orderselection.aspx?id=453147610">https://www.actexamdriver.com/orderselection.aspx?id=453147610</a>
Litterman B, Quantitative Resources Group. 2003. <i>Modern Investment Management: An Equilibrium Approach</i> . Hoboken (NJ): Wiley. Chapters 9, 10.	<a href="https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108">https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108</a>

### 4. Equities (20%)

1. Explain the nature and role of equity investments within portfolios that may include other asset classes. (A2)
2. Understand and critique the basic concepts surrounding passive, active, and semi-active enhanced index equity investing as well as factor-based investing, including managing exposures. (B5)
3. Explain and critique the basic active equity selection strategies including value, growth, and combination approaches. (B5)
4. Understand and calculate equity indices and their construction, including distinguishing among the weighting schemes and their biases. (C3)
5. Identify and evaluate methods for establishing passive exposure to an equity market. (B5)
6. Compare and critique techniques for characterizing the investment style of an investor. (C5)
7. Recommend and justify, in a risk-return framework, the optimal portfolio allocations to a group of investment managers. (C5)
8. Describe and critique the core-satellite approach to portfolio construction with a completeness fund to control overall risk exposures. (B5)
9. Explain and critique alpha and beta separation as an approach to active management and demonstrate the use of portable alpha. (B5)
10. Describe and critique the process of identifying, selecting, contracting with, and overseeing equity managers. (B5)
11. Distinguish between active share and active risk and discuss how each measure relates to a manager's investment strategy. (C5)



Reference	Source
Maginn JL, Tuttle DL, Pinto JE, McLeavey DW, editors. 2007. <i>Managing Investment Portfolios: A Dynamic Process</i> . 3rd ed. Hoboken (NJ): Wiley. Chapter 7.	<a href="https://www.actexamdriver.com/orderselection.aspx?id=453147610">https://www.actexamdriver.com/orderselection.aspx?id=453147610</a>
Litterman B, Quantitative Resources Group. 2003. <i>Modern Investment Management: An Equilibrium Approach</i> . Hoboken (NJ): Wiley. Chapters 23, 28.	<a href="https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108">https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108</a>
Ibbotson RG, Chen Z, Kim D, Hu WY. 2012 [last revised 2013 May 24]. "Liquidity as an investment style." <i>Financial Analysts Journal</i> . 69(3). SSRN.	<a href="https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1817889">https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1817889</a>

## 5. Advanced option pricing (20%)

1. Identify and differentiate the features of the classic short-rate models including the Vasicek and the Cox-Ingersoll-Ross models. (C4)
2. Understand and explain the terms "time-homogeneous models," "affine-term structure models," and "affine-coefficient models," and explain their significance in the context of short-rate interest models. (D2)
3. Explain the dynamics of and motivation for the Hull-White extension of the Vasicek model. (D5)
4. Explain the features of the Black-Karasinski model. (B2)
5. Understand and explain the relationship between market-quoted caplet volatilities and model volatilities. (B2)
6. Explain how deterministic shifts can be used to fit any given interest rate term structure and demonstrate an understanding of the Cox-Ingersoll-Ross++ model. (C2)
7. Understand and explain the features of the G2++ model, including the motivation for more than one factor, calibration approaches, the pricing of bonds and options, and the model's relationship to the two-factor Hull-White model. (C3)
8. Describe and apply models that account for negative interest rates, such as Black's model and shifted log-normal. (C3)
9. Explain the concept of volatility smile and some arguments for its existence. (B5)
10. Calculate the hedge ratio for a call option given the dependency of the Black-Scholes volatility on the underlying asset. (C3)
11. Compare and contrast "floating" and "sticky" volatility smiles. (C4)
12. Calculate the risk-neutral density given call option prices. (C3)
13. Identify several stylized empirical facts about smiles in a variety of options markets. (B2)
14. Describe and contrast several approaches for modelling smiles, including stochastic volatility, local volatility, jump diffusions, variance gamma, and mixture models. (C4)
15. Describe and compare various issues and approaches for fitting a volatility surface. (C4)

Reference	Source
Brigo D, Mercurio F. 2006. <i>Interest Rate Models – Theory and Practice: With Smile, Inflation and Credit</i> . 2nd ed. New York (NY): Springer. Chapters 1, 2, 3 (Sections 3.1-3.9), 4 (Sections 4.1, 4.2, excluding appendices), 5 (Sections 5.1, 5.2, background only).	<a href="https://link.springer.com/book/10.1007/978-3-540-34604-3">https://link.springer.com/book/10.1007/978-3-540-34604-3</a>
Rebonato R. 2004. <i>Volatility and Correlation: The Perfect Hedger and the Fox</i> . 2nd ed. Hoboken (NJ): Wiley. Chapters 6, 7, 8 (Sections 8.1-8.5), 9 (Sections 9.1-9.9).	<a href="https://www.wiley.com/en-us/Volatility+and+Correlation%3A+The+Perfect+Hedger+and+the+Fox%2C+2nd+Edition-p-9780470091401">https://www.wiley.com/en-us/Volatility+and+Correlation%3A+The+Perfect+Hedger+and+the+Fox%2C+2nd+Edition-p-9780470091401</a>

