

# ERM – Enterprise Risk Management Exam

Fall 2019

## Important Exam Information:

Reading Extensions	At registration, candidates must select from one of six reading extensions. The readings for each extension appear at the end of this document. The study note package includes all extensions. Seventy-five percent of the exam points will come from the core readings and will be common for all candidates. The remaining twenty-five percent will be based on the readings for the selected extension. These questions may also draw on material from the core reading. <b>Beginning with this administration, questions in both the core and the extension may be based on the case study.</b>
<a href="#">Exam Registration</a>	Candidates may register online or with an application.
<a href="#">Order Study Notes</a>	Study notes are part of the required syllabus and are not available electronically but may be purchased through the online store.
Courseware	This document will guide candidates through the syllabus material and reinforce learning that is expected from each topic. It is not intended to duplicate or replace the study material, but rather to enhance it. Courseware is required reading and is in the Study Note package as ERM-52-17.
<a href="#">Introductory Study Note</a>	The Introductory Study Note has a complete listing of all study notes as well as errata and other important information.
<a href="#">Case Study</a>	This case study will also be provided with the examination. Candidates will not be allowed to bring their copy of the case study into the examination room. There is a single case study. However, within the case study are instructions as to which parts are applicable to all candidates and which parts apply to each extension.
<a href="#">Past Exams</a>	Past Exams from 2012-present are available on SOA website.
<a href="#">Updates</a>	Candidates should be sure to check the Updates page on the exam home page periodically for additional corrections or notices.

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The five topics that follow are the core learning objectives and readings for this examination. All candidates are responsible for this material.

<b>1. Topic: Risk Categories and Identification</b>
<b>Learning Objectives</b>
The candidate will understand the types of risks faced by an entity and be able to identify and analyze these risks.
<b>Learning Outcomes</b>
The Candidate will be able to: <ul style="list-style-type: none"><li>a) Explain risk concepts and be able to apply risk definitions to different entities</li><li>b) Explain risk taxonomy and its application to different frameworks</li><li>c) Identify and assess the potential impact of risks faced by an entity, including but not limited to market risk, currency risk, credit risk, counterparty risk, spread risk, liquidity risk, interest rate risk, equity risk, hazard/insurance risk, inflationary risk, environmental risk, pricing risk, product risk, legal risk, operational risk, project risk and strategic risk</li></ul>
<b>Resources</b>
<ul style="list-style-type: none"><li>• <i>Financial Enterprise Risk Management</i>, Sweeting, Paul, 2<sup>nd</sup> Edition, 2017<ul style="list-style-type: none"><li>○ Ch. 8: Risk Identification</li></ul></li><li>• <i>Value at Risk: The New Benchmark for Managing Financial Risk</i>, Jorion, Philippe, 3<sup>rd</sup> Edition, 2007<ul style="list-style-type: none"><li>○ Ch. 13: Liquidity Risk</li></ul></li><li>• ERM-107-12: Strategic Risk Management Practice, Andersen and Schroder, 2010, Ch. 7: Strategic Risk Analyses</li><li>• ERM-127-17: Quantitative Enterprise Risk Management, Hardy, Ch. 2 Risk Taxonomy</li><li>• ERM-133-19: Emerging Risks and Enterprise Risk Management, pp. 2-6</li><li>• ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9-38</li><li>• <a href="#">Embedding Cyber Risk in Risk Management: An Insurer's Perspective</a>, pp. 12-15 of Cybersecurity: Impact on Insurance Business and Operations</li></ul>

## 2. Topic: Risk Modeling and Aggregation of Risks

### Learning Objectives

The candidate will understand the concepts of risk modeling and be able to evaluate and understand the importance of risk models.

### Learning Outcomes

The Candidate will be able to:

- a) Demonstrate how each of the financial and non-financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, and scenario analysis
- b) Evaluate how risks are correlated, and give examples of risks that are positively correlated and risks that are negatively correlated
- c) Analyze and evaluate risk aggregation techniques, including use of correlation, integrated risk distributions and copulas
- d) Apply and analyze scenario and stress testing in the risk measurement process
- e) Evaluate the theory and applications of extreme value theory in the measuring and modeling of risk
- f) Analyze the importance of tails of distributions, tail correlations, and low frequency / high severity events
- g) Analyze and evaluate model and parameter risk
- h) Construct approaches to modeling various risks and evaluate how an entity makes decisions about techniques to model, measure and aggregate risks including but not limited to stochastic processes

