

# Enterprise Risk Management Exam

Fall 2017

## 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 case study and/or the readings for the selected extension. These questions may also draw on material from the core reading.
<a href="#">Exam Registration Order</a>	Candidates may register online or with an application.
<a href="#">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 relate to which reading extension.
<a href="#">Past Exams</a>	Past Exams from 2012 - present are available on the 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>• Financial Enterprise Risk Management, Sweeting<ul style="list-style-type: none"><li>○ Ch. 8 Risk Identification</li></ul></li><li>• Value-at- Risk: The New Benchmark for Managing Financial Risk, Jorion, 3<sup>rd</sup> Edition<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-117-14: AAA Practice Note: Insurance Enterprise Risk Management Practices (pp. 4- 26)</li><li>• ERM-127-17: Quantitative Enterprise Risk Management, Hardy, Ch.2 Risk Taxonomy</li><li>• ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9–38</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
  - 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, 3<sup>rd</sup> Edition
  - Ch. 5 Computing VaR, Sections 5.1-5.3 including appendices
  - Ch. 7 Portfolio Risk: Analytical Methods
  - Ch. 9 Forecasting Risk Correlations (only Section 9.3 Modelling Correlations, pp. 232-236)
  - Ch. 12 Monte Carlo Methods
- ERM-101-12: Measurement and Modeling of Dependencies in Economic Capital, Ch. 4-5
- ERM-103-12: Basel Committee - Developments in Modelling Risk Aggregation, pp. 72 -89
- ERM-104-12: Study Note on Parameter Risk, Venter and Sahasrabudhe
- ERM-106-12: Economic Capital-Practical Considerations, Milliman

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- ERM-117-14: AAA Practice Note: Insurance Enterprise Risk Management Practices (pp. 4- 26)
- 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)
- 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
- ERM-125-15: Loss Models Further Topics, Klugman, Panjer and Wilmot, Ch. 10 Copula models
- ERM-602-12: *Investment Management for Insurers*, Babbel and Fabozzi, Ch. 11, The Four Faces of an Interest Model
- [Risk Appetite: Linkage with Strategic Planning Report](#)
- [Modeling Tail Behavior with Extreme Value Theory](#), Risk Management, Sept 2009
- [SOA Monograph- A New Approach to Managing Operational Risk, Ch. 8](#)
- [Summary of "Variance of the CTE Estimator,"](#) Risk Management, Aug 2008

### 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
  - Ch. 9 Some Useful Statistics (Background only)
  - Ch. 15.5 Unquantifiable Risks
- Value-at-Risk: The New Benchmark for Managing Financial Risk, Jorion, 3<sup>rd</sup> Edition
  - Ch. 5 Computing VaR, Sections 5.1-5.3 including
  - 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>• Financial Enterprise Risk Management, Sweeting<ul style="list-style-type: none"><li>○ Ch. 16 Responses to Risk</li></ul></li><li>• Value-at- Risk: The New Benchmark for Managing Financial Risk, Jorion, 3<sup>rd</sup> Edition<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></ul>

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- ERM-107-12: Strategic Risk Management Practice, Andersen and Schroder, 2010, Ch. 7: Strategic Risk Analyses
- 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-117-14: AAA Practice Note: Insurance Enterprise Risk Management Practices (pp. 4-26)
- 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
- ERM-702-12: IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry, pp. 9-38
- [SOA 2012 Annual Meeting – Session 53 – Assumption Setting Best Practices](#), Towers Watson (Steiner slides only)
- [SOA Monograph- A New Approach to Managing Operational Risk](#), Ch. 8
- [Risk Appetite: Linkage with Strategic Planning Report](#)

<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: <ul style="list-style-type: none"><li>a) 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>b) 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>c) Apply risk measures and demonstrate how to use them in capital assessment. Contrast regulatory, accounting, statutory and economic capital.</li><li>d) 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>e) Demonstrate the ability to develop a capital model for a representative financial firm.</li></ul>
<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)</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-501-12: Risk Based Capital–General Overview</li><li>• <a href="#">Risk Appetite: Linkage with Strategic Planning Report</a></li><li>• <a href="#">SOA 2012 Annual Meeting – Session 53 – Assumption Setting Best Practices</a>, Towers Watson (Steiner slides only)</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.