## 6. Alternative assets (10%)

1. Understand and evaluate the types of alternative investments available in each market and their most important differences for an investor, like: (D5)
  - a. Real estate and infrastructure.
  - b. Agriculture and timberland.
  - c. Green assets.
  - d. Longevity bonds.
  - e. Insurance-linked securities (contingent convertibles, catastrophe bonds).
  - f. Hedge funds.
  - g. Venture capital.
  - h. Derivative contracts.
  - i. Private equity.
  - j. Private debt/credit.
2. Understand and calculate benchmarks available to evaluate the performance of alternative investment managers. (C3)
3. Describe the limitations of the benchmarks and evaluate how to circumvent these limitations. (B5)
4. Understand and evaluate investment strategies and portfolio roles as well as their specific construction/implementation nuances that are characteristic of each alternative investment. (D5)
5. Perform a due diligence and oversight processes and the impact of negotiated covenants on the risk-return profile for alternative investments. (C3)
6. Discuss how hedge-fund strategies may be classified and evaluate the impact of an allocation to a hedge-fund strategy in an investment portfolio. (C5)

Reference	Source
Inderst G, Kaminker Ch, Stewart F. 2012. "Defining and measuring green investments: Implications for institutional investors' asset allocations." Paris: OECD Publishing. (OECD Working Papers on Finance, Insurance and Private Pensions, No. 24.)	<a href="https://www.oecd.org/environment/WP_24_Defining_and_Measuring_Green_Investments.pdf">https://www.oecd.org/environment/WP_24_Defining_and_Measuring_Green_Investments.pdf</a>
Thomsen J, Andersen JV. 2007. "Longevity bonds – a financial market instrument to manage longevity risk." <i>Denmark National Bank Monetary Review 4th Quarter</i> . (4): 29-44.	<a href="https://www.oecd.org/finance/private-pensions/41668679.pdf">https://www.oecd.org/finance/private-pensions/41668679.pdf</a>
DiFiore P, Drui C, Ware S. 2021. <i>Catastrophe Bonds: Natural Diversification</i> . New York (NY): Neuberger Berman.	<a href="https://www.nb.com/en/global/insights/white-paper-catastrophe-bonds-natural-diversification">https://www.nb.com/en/global/insights/white-paper-catastrophe-bonds-natural-diversification</a>
Maginn JL, Tuttle DL, Pinto JE, McLeavey DW, editors. 2007. <i>Managing Investment Portfolios: A Dynamic Process</i> . 3rd ed. Hoboken (NJ): Wiley. Chapter 8.	<a href="https://www.actexamdriver.com/orderselection.aspx?id=453147610">https://www.actexamdriver.com/orderselection.aspx?id=453147610</a>

## 7. Machine learning, neural networks, application of blockchain on insurance (10%)

1. Discuss the applications of cryptocurrency and blockchain technology in the insurance industry. (B5)
2. Distinguish between supervised machine learning, unsupervised machine learning, neural networks, and deep-learning methods. (B4)
3. Analyze overfitting and identify methods of addressing it. (B4)
4. Describe unsupervised machine-learning algorithms — including principal components analysis, k-means clustering, and hierarchical clustering — and determine the problems for which they are best suited. (A5)
5. Describe and differentiate neural networks, deep-learning nets, and reinforcement learning. (B4)
6. Identify and explain steps in a data-analysis project. (C2)
7. Describe objectives, steps, and examples of preparing and wrangling data. (C2)
8. Describe objectives, methods, and examples of data exploration. (C2)
9. Describe objectives, steps, and techniques in model training. (C2)
10. Evaluate the fit of a machine-learning algorithm. (C5)

Reference	Source
Popovic D, Avis C, Byrne M, Cheung C, Donovan M, Flynn Y, Fothergill C, Hosseinzadeh Z, Lim Z, Shah J. 2020. <i>Understanding Blockchain For Insurance Use Cases: A Practical Guide for the Insurance Industry</i> . London (UK): Institute and Faculty of Actuaries.	<a href="https://www.actuaries.org.uk/system/files/field/document/Blockchain-Workstream-v1.8%20FINAL.pdf">https://www.actuaries.org.uk/system/files/field/document/Blockchain-Workstream-v1.8%20FINAL.pdf</a>
Richman R. 2018. <i>AI in Actuarial Science</i> [presentation]. Actuarial Society of South Africa Convention; 2018 Oct 24-25, Cape Town (ZA).	<a href="https://www.actuarialsociety.org.za/convention/wp-content/uploads/2018/11/AI-IN-ACTUARIAL-SCIENCE-Ronald-Richman.pdf">https://www.actuarialsociety.org.za/convention/wp-content/uploads/2018/11/AI-IN-ACTUARIAL-SCIENCE-Ronald-Richman.pdf</a>
Perkins S, Davis H, du Preez V. 2020. <i>Practical Data Science for Actuarial Tasks</i> . London (UK): Institute and Faculty of Actuaries.	<a href="https://www.actuaries.org.uk/system/files/field/document/Practical%20Data%20Science%20for%20Actuarial%20Tasks%20v1.8.pdf">https://www.actuaries.org.uk/system/files/field/document/Practical%20Data%20Science%20for%20Actuarial%20Tasks%20v1.8.pdf</a>
Chalk A, McMurtrie C. 2016. "A practical introduction to machine learning concepts for actuaries." <i>E-Forum</i> . Arlington (VA): Casualty Actuarial Society.	<a href="https://www.casact.org/sites/default/files/database/forum_16spforum_chalk_mcmurtrie.pdf">https://www.casact.org/sites/default/files/database/forum_16spforum_chalk_mcmurtrie.pdf</a>