### Resources

- *Financial Enterprise Risk Management*, Sweeting, Paul, 2<sup>nd</sup> Edition, 2017
  - Ch. 12: Extreme Value Theory
  - Ch. 14: Quantifying Particular Risks
  - Ch. 15.5: Unquantifiable Risks
- *Value at Risk: The New Benchmark for Managing Financial Risk*, Jorion, Philippe, 3<sup>rd</sup> Edition, 2007
  - Ch. 5: Computing VaR (sections 5.1-5.3 and Appendices only)
  - Ch. 7: Portfolio Risk: Analytical Methods
  - Ch. 9: Forecasting Risk Correlations (section 9.3 only)
  - Ch. 12: Monte Carlo Methods
- ERM-101-12: Measurement and Modeling of Dependencies in Economic Capital, Ch. 4-5
- ERM-102-12: Value-at-Risk: Evolution, Deficiencies and Alternatives
- ERM-103-12: Basel Committee - Developments in Modelling Risk Aggregation, pp. 72-89
- ERM-104-12: Study Note on Parameter Risk, Venter and Sahasrabudde

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- ERM-106-12: Economic Capital-Practical Considerations, Milliman
- ERM-118-14: Model Validation Principles Applied to Risk and Capital Models in the Insurance Industry
- ERM-119-14: Aggregation of Risks and Allocation of Capital (sections 4-7, excluding section 6.3)
- ERM-120-14: IAA Note on Stress Testing and Scenario Analysis (pp. 1-6 and 14-17)
- ERM-124-15: Counterparty Credit Risk: The New Challenge for Global Financial Markets, Ch.2: Defining Counterparty Credit Risk
- [Risk Appetite: Linkage with Strategic Planning Report](#)
- [Modeling Tail Behavior with Extreme Value Theory](#), Risk Management, Sep 2009
- [A New Approach for Managing Operational Risk](#), Ch. 8
- [Summary of "Variance of the CTE Estimator"](#), Risk Management, Aug 2008
- [Risk Aggregation for Capital Requirements Using the Copula Technique](#), Risk Management, Mar 2005, pp. 11-13
- [Economic Scenario Generators: A Practical Guide](#), pp. 7-17

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### 3. Topic: Risk Measures

#### Learning Objectives

The candidate will understand how the risks faced by an entity can be quantified and the use of metrics to measure risk.

#### Learning Outcomes

The Candidate will be able to:

- a) Apply and construct risk metrics to quantify major types of risk exposure such as market risk, credit risk, liquidity risk, operational risk, regulatory risk, etc., and tolerances in the context of an integrated risk management process
- b) Analyze and evaluate the properties of risk measures (e.g., Delta, volatility, duration, VaR, TVaR, etc.) and their limitations
- c) Analyze quantitative financial market data and insurance data (including asset prices, credit spreads and defaults, interest rates, incidence, causes and losses) using modern statistical methods. Construct measures from the data and contrast the methods with respect to scope, coverage and application
- d) Analyze risks that are not easily quantifiable, such as operational and liquidity risks

#### Resources

- *Financial Enterprise Risk Management*, Sweeting, Paul, 2<sup>nd</sup> Edition, 2017
  - Ch. 9: Some Useful Statistics (background only)
  - Ch. 15.5: Unquantifiable Risks
- *Value at Risk: The New Benchmark for Managing Financial Risk*, Jorion, Philippe, 3<sup>rd</sup> Edition, 2007
  - Ch. 5: Computing VaR (sections 5.1-5.3 and Appendices only)
  - Ch. 7: Portfolio Risk: Analytical Methods
  - Ch. 9: Forecasting Risk and Correlations
  - Ch. 12: Monte Carlo Methods
  - Ch. 13: Liquidity Risk
  - Ch. 18: Credit Risk Management (excluding Appendices)
- ERM-102-12: Value at Risk: Evolution, Deficiencies, and Alternatives
- ERM-105-12: Coherent Measures of Risk – An Exposition for the Lay Actuary, Meyers, Glenn
- ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9-38
- [Summary of “Variance of the CTE Estimator”](#), Risk Management, Aug 2008
- [ASOP 23: Data Quality](#), pp. 1-9