## RETIREMENT BENEFITS

- ERM-309-13: Risk Assessment Framework for Federal Regulated Private Pension Plans, OSFI
- ERM-321-14: LDI Evolution: Implementing Dynamic Asset Allocation Strategies that Respond to Changes in Funded Status
- ERM-327-17: Pension Funding Strategy
- ERM-328-17: Retirement for the Ages
- ERM-329-17: Risk Factors as building blocks for Portfolio Diversification: The Chemistry of Asset Allocation
- ERM-330-17: Liability Relative Investing I
- ERM-331-17: Quantifying the Mortality – Longevity Offset
  
- [Quantifying Defined Contribution Risk](#)
- [Pension Risk Transfer](#) pp. 1-7 and 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 and 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-407-14: Equity Indexed Annuities: Downside Protection, But at What Cost?
- 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-411-17: Repercussions of a Sustained Interest-Rate Environment on Life Insurance Products
- 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
  
- [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 Chapters 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-509-13: PPACA MLR Regulations
- 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-515-14: Health Insurance Market Reforms: Rate Restrictions
- ERM-516-14: AAA Financial Reporting Implications Under the Affordable Care Act
- ERM-517-15: The Cost of Waiting, Nov/Dec 2014 Contingencies
- ERM-518-17: NAIC Own Risk and Solvency Assessment (ORSA) Guidance Manual
- ERM-519-17: Top Health Industry Issues of 2016
- 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
  
- [Risk & Mitigation for Health Insurance Companies](#)
- [A Health Insurance Insolvency Case Study](#), Health Section News, No 38, 2000 , pp.1 & 20-25

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**INVESTMENT**

- Value-at- Risk: The New Benchmark for Managing Financial Risk, Jorion, 3<sup>rd</sup> Edition
  - 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-329-17: Risk Factors as building blocks for Portfolio Diversification: The Chemistry of Asset Allocation
- ERM-330-17: Barton Waring Liability–Relative Investing I
- ERM-610-17: Barton Waring Liability–Relative Investing II
- ERM-611-17: Investment Management for Insurers, Ch. 26, The Use of Derivatives in Managing Equity Portfolios
- 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, 3rd Edition Chapter 6, Sections 4 and 5, pp 346-385

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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 (exclude Appendices)
- ERM-712-16: Catastrophe Modelling: Guidance for Non-Catastrophe Modellers
- ERM-713-16: Stochastic Modelling of Catastrophe Risks in DFA Models
  
- [We're Going to Need a Bigger Boat](#), CAS, Part 1 pp. 15-16, Aug 2010 (Ingram and Underwood)
- [Riding the Waves of the Cycle](#), CAS, Part 2, pp. 26–27, Nov 2010 (Ingram and Underwood)
- [Human Dynamics of Insurance Cycles and Implications for Insurers](#)
- [Regulatory Capital Standards for Property and Casualty Insurers under US, Canadian and Proposed Solvency II \(Standard\) Formulas](#)
- [Research paper on Quantification of Variability in P&C Liabilities](#), CIA

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**GENERAL CORPORATE ERM**

- ERM-123-14: S&P Enterprise Risk Management Criteria (Paragraphs 72-85)
- ERM-402-12: Countering the Biggest Risk of All
- 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-815-15: Basel Committee – Developments in Modelling Risk Aggregation, Sections 3-8
- ERM-816-17: SIFI Designation and its Potential Impact on Nonbank Financial Companies
- ERM-817-17: Speech by SEC Staff: The Role of Compliance and Ethics in Risk Management
- ERM-818-17: The Five Critical Attributes of Effective Cybersecurity Risk Management
  
- [ERM for Strategic Management](#) - Status Report, Venter
- [Incentive Compensation/Risk Management – Integration Incentive Alignment and Risk Mitigation](#) – Beal
- [A New Approach for Managing Operational Risk](#), Sections 5-7
- [Regulatory Risk and North American Insurance Organizations](#), Sections 6.1-6.14 and 7