## 8. Financial reporting (15%)

1. Describe the basic features of a financial-reporting conceptual framework. (B2)
2. Explain and critique the key concepts in determining fair value. (B5)
3. Describe International Financial Reporting Standards (IFRS) 17. (B2)
4. Explain and apply the general concepts underlying specific U.S. accounting standards for asset reporting, valuing deferred acquisition cost assets, and valuing liabilities. (C6)
5. Apply the IFRS 17 general method approach, variable fee approach, or premium allocation approach to appropriately value liabilities for remaining coverage and for incurred claims. (C6)
6. Explain how liabilities are calculated under U.S. statutory reporting. (C6)
7. Explain the objectives and features of regulatory risk-based capital requirements. (B2)
8. Perform risk-based capital RBC calculations required by C3 Phase II. (C6)
9. Apply Life Insurance Capital Adequacy Test (LICAT) calculations and understand the components that form the LICAT ratio. (C6)

Reference	Source
CIA Educational Note: <i>Application of IFRS 17 Insurance Contracts</i> . (Excluding Section C, Chapter 11; Section D; and Section E.)	<a href="https://www.cia-ica.ca/docs/default-source/2021/221117e.pdf">https://www.cia-ica.ca/docs/default-source/2021/221117e.pdf</a>
Actuarial Standards Board, Task Force on Principle-Based Reserves of the Life Committee. Document No.: 189. <i>Principle-Based Reserves for Life Products under the NAIC Valuation Manual</i> . Washington (DC): Actuarial Standards Board.	<a href="http://www.actuarialstandardsboard.org/wp-content/uploads/2017/10/asop052_189.pdf">http://www.actuarialstandardsboard.org/wp-content/uploads/2017/10/asop052_189.pdf</a>
CIA Educational Note: <i>Comparison of IFRS 17 to Current CIA Standards of Practice</i> .	<a href="https://www.cia-ica.ca/publications/publication-details/222094">https://www.cia-ica.ca/publications/publication-details/222094</a>
SOA Research Report: <i>Principle-Based Reserves Simplified Methods</i> .	<a href="https://www.soa.org/globalassets/assets/files/resources/research-report/2020/2020-simplified-methods.pdf">https://www.soa.org/globalassets/assets/files/resources/research-report/2020/2020-simplified-methods.pdf</a>
CIA Educational Note: <i>Life Insurance Capital Adequacy Test (LICAT) and Capital Adequacy Requirements for Life and Health Insurance (CARLI)</i> .	<a href="https://www.cia-ica.ca/publications/publication-details/223095">https://www.cia-ica.ca/publications/publication-details/223095</a>

## Exam F3FIE: Risk Management

The aim of this exam is for candidates to develop the following skills:

1. Understand the main principles and techniques of enterprise risk management (ERM) and economic capital modelling that are relevant to life insurance.
2. Apply these principles and techniques within the context of investments.
3. Understand how ERM and economic capital modelling links to wider business processes (e.g., business planning, pricing, and capital setting).
4. Create and evaluate hypothetical scenarios, including using judgement to assess the implications of possible actions and to develop appropriate investment proposals or recommendations.

1. Principal terms	
1. Define principal terms used in enterprise risk management, economic capital modelling, and stress and scenario testing. (A1)	
Reading reference	Source
Sweeting P. 2017. <i>Financial Enterprise Risk Management</i> . 2nd ed. Cambridge (UK): Cambridge University Press. Chapter 1.	<a href="https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR">https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR</a>
Lam J. 2014. <i>Enterprise Risk Management: From Incentives to Controls</i> . 2nd ed. Hoboken (NJ): Wiley. Chapter 1.	<a href="https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616">https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616</a>

2. ERM concept, framework, and process (10%)	
<ol style="list-style-type: none"> <li>1. Apply the concept of ERM. (D3)</li> <li>2. Apply the framework for risk management and control within an insurer. (D3)</li> <li>3. Describe regulatory requirements related to ERM including own-risk and solvency assessment. (A2)</li> <li>4. Describe the perspectives of credit-rating agencies. (B2)</li> <li>5. Reflect data issues in general and special considerations with respect to ERM. (C3)</li> <li>6. Demonstrate how to determine and articulate: (C3)               <ol style="list-style-type: none"> <li>a. Risk appetite.</li> <li>b. Risk identification.</li> <li>c. Risk assessment.</li> <li>d. Risk monitoring.</li> <li>e. Risk limits.</li> <li>f. Risk mitigation.</li> <li>g. Risk capacity.</li> <li>h. Risk tolerances.</li> <li>i. Desired risk profile.</li> <li>j. Risk objectives.</li> <li>k. Risk reporting.</li> </ol> </li> <li>7. Assess the implications of financial and other risks and opportunities for strategic planning. (C4)</li> <li>8. Describe the risk management control cycle, including the relevance of external influences and emerging risks. (C2)</li> <li>9. Utilize methods to identify risks and their causes and implications. (D4)</li> </ol>	
Reading reference	Source
Sweeting P. 2017. <i>Financial Enterprise Risk Management</i> . 2nd ed. Cambridge (UK): Cambridge University Press. Chapters 2, 3.	<a href="https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR">https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR</a>