<b>4. Topic: Risk Management Tools and Techniques</b>
<b>Learning Objectives</b>
The candidate will understand the approaches for managing risks and how an entity makes decisions about appropriate techniques.
<b>Learning Outcomes</b>
The Candidate will be able to: <ul style="list-style-type: none"><li>a) Demonstrate and analyze applicability of risk optimization techniques and the impact of an ERM strategy on an organization’s value. Analyze the risk and return trade-offs that result from changes in the organization’s risk profile</li><li>b) Demonstrate means for transferring risk to a third party, and estimate the costs and benefits of doing so</li><li>c) Demonstrate means for reducing risk without transferring it</li><li>d) Demonstrate how derivatives, synthetic securities, and financial contracting may be used to reduce risk or to assign it to the party most able to bear it</li><li>e) Develop an appropriate choice of a risk mitigation strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks</li><li>f) Analyze the practicalities of market risk hedging, including dynamic hedging</li><li>g) Demonstrate the use of tools and techniques for analyzing and managing credit and counterparty risk</li><li>h) Analyze funding and portfolio management strategies to control equity and interest rate risk, including key rate risks. Contrast the various risk measures and be able to apply these risk measures to various entities. Explain the concepts of immunization including modern refinements and practical limitations</li><li>i) Analyze the application of Asset Liability Management and Liability Driven Investment principles to Investment Policy and Asset Allocation</li><li>j) Demonstrate risk management strategies for other key risks (for example, operational, strategic, legal, and insurance risks)</li><li>k) Apply best practices in risk measurement, modeling and management of various financial and non-financial risks faced by an entity</li></ul>
<b>Resources</b>
<ul style="list-style-type: none"><li>• <i>Financial Enterprise Risk Management</i>, Sweeting, Paul, 2<sup>nd</sup> Edition, 2017<ul style="list-style-type: none"><li>○ Ch. 16: Responses to Risk</li></ul></li><li>• <i>Value at Risk: The New Benchmark for Managing Financial Risk</i>, Jorion, Philippe, 3<sup>rd</sup> Edition, 2007<ul style="list-style-type: none"><li>○ Ch. 7: Portfolio Risk: Analytical Methods</li><li>○ Ch. 18: Credit Risk Management (excluding Appendices)</li></ul></li><li>• ERM-107-12: Strategic Risk Management Practice, Andersen and Schroder, 2010, Ch. 7: Strategic Risk Analyses</li></ul>

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- ERM-110-12: Derivatives: Practice and Principles, Recommendations 9-24 & Section III
- ERM-111-12: Key Rate Durations: Measures of Interest Rate Risks
- ERM-112-12: Revisiting the Role of Insurance Company ALM within a Risk Management Framework
- ERM-115-13: Creating an Understanding of Special Purpose Vehicles, PWC
- ERM-122-16: Chapter 1 of *Captives and the Management of Risk*, 3<sup>rd</sup> Edition, Kate Westover
- ERM-124-15: Counterparty Credit Risk: The New Challenge for Global Financial Markets, Ch.2: Defining Counterparty Credit Risk
- ERM-128-17: The Breadth and Scope of the Global Reinsurance Market and the Critical Role Such Market Plays in Supporting Insurance in the United States (III, IV & VI)
- ERM-129-18: AAA PBR Checklist - Assumptions Setting (section C)
- ERM-130-18: AAA Model Governance Practice Note
- ERM-131-18: Leveraging COSO Across The Three Lines Of Defenses
- ERM-132-18: Best Practices For Creating Your Own ORSA Report
- ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9-38
- [A New Approach to Managing Operational Risk](#), Ch. 8
- [Risk Appetite: Linkage with Strategic Planning Report](#)
- [End to End Assumption Documentation Practices](#), Product Matters, Jul 2016
- [Embedding Cyber Risk in Risk Management: An Insurer's Perspective](#), pp. 12-15 of Cybersecurity: Impact on Insurance Business and Operations

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<b>5. Topic: Capital Management</b>
<b>Learning Objectives</b>
The candidate will understand the concept of economic capital, risk measures in capital assessment and techniques to allocate the cost of risks within business units.
<b>Learning Outcomes</b>
The Candidate will be able to: <ol style="list-style-type: none"><li>Describe the concepts of measures of value and capital requirements (for example, EVA, embedded value, economic capital, regulatory measures, and accounting measures) and demonstrate their uses in the risk management and corporate decision-making processes</li><li>Define the basic elements and explain the uses of economic capital. Explain the challenges and limits of economic capital calculations and explain how economic capital may differ from external requirements of rating agencies and regulators</li><li>Apply risk measures and demonstrate how to use them in capital assessment. Contrast regulatory, accounting, statutory and economic capital</li><li>Propose techniques for allocating /appropriating the cost of risks/capital/hedge strategy to business units in order to gauge performance (risk adjusted performance measures)</li><li>Demonstrate the ability to develop a capital model for a representative financial firm</li></ol>
<b>Resources</b>
<ul style="list-style-type: none"><li>ERM-101-12: Measurement and Modelling of Dependencies in Economic Capital, Ch. 3</li><li>ERM-106-12: Economic Capital – Practical Considerations, Milliman</li><li>ERM-112-12: Revisiting the Role of Insurance Company ALM within a Risk Management Framework</li><li>ERM-119-14: Aggregation of Risks and Allocation of Capital (sections 4-7, excluding section 6.3)</li><li>ERM-123-14: S&amp;P Enterprise Risk Management Criteria (paragraphs 1-71, 86-88)</li><li>ERM-126-15: ORSA – An International Requirement (sections 3.1 and 4.1)</li><li>ERM-134-19: Group Insurance, Skwire, 2016, Ch. 39: Risk Based Capital Formulas</li><li><a href="#">Risk Appetite: Linkage with Strategic Planning Report</a></li></ul>



## READING EXTENSIONS

The following are the resources for the six extensions. They apply risk management across the set of learning objectives for this examination. Candidates are responsible only for the readings in the extension for which they registered.

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## RETIREMENT BENEFITS

- ERM-321-14: LDI Evolution: Implementing Dynamic Asset Allocation Strategies that Respond to Changes in Funded Status
- ERM-327-17: Pension Funding Strategy
- ERM-330-17: Liability Relative Investing I
- ERM-331-17: Quantifying the Mortality – Longevity Offset
- [ASOP 51: Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions](#)
- [Pension Risk Transfer](#), pp. 1-7 & 11-46
- [Corporate Pension Risk Management and Corporate Finance: Bridging the Gap between Theory and Practice in Pension Risk Management](#)
- [Embedded Options in Pension Plans](#), pp. 6-7 & 28-60

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**INDIVIDUAL LIFE AND ANNUITIES**

- ERM-123-14: S&P Enterprise Risk Management Criteria (paragraphs 72-73)
- ERM-331-17: Quantifying the Mortality-Longevity Offset
- ERM-401-12: Mapping of Life Insurance Risks
- ERM-405-14: Secondary Guarantee Universal Life - Practical Considerations (excluding sections 1, 2, and 7 Introduction, Overview and Principle-based Reserve Sections)
- ERM-408-14: The Captive Triangle: Where Life Insurers' Reserve and Capital Requirements Disappear, pp. 1-11
- ERM-409-14: A Brief Primer on Financial Reinsurance
- ERM-410-14: Coinsurance and its Variants
- ERM-412-17: Surrenders in the Life Insurance Industry (through Section 4)
- ERM-413-17: Hedging for Liabilities in Life Insurance Companies
- ERM-414-17: A Tale of Two Formulas
- ERM-415-17: Strategic Risk Management in Insurance: Navigating the Rough Waters Ahead
- ERM-416-19: Responding to the Variable Annuity Crisis, pp. 1-14
- ERM-417-19: A Natural Hedge for Equity Indexed Annuities
- ERM-418-19: Low Interest Rates and the Implications on Life Insurers
- ERM-419-19: How Life Insurers Combat Anti-Selection
- [Life Insurance for the Digital Age: An End-to-End View](#), Product Matters, Nov 2017
- [How Fair Value Measurement Changes Risk Management Behavior in the Insurance Industry](#)
- [Global Mortality Improvement Experience and Projection Techniques](#), pp. 21-33 & 74-83
- [Modeling of Policyholder Behavior for Live Insurance and Annuity Products](#), pp. 8-15

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**GROUP AND HEALTH**

- Group Insurance, Skwire 7<sup>th</sup> Edition, Ch. 39 (Risk Based Capital Formulas) and 42 (Enterprise Risk Management for Group Health Insurers)
- ERM-123-14: S&P Enterprise Risk Management Criteria (paragraphs 72-73, 82-85)
- ERM-512-13: Economics and Financing, Getzen (sections 5.4 & 5.5)
- ERM-513-13: Extending the Insurance ERM Criteria to the Health Insurance Sector
- ERM-517-15: The Cost of Waiting, Nov/Dec 2014 Contingencies
- ERM-518-19: NAIC Own Risk and Solvency Assessment (ORSA) Guidance Manual
- ERM-520-17: Differing Impacts of Market Concentration on Affordable Care Act
- ERM-521-17: Risk Transfer Formula for Individual and Small Group Markets under the Affordable Care Act
- ERM-522-17: Risk Selection Threatens Quality of Care for Certain Patients: Lessons from Europe's Health Insurance Exchanges
- ERM-523-18: Why are Many Co-Ops Failing?
- ERM-524-18: Life, Health and Annuity Reinsurance, Ch. 18
- ERM-525-19: Top Health Industry Issues of 2018, PWC
- ERM-526-19: The Risk of Pricing New Insurance Products: The Case of Long-Term Care
- [Risk & Mitigation for Health Insurance Companies](#)
- [Time to Update your Trend Process?](#), Health Watch, Feb 2018