Lam J. 2014. <i>Enterprise Risk Management: From Incentives to Controls</i> . 2nd ed. Hoboken (NJ): Wiley. Chapters 3, 4.	<a href="https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616">https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616</a>
Office of the Superintendent of Financial Institutions (OSFI). 2017. Guideline A-4: <i>Regulatory Capital and Internal Capital Targets</i> . Ottawa (ON): OSFI.	<a href="https://www.osfi-bsif.gc.ca/Eng/Docs/a4_gd18.pdf">https://www.osfi-bsif.gc.ca/Eng/Docs/a4_gd18.pdf</a>
Office of the Superintendent of Financial Institutions (OSFI). 2017. Guideline E-19: <i>Own Risk and Solvency Assessment</i> . Ottawa (ON): OSFI.	<a href="https://www.osfi-bsif.gc.ca/Eng/Docs/e1918.pdf">https://www.osfi-bsif.gc.ca/Eng/Docs/e1918.pdf</a>
Wong-Fupuy C, McGuignan M. 2020. <i>Best's Credit Rating Methodology</i> . Oldwick (NJ): AM Best. p. 21-24.	<a href="https://www3.ambest.com/ambv/ratingmethodology/OpenPDF.aspx?rc=250950">https://www3.ambest.com/ambv/ratingmethodology/OpenPDF.aspx?rc=250950</a>
CRO Forum, 2020, Data quality in the insurance sector.	<a href="https://www.thecroforum.org/wp-content/uploads/2020/09/Data-quality-in-the-insurance-sector.pdf">https://www.thecroforum.org/wp-content/uploads/2020/09/Data-quality-in-the-insurance-sector.pdf</a>
Herzog TN, Scheuren FJ, Winkler WE. 2007. <i>Data Quality and Record Linkage Techniques</i> . New York (NY): Springer. Chapters 2, 5.	<a href="https://link.springer.com/book/10.1007/0-387-69505-2">https://link.springer.com/book/10.1007/0-387-69505-2</a>
Hardy MR, Saunders D. 2022. <i>Quantitative Enterprise Risk Management</i> . Cambridge (UK): Cambridge University Press. Chapters 3, 11, 12, 13.	<a href="https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview">https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview</a>
Airmic. 2021. <i>Risk Appetite: The Facts, the Myths, and the Links with Culture, Maturity and Sustainability</i> . London (UK): Airmic. (Airmic Explained Guides). Section 2.	<a href="https://www.airmic.com/sites/default/files/Airmic-EXPLAINED-guide-Risk-Appetite-Revised.pdf">https://www.airmic.com/sites/default/files/Airmic-EXPLAINED-guide-Risk-Appetite-Revised.pdf</a>
CAS/CIA/SOA Research Report: <i>Risk Appetite: Linkage with Strategic Planning</i> .	<a href="https://www.soa.org/globalassets/assets/Files/Research/Projects/research-risk-app-link-report.pdf">https://www.soa.org/globalassets/assets/Files/Research/Projects/research-risk-app-link-report.pdf</a>

### 3. Risk categories and risk identification (10%)

1. Explain what is meant by risk and uncertainty, including different definitions and concepts of risk. (B2)
2. Describe risk taxonomy, including an awareness of how individual risks might be categorized in different ways. (B1)
3. Describe and assess common risks faced by life insurers, including: (B2)
  - a. Market risk.
  - b. Currency risk.
  - c. Credit risk.
  - d. Spread risk.
  - e. Liquidity risk.
  - f. Interest rate risk.
  - g. Prepayment risk.
  - h. Reinvestment risk.
  - i. Equity risk.
  - j. Hazard/insurance risk.
  - k. Inflationary risk.
  - l. ESG and climate-related risk.
  - m. Pricing risk.
  - n. Foreign exchange risk.
  - o. Country and sovereign credit risk.
4. Analyze the relationship between systemic risk vs. non-systemic and specific risk vs. concentration of risk. (B4)

Reading reference	Source
Jorion P. 2007. <i>Value at Risk: The New Benchmark for Managing Financial Risk</i> . 3rd ed. New York (NY): McGraw Hill. Chapters 1, 4.	<a href="https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html">https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html</a>
Sweeting P. 2017. <i>Financial Enterprise Risk Management</i> . 2nd ed. Cambridge (UK): Cambridge University Press. Chapters 5, 8, 7, 14.	<a href="https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-">https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-</a>

16.	<a href="#">management-2nd-edition?format=AR</a>
CIA Practice Resource Document: <i>Climate Change Scenario</i> . (Must be logged in to the CIA website; including Excel Workbook.)	<a href="https://www.cia-ica.ca/publications/publication-details/221036">https://www.cia-ica.ca/publications/publication-details/221036</a>
International Actuarial Association (IAA), Climate Risk Task Force. 2020. <i>Importance of Climate-Related Risks for Actuaries</i> . Ottawa (ON): IAA.	<a href="https://www.actuaries.org/IAA/Documents/Publications/Papers/CR_TF_ImportanceClimateRelatedRisksActuaries_FINAL.pdf">https://www.actuaries.org/IAA/Documents/Publications/Papers/CR_TF_ImportanceClimateRelatedRisksActuaries_FINAL.pdf</a>
Litterman B, Quantitative Resources Group. 2003. <i>Modern Investment Management: An Equilibrium Approach</i> . Hoboken (NJ): Wiley. p. 392-395.	<a href="https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108">https://www.wiley.com/en-us/Modern+Investment+Management:+An+Equilibrium+Approach-p-9780471124108</a>

#### 4. Economic capital modelling and aggregation of risks (25%)

1. Describe the extent to which each of the risks in 3.3 can be amenable to quantitative analysis. (B2)
2. Demonstrate an understanding of the use of correlation measures.
  - a. Describe enterprise-wide risk aggregation techniques that incorporate the use of correlation. (C2)
  - b. Apply different correlation measures based on their relative merits and implications. (C4)
3. Apply copulas as part of the process of modelling multivariate risks and evaluate different types of copulas for a given situation. (C5)
4. Reflect the importance of the tails of distributions and tail correlations. (C4)
5. Describe how extreme-value theory can be used to help model risks that have a low probability. (C2)
6. Demonstrate how model and parameter risk can be incorporated into an economic capital model. (C4)
7. Use economic capital models in the overall ERM decision-making process. (C4)
  - a. Describe the development and use of models for decision-making purposes in ERM. (B2)
  - b. Demonstrate how the decision-making process considers the organization's risk appetite and corporate governance, and builds on the results of stochastic modelling, scenario analysis, stress testing, and analysis of model and parameter risk. (D4)
  - c. Evaluate different types of models for a given purpose. (D5)