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**INVESTMENT**

- *Value at Risk: The New Benchmark for Managing Financial Risk*, Jorion, Philippe, 3<sup>rd</sup> Edition, 2007
  - Ch. 8: Multivariate Models
  - Ch. 11: VAR Mapping
  - Ch. 17: VAR and Risk Budgeting in Investment Management (excluding sections 17.3 and 17.4)
- ERM-330-17: Barton Waring Liability–Relative Investing I (including Endnotes)
- ERM-612-17: Modern Investment Management: An Equilibrium Approach, Ch. 7: Beyond Equilibrium, the Black-Litterman Approach
- ERM-613-17: Managing Investment Portfolios, Maginn and Tuttle, 3<sup>rd</sup> Edition Ch. 6 (sections 4 & 5 only)
- ERM-614-19: An Asset-Liability Version of the Capital Asset Pricing Model with a Multi-Period Two-Fund Theorem (including Endnotes)
- ERM-615-19: The devil is in the tails: actuarial mathematics and the subprime mortgage crisis
- ERM-616-19: Replicating Portfolios, Milliman Research Report, pp. 2-27
- ERM-617-19: Chapters 17 (pp. 365-377), 19 (pp. 397-425) and 29 (pp. 670-686) of *Options, Futures and other Derivatives*, Hull, John, 10<sup>th</sup> Edition, 2018
- [Strategic Asset Allocation in Asia: Optimizing Across Portfolios](#), Investment Newsletter, Issue 69

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**GENERAL INSURANCE**

- ERM-123-14: S&P Enterprise Risk Management Criteria (paragraphs 74-81)
- ERM-415-17: Strategic Risk Management in Insurance: Navigating the Rough Wates Ahead
- ERM-705-12: P&C RAROC: A Catalyst for the Improved Capital Management in the Property and Casualty Insurance Industry
- ERM-708-13: Natural Catastrophe Loss Modeling
- ERM-710-14: Allocation of Capital in the Insurance Industry
- ERM-711-16: Risk Appetite for a General Insurance Undertaking (excluding Appendices)
- ERM-712-16: Catastrophe Modelling: Guidance for Non-Catastrophe Modellers
- ERM-713-16: Stochastic Modelling of Catastrophe Risks in DFA Models
- ERM-714-18: U.S. Property-Casualty: Underwriting Cycle Modeling and Risk Benchmarks (section 2, pp. 92-103)
- ERM-715-19: The US Casualty Market in 2018: Our Top 10 List
- ERM-716-19: Property/Casualty Insurance Company Insolvencies
- ERM-717-19: 2018 Insurance Industry Outlook
- ERM-718-19: Why Insurers Fail
- ERM-719-19: Top 10 Trends in Property and Casualty Insurance, 2018
- ERM-720-19: Insurance, Climate and Sustainable Development
- [ERM for Property-Casualty Insurance Companies](#), section 2
- [Human Dynamics of Insurance Cycles and Implications for Insurers](#)
- [CIA Research Paper on Quantification of Variability in P&C Liabilities](#)

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**GENERAL CORPORATE ERM**

- ERM-123-14: S&P Enterprise Risk Management Criteria (paragraphs 72-85)
- ERM-414-17: A Tale of Two Formulas
- ERM-811-15: Agency Theory and Asymmetric Information
- ERM-812-15: Valuation for Mergers and Acquisitions, Ch. 1
- ERM-813-15: Financial Structure, Capital Structure (Capitalization), and Leverage Explained
- ERM-814-15: Cognitive Bias and their Implications on the Financial Market
- ERM-817-17: Speech by SEC Staff: The Role of Compliance and Ethics in Risk Management
- ERM-819-19: Exchange Rate Risk Measurement and Management
- ERM-820-19: CRO Forum Concept Paper on a Proposed Categorisation Methodology of Cyber Risk, Jun 2016
- [Incentive Compensation/Risk Management – Integration Incentive Alignment and Risk Mitigation](#), Beal et al.
- [A New Approach for Managing Operational Risk](#), sections 5-7, 9 & 10
- [Regulatory Risk and North American Insurance Organizations](#), sections 6.1-6.14 & 7
- [Risk Aggregation and Diversification](#), excluding Appendices
- [Embedding Cyber Risk in Risk Management: An Insurer's Perspective](#), pp. 12-15 of “Cybersecurity: Impact on Insurance Business and Operations”
- [Integration of Risk Management into Strategic Planning](#)