Reading reference	Source
Lam J. 2014. <i>Enterprise Risk Management: From Incentives to Controls</i> . 2nd ed. Hoboken (NJ): Wiley. Chapter 21 (p. 369-373).	<a href="https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616">https://www.wiley.com/en-us/Enterprise+Risk+Management%3A+From+Incentives+to+Controls%2C+2nd+Edition-p-9781118413616</a>
Jorion P. 2007. <i>Value at Risk: The New Benchmark for Managing Financial Risk</i> . 3rd ed. New York (NY): McGraw Hill. Chapters 1 (Section 1.33), 7, 9.	<a href="https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html">https://www.mheducation.com/highered/custom/product/value-risk-3rd-ed/9780071464956.html</a>
Hardy MR, Saunders D. 2022. <i>Quantitative Enterprise Risk Management</i> . Cambridge (UK): Cambridge University Press. Chapters 5, 6, 14.	<a href="https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview">https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview</a>
Finkelstein G, Hoshino T, Ino R, Morgan E. 2006. <i>Economic Capital Modeling: Practical Considerations</i> . Seattle (WA): Milliman Inc.	<a href="https://www.milliman.com/-/media/milliman/pdfs/articles/economic_capital_modeling_practical_considerations.ashx">https://www.milliman.com/-/media/milliman/pdfs/articles/economic_capital_modeling_practical_considerations.ashx</a>
Sweeting P. 2017. <i>Financial Enterprise Risk Management</i> . 2nd ed. Cambridge (UK): Cambridge University Press. Chapters 9, 11, 15.	<a href="https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR">https://www.cambridge.org/ca/academic/subjects/mathematics/optimization-or-and-risk-analysis/financial-enterprise-risk-management-2nd-edition?format=AR</a>
CIA Educational Note: <i>Use of Models</i> .	<a href="https://www.cia-ica.ca/docs/default-source/2017/217007e.pdf">https://www.cia-ica.ca/docs/default-source/2017/217007e.pdf</a>

## 5. Risk measurement and assessment (25%)

1. Using common risk measures (such as VAR, TVAR, and probability of ruin), determine risk exposures and tolerances using these measures. (C3)
2. Understand the key considerations in deriving and applying economic capital-modelling techniques using deterministic and stochastic models. (D2)
3. Recommend a specific choice of model based on the results of both quantitative and qualitative analysis of financial and insurance data. (D5)
4. Describe approaches, including parameterization and validation, for the assessment of capital requirements for the following risk types: (C2)
  - a. Market.
  - b. Credit.
  - c. Liquidity.
  - d. Regulatory.
  - e. Operational.
  - f. Climate related.
5. Explain the advantages and limitations of different risk metrics, including value at risk, sensitivities, Greeks, minor Greeks, etc. (C4)
6. Describe the practical considerations including data availability, parameterization, and validation procedures) that should be borne in mind when undertaking capital modelling. (D2)
7. Calculate regulatory capital requirement. (C3)

Reading reference	Source
Hardy MR, Saunders D. 2022. <i>Quantitative Enterprise Risk Management</i> . Cambridge (UK): Cambridge University Press. Chapters 3, 11, 12, 13, 14.	<a href="https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview">https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview</a>
Office of the Superintendent of Financial Institutions Canada. 2022. Guideline A: <i>Life Insurance Capital Adequacy Test</i> . Ottawa (ON): Office of the Superintendent of Financial Institutions Canada. Chapters 1, 2 (through 2.3), 8.	<a href="https://www.osfi-bsif.gc.ca/Eng/Docs/licat23.pdf">https://www.osfi-bsif.gc.ca/Eng/Docs/licat23.pdf</a>
CIA Practice Resource Document: <i>Climate Change Scenario</i> . (Must be logged in to the CIA website; including Excel Workbook.)	<a href="https://www.cia-ica.ca/publications/publication-details/221036">https://www.cia-ica.ca/publications/publication-details/221036</a>
CIA Educational Note: <i>Use of Models</i> .	<a href="https://www.cia-ica.ca/docs/default-source/2017/217007e.pdf">https://www.cia-ica.ca/docs/default-source/2017/217007e.pdf</a>

## 6. Stress and scenario testing (15%)

1. Describe the use of scenario analysis and stress testing in the risk-measurement process, including the advantages and disadvantages of each. (B2)
2. Describe the Appointed Actuary's responsibilities related to financial condition testing (FCT). (A2)
3. Explain the primary categories of risk associated with climate change from an investment perspective. (A2)
4. Describe the actuary's role with respect to climate-change risk. (B2)

Reading reference	Source
International Actuarial Association (IAA), Insurance Regulation Committee. 2013. <i>Stress Testing and Scenario Analysis</i> . Ottawa (ON): IAA. p. 1-6, 14-17, 19-25.	<a href="https://www.actuaries.org/CTTEES_SOLV/Documents/StressTestingPaper.pdf">https://www.actuaries.org/CTTEES_SOLV/Documents/StressTestingPaper.pdf</a>
CIA Educational Note: <i>Financial Condition Testing</i> .	<a href="https://www.cia-ica.ca/docs/default-source/2020/220057e.pdf">https://www.cia-ica.ca/docs/default-source/2020/220057e.pdf</a>
Bank of Canada; Office of the Superintendent of Financial Institutions (OSFI). 2022. <i>Using Scenario Analysis to Assess Climate Transition Risk</i> . Ottawa (ON): Bank of Canada; OSFI.	<a href="https://www.bankofcanada.ca/wp-content/uploads/2021/11/BoC-OSFI-Using-Scenario-Analysis-to-Assess-Climate-Transition-Risk.pdf">https://www.bankofcanada.ca/wp-content/uploads/2021/11/BoC-OSFI-Using-Scenario-Analysis-to-Assess-Climate-Transition-Risk.pdf</a>
CIA Public Statement: <i>Time to Act: Facing the Risks of a Changing Climate</i> .	<a href="https://www.cia-ica.ca/docs/default-source/2019/219104e.pdf">https://www.cia-ica.ca/docs/default-source/2019/219104e.pdf</a>

## 7. Economic capital and ORSA (15%)

1. Describe the concept of economic measures of value (e.g., market-consistent embedded value) and demonstrate their uses in the risk management and corporate decision-making processes. (B6)
2. Determine and evaluate the key elements of own-risk and solvency assessment (ORSA) and FCT, specifically risk identification and assessment, quantification of risk to capital, board oversight and senior management responsibility, monitoring, reporting, and internal controls. (C5)
3. Demonstrate an understanding of capital calculations:
  - a. Utilize the concept of economic measures of value and capital and their uses in corporate decision-making processes. (D5)
  - b. Evaluate different risk measures and capital-assessment approaches. (D5)
  - c. Demonstrate the ability to develop a capital model for a representative financial firm. (D6)
4. Compare techniques for allocating capital across an organization. (C4)

Reading reference	Source
CIA Educational Note: <i>IFRS 17 Market Consistent Valuation of Financial Guarantees for Life and Health Insurance Contracts</i> .	<a href="https://www.cia-ica.ca/publications/publication-details/222073">https://www.cia-ica.ca/publications/publication-details/222073</a>
Hardy MR, Saunders D. 2022. <i>Quantitative Enterprise Risk Management</i> . Cambridge (UK): Cambridge University Press. Chapter 18.	<a href="https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview">https://www.cambridge.org/highereducation/books/quantitative-enterprise-risk-management/C861F6558943791EBF7DC55AD9B554B5#overview</a>



## Exam F3BNK: Banking Applications

The aim of exam F3BNK is to expose candidates to key principles of risk management and banking practice and the application thereof, including governance and strategy setting and the principles of actuarial practice in solving problems, and to produce coherent advice and recommendations in the management of a banking operation.

Candidates will need to register as non-members of the Actuarial Society of South Africa (ASSA) to access the web shop to purchase the study material. Please follow instructions on Section 4 of the ASSA booklet:

[https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdm\\_dl=16146&refresh=64660e9bdcdbf1684410011](https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdm_dl=16146&refresh=64660e9bdcdbf1684410011)

1. Principal terms	
1. Define principal terms used in the banking industry. (A1)	
Reference	Source
Office of the Superintendent of Financial Institutions (OSFI). 2023. Ottawa (ON): OSFI. "Glossary of terms." [updated 2017 Sep 25]. (As background.)	<a href="https://www.osfi-bsif.gc.ca/eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/dti30e00.aspx">https://www.osfi-bsif.gc.ca/eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/dti30e00.aspx</a>

2. Operations of a banking institution (15%)
<ol style="list-style-type: none"><li>1. Discuss the role of banking institutions in economies: (C4)<ol style="list-style-type: none"><li>a. To facilitate loan-deposit transformation.</li><li>b. To facilitate investments by firms and to enable growth and job creation.</li><li>c. To facilitate local and international trade.</li></ol></li><li>2. Discuss the implication of the different types of banks on the overall economic cycle, including: (D4)<ol style="list-style-type: none"><li>a. Central banks/reserve banks.</li><li>b. Lending banks funded by customer deposits.</li><li>c. Lending banks funded by wholesale deposits.</li><li>d. Investment banks.</li><li>e. Universal banks.</li><li>f. Community banks/mutual banks.</li><li>g. Development banks.</li></ol></li><li>3. Demonstrate what constitutes the main risks for various activities carried out by banks, including: (C2)<ol style="list-style-type: none"><li>a. Retail banking activities and various products offered.</li><li>b. Corporate banking activities and various products offered.</li><li>c. Investment banking activities and various products offered.</li><li>d. Features and pricing of banking products.</li></ol></li><li>4. Demonstrate how to mitigate a bank's risks exposure regarding its different sources of revenue, including: (D3)<ol style="list-style-type: none"><li>a. Net interest income from banking book operations.</li><li>b. Non-interest income from banking book operations.</li><li>c. Trading income from trading book operations.</li></ol></li><li>5. Quantify the impact of a bank's cost base on trading book and banking book product lines, including: (B5)<ol style="list-style-type: none"><li>a. Operational expenses.</li><li>b. Cost of credit.</li><li>c. Cost of capital.</li><li>d. Cost of liquidity.</li><li>e. Tax.</li></ol></li></ol>

6. Produce a bank's financial statements and balance sheet. (C6)
7. Analyze the main types of capital that must be held by a bank, including: (B4)
  - a. Capital requirements based on risk-weighted assets.
  - b. Regulatory capital.
  - c. Economic capital requirements.
  - d. Available capital or book capital.
8. Determine and analyze the various sources of funds that banks use to fund their operations, including: (B4)
  - a. Deposit taking.
  - b. Wholesale markets funding.
  - c. Central bank funding.
  - d. Retained earnings.
9. Derive similarities and differences between the main types of financial and non-financial risks faced by a bank vs. a traditional actuarial practice area (i.e., pension, insurance, etc.). (D4)
10. Explain how actuaries can play a key role in a banking operation. (D5)

Reference	Source
Actuarial Society of South Africa (ASSA). Subject F107. Cape Town (ZA): ASSA. Chapters 1 (Overview of banking), 4 (Pricing).	<a href="https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011">https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011</a>
Choudhry M. 2012. <i>The Principles of Banking</i> . Hoboken (NJ): Wiley. Chapters 1, 2, 4.	<a href="https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024">https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024</a>
International Actuarial Association (IAA), Banking Forum. 2021. <i>Opportunities for Applying Actuarial Techniques in Banking</i> . Ottawa (ON): IAA. Section 2.	<a href="https://www.actuaries.org/IAA/Documents/Publications/Papers/Opportunities_Applying_Actuarial_Techniques_Banking.pdf">https://www.actuaries.org/IAA/Documents/Publications/Papers/Opportunities_Applying_Actuarial_Techniques_Banking.pdf</a>

### 3. The banking regulatory framework (20%)

1. Describe the main provisions of the Canadian *Bank Act* and its regulations. (B2)
2. Describe a typical corporate governance structure of a banking operation, including: (C2)
  - a. Board of directors, board committees, roles, and responsibilities.
  - b. Executive committee and senior management, roles, and responsibilities.
  - c. Various committees existing within a bank and their roles and responsibilities.
3. Outline the key elements of the Basel I framework and perceived shortcomings of the Basel I accord. (C2)
4. Understand the Basel II framework and discuss the implications of Basel II for banking operations. (D5)
5. Understand the Basel III framework and discuss the implications of Basel III for banking operations. (D5)
6. Outline the roles of central/reserve banks in managing and regulating banking operations. (B2)
7. Outline the evolution of the Basel regulations. (B2)
8. Discuss how failure to implement key principles for effective risk data aggregation and risk reporting under Basel framework may lead to major losses. (D4)
9. Understand the various international legislation, guidance notes, and accounting standards under which banks operate, including: (B2)
  - a. Legislation governing companies.
  - b. Legislation governing banks.
  - c. Directives and guidance notes issued by the Basel Committee on Banking Supervision.
  - d. Central/reserve banks and other local and international regulatory bodies.
  - e. Canadian and international accounting standards.

Reference	Source
Office of the Superintendent of Financial Institutions	<a href="https://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/Pages/CAR19_index.aspx">https://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/Pages/CAR19_index.aspx</a>

(OSFI). 2023. Ottawa (ON): OSFI. "Capital adequacy requirements (CAR) 2019." [modified 2020 Apr 9].	
Actuarial Society of South Africa (ASSA), 2022. Subject F107. Cape Town (ZA): ASSA. Chapters 2, 3, 5, 6, 7.	<a href="https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011">https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011</a>
Actuarial Society of South Africa (ASSA), 2022. Subject F207. Cape Town (ZA): ASSA. Chapters 1, 2, 3, 5, 7.	
<i>Bank Act</i> , SC 1991, c. 46. Part VI – Corporate Governance.	<a href="https://laws-lois.justice.gc.ca/eng/acts/B-1.01/index.html">https://laws-lois.justice.gc.ca/eng/acts/B-1.01/index.html</a>
Choudhry M. 2012. <i>The Principles of Banking</i> . Hoboken (NJ): Wiley. Chapters 2, 3, 6-8.	<a href="https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024">https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024</a>
Office of the Superintendent of Financial Institutions (OSFI). [revised 2022]. <i>Basel Capital Adequacy Reporting (BCAR)</i> . Ottawa (ON): OSFI.	<a href="https://www.osfi-bsif.gc.ca/Eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/BCAR21_BA.aspx">https://www.osfi-bsif.gc.ca/Eng/fi-if/rtn-rlv/fr-rf/dti-id/Pages/BCAR21_BA.aspx</a>
Office of the Superintendent of Financial Institutions (OSFI). 2022. <i>Liquidity Adequacy Requirements (LAR) Guideline</i> [guideline impact analysis statement]. Ottawa (ON): OSFI.	<a href="https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/LAR22_gias.aspx">https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/LAR22_gias.aspx</a>
Ferreira C, Jenkinson N, Wilson C. 2019. <i>From Basel I to Basel III: Sequencing Implementation in Developing Economies</i> . Washington (DC): International Monetary Fund. (IMF Working Papers, No. 2019/127).	<a href="https://www.imf.org/en/Publications/WP/Issues/2019/06/14/From-Basel-I-to-Basel-III-Sequencing-Implementation-in-Developing-Economies-46895">https://www.imf.org/en/Publications/WP/Issues/2019/06/14/From-Basel-I-to-Basel-III-Sequencing-Implementation-in-Developing-Economies-46895</a>
Office of the Superintendent of Financial Institutions (OSFI). 2023. <i>Leverage Requirements Guideline</i> . Ottawa (ON): OSFI.	<a href="https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/LR22.aspx">https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/LR22.aspx</a>
Office of the Superintendent of Financial Institutions (OSFI). 2023. Ottawa (ON): OSFI. "Frequently asked questions – Basel III reforms." [last modified 2022 Nov 15].	<a href="https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/basel-faqs.aspx">https://www.osfi-bsif.gc.ca/Eng/fi-if/rq-ro/gdn-ort/gl-ld/Pages/basel-faqs.aspx</a>

#### 4. Risk management in a banking operation (25%)

1. Discuss the role of high-level risk management in a banking operation (D4).
2. Discuss the role of an ERM risk management framework in banking. (D4)
3. Discuss the root cause of major financial failures of the past. (D4)
4. Discuss the impact on banking operations of an aggregation of risk, including (D4):
  - a. Diversification.
  - b. Concentration.
  - c. Correlation.
5. Derive similarities and differences between the process of controlling risks in a banking operation vs. a traditional actuarial practice area (i.e., pension, insurance, etc.), including but not limited to: (D5)
  - a. Setting loan-sanctioning criteria.
  - b. Setting risk appetite, tolerance, and limits.
  - c. Allocation of risk-based capital.
6. Demonstrate how risk modelling may be used to identify and measure the different types of risks in a banking operation, including: (C3)
  - a. Frequency, severity, and exposure modelling for both credit and operational risk.
  - b. Statistical modelling for portfolio management.
  - c. Survival models for credit risk management.
  - d. Market-implied probability of default and survival curves:
    - i. Default and survival curves.
    - ii. Closed-form analytical approximations vs. Monte Carlo simulation.
    - iii. Emerging modelling techniques

- e. Asset/liability modelling for balance-sheet management.
  - f. Control cycle for all models.
  - g. Cash-flow models for budgeting and balance-sheet management.
7. Discuss the nature, impact, and risk-mitigation procedures relative to: (D4)
- a. Operational risk.
  - b. Liquidity risk.
  - c. Credit risk – standardized approach.
  - d. Credit risk – internal ratings-based approach.
  - e. Settlement and counterparty risk.
  - f. Credit valuation adjustment (CVA) risk.
  - g. Market risk.
  - h. Climate-change risk.
8. Derive similarities and differences in how risks in a banking operation may be mitigated and/or managed vs. a traditional actuarial practice area (i.e., pension, insurance etc.), including but not limited to: (D5)
- a. Positions.
  - b. Credit hedging.
  - c. Securitization.
  - d. Dealing with central counterparty clearing house (CCP).

Reference	Source
Actuarial Society of South Africa (ASSA), 2022. Subject F107. Cape Town (ZA): ASSA. Chapters 3, 5, 6, 7.	<a href="https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011">https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011</a>
Actuarial Society of South Africa (ASSA), 2022. Subject F207. Cape Town (ZA): ASSA. Chapters 1, 2, 3, 5.	
<i>Bank Act</i> , SC 1991, c. 46. Part VI.	<a href="https://laws-lois.justice.gc.ca/eng/acts/B-1.01/index.html">https://laws-lois.justice.gc.ca/eng/acts/B-1.01/index.html</a>
Choudhry M. 2012. <i>The Principles of Banking</i> . Hoboken (NJ): Wiley. Chapters 6-8.	<a href="https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024">https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024</a>

## 5. Bank capital management framework (25%)

1. Understand and evaluate the banking model and capital, including: (D5)
  - a. The difference between capital and liquidity.
  - b. Bank balance sheet.
  - c. Capital to cover possible losses.
  - d. Expected (per IFRS 9) and unexpected losses.
  - e. Capital regulation.
2. Discuss key capital considerations, including: (C5)
  - a. Regulatory capital adequacy requirements (risk-weighted assets).
  - b. Regulatory minimum leverage ratio (unweighted assets).
  - c. Capital ratio, based on risk-weighted assets.
  - d. Regulatory liquidity adequacy requirements.
  - e. Credit rating considerations.
3. Understand and create a capital management policy. (C6)
4. Understand and create a liquidity management policy. (C6)
5. Understand a bank's dividend policy and its remuneration policy and assess their implications for capital management. (B4)

6. Understand and perform a reverse stress test. (C3)
7. Discuss the resulting risks of a poor implementation of a bank's recovery plan. (D4)

Reference	Source
Actuarial Society of South Africa (ASSA), 2022. Subject F107. Cape Town (ZA): ASSA. Chapter 5.	<a href="https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011">https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011</a>
Actuarial Society of South Africa (ASSA), 2022. Subject F207. Cape Town (ZA): ASSA. Chapters 4, 5, 6.	
Choudhry M. 2012. <i>The Principles of Banking</i> . Hoboken (NJ): Wiley. Chapters 5, 12-15.	<a href="https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024">https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024</a>

## 6. Banking strategies and problem solving (15%)

1. Analyze the implications of competing business lines on a bank's strategy and business model, including: (D4)
  - a. Economic and competition outlook.
  - b. Business strategy.
  - c. Ability to support business strategy.
  - d. Financial forecasts.
  - e. Considerations of strategy and business plan.
  - f. Possible acquisitions/disposals.
  - g. Approval of strategy and business plan.
2. Discuss the implementation and evaluation of a bank's strategy and business plan and subsequent monitoring. (D2)
3. Through analysis, integration, and critically evaluating results, draw conclusions and make recommendations, particularly about a bank's optimal strategy. (D5)
4. Analyze a case study and solve complex problems associated with it. (C4)

Reference	Source
Actuarial Society of South Africa (ASSA), 2022. Subject F207. Cape Town (ZA): ASSA. Chapters 8, 9.	<a href="https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011">https://www.actuarialsociety.org.za/download/international-student-guide-booklet/?wpdmdl=16146&amp;refresh=64660e9bdcdbf1684410011</a>
Choudhry M. 2012. <i>The Principles of Banking</i> . Hoboken (NJ): Wiley. Chapters 16-18.	<a href="https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024">https://www.wiley.com/en-us/The+Principles+of+Banking-p-9780470827024</a>