

2011 Exam 7

Estimation of Policy Liabilities, Insurance Company Valuation, and Enterprise Risk Management

Before commencing study for this four-hour examination, candidates should read the “Introduction” to “Materials for Study” for important information about learning objectives, knowledge statements, readings, and the range of weights. Items marked with a bold **SK** constitute the 2011 CAS Exam 7 Study Kit that may be purchased from the CAS Online Store. Items marked with a bold **W** (2011 Exam 7 Web Notes) are available at no charge and may be downloaded from links in the Complete Text References section below—or a printed version may be purchased from the CAS Online Store. Items marked with a bold **OE** are available online exclusively.

Please check the “Syllabus Updates” section of the CAS Web Site for any changes to the *Syllabus*.

The CAS will test the candidate’s knowledge of topics that are presented in the learning objectives. Thus, the candidate should expect that each exam will cover a large proportion of the learning objectives and associated knowledge statements and syllabus readings, and that all of these will be tested at least once over the course of a few years—but each one may not be covered on a particular exam.

A. Estimation of Policy Liabilities

Range of weight for Section A: 40–50 percent

This section focuses on advanced techniques that the actuary may need to estimate reserves for unpaid claims. The candidate is expected to be well versed in the basic Principles and Standards of Practice for unpaid claim estimation. This section addresses how actuarial concepts are adapted to evaluate liabilities arising in complex risk transfer agreements common in excess insurance and reinsurance contracts. Emphasis is placed on developing ranges around a best estimate.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Calculate unpaid claim estimates using credibility models. Range of weight: 2–4 percent	a. Application of credibility b. Mechanics of the method c. Strengths and weaknesses d. Testing results for reasonableness
READINGS	
Brosius Mack (2000)	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Estimate parameters and unpaid claims using claims development models related to loss reserving methods such as: <ul style="list-style-type: none"> • Chain ladder • Cape Cod • Chain ladder plus calendar-year effects • Bornhuetter-Ferguson 	a. Key assumptions of the models and testing of assumptions b. Original Mack chain ladder assumptions c. Relationship of variance assumptions to methods of calculating development factors d. Row-factor times column-factor models e. Calendar-year effects in development factor models and in row-column factor models
3. Calculate the moments and percentiles of unpaid claim distributions implied by the models. Range of weight: 16-18 percent	f. Effect of trends and their interrelationship (e.g., calendar year, accident year, and development year trends) g. Testing for and eliminating insignificant

	<p>parameters</p> <p>h. Testing whether the methods work and how well the models fit</p> <p>i. Moments of the chain ladder unpaid claim estimate when factors are calculated based on different variance assumptions</p> <p>j. Simulation of parameter percentiles and unpaid claims percentiles when models assume a distribution of residuals fit by MLE</p>
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READINGS

Clark
Mack (1994)
Venter

EARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>4. Estimate unpaid claims for various layers of claims. Range of weight: 1–3 percent</p>	<p>a. Methods for estimating unpaid claims in a deductible layer</p> <p>b. Methods for estimating unlimited unpaid claims excess of a threshold</p> <p>c. Methods for estimating unpaid claims excess of a retention but bounded by a limit</p> <p>d. Interrelationships between parameters for forecasting deductible, unlimited excess, layer excess and total claims</p>

READINGS

Siewert

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
<p>5. Calculate the mean and prediction error of a reserve given an underlying statistical model. Range of weight: for Learning Objectives A5-A7 collectively: 7-9 percent</p>	<p>a. Distributions and distribution-free models</p> <p>b. Comparison of Chain Ladder stochastic models</p>
<p>6. Derive predictive distributions using bootstrapping and simulation techniques. Range of weight: for Learning Objectives A5-A7 collectively: 7-9 percent</p>	<p>a. Comparison of methods</p> <p>b. Simulation using bootstrapping</p> <p>c. Simulation from parameters</p> <p>d. Bayesian methods</p>
<p>7. Adjust stochastic reserving models for changes in underlying reserve assumptions Range of weight: for Learning Objectives A5-A7 collectively: 7-9 percent</p>	<p>a. Bayesian methods</p> <p>b. Apply adjustments to various reserving techniques</p>

READINGS

England and Verrall
Verrall

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. Compare and contrast reinsurance and primary reserving procedures. 9. Adjust primary methods and data to be used for reinsurance reserving. 10. Calculate ceded loss reserves using appropriate methods. Range of weight: 12–14 percent	a. Overview of reinsurance and primary reserving methods b. Impact on assumptions from differences in information available to reinsurers c. Stanard-Buhlmann method d. Cape Cod method e. Underlying business characteristics of reinsurance contracts e.g., concentration of exposures f. Data structures: <ul style="list-style-type: none"> • Ground up versus excess loss • Accident year versus treaty year g. Reinsurance reserving methods
READINGS	
Patrik	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
11. Forecast Premium Reserves. Range of weight 2-4 percent	a. Reserves for retrospective premiums b. Reserves for unearned premiums for policies with non pro-rata earning patterns
READINGS	
Teng and Perkins	

B. Insurance Company Valuation

Range of weight for Section B: 5–7 percent

This section focuses on methods used to determine the theoretical value of equity securities and extending the methodology to value property and casualty insurance companies. The candidate is expected to be proficient with the basic tools and techniques commonly used in the financial analysis of corporations as described in the knowledge requirements set forth for VEE–Corporate Finance.

Learning Objectives	Knowledge Statements
1. Calculate the effect of loss and expense reserve requirements and regulatory or rating agency capital requirements on the free cash flow to equity for a P&C insurer. Range of weight for Learning Objectives B1-B3 collectively: 5-7 percent	a. Free cash flow to equity for a P&C insurer
2. Value the equity of a P&C insurer based on its expected future dividends, its free cash flow to equity, or its expected abnormal earnings Range of weight for Learning Objectives B1-B3 collectively: 5-7 percent	a. Dividend Discount Model (DDM) b. Free cash flow to equity for a P&C insurer c. Discounted Cash Flow (DCF) Valuation using free cash flow to equity (FCFE), including impact of alternative methods of estimating terminal values and reasons why this method is preferred over the free cash flow to the firm (FCFF) method for P&C insurers d. Abnormal earnings e. Abnormal Earnings Valuation (AE), including impact of alternative methods of estimating terminal values
3. Value the equity of a firm using comparative or relative valuation methods based on multiples of selected financial variables obtained from either peer companies or from underlying fundamentals. Range of weight for Learning Objectives B1-B3 collectively: 5-7 percent	a. Comparative valuation ratios including price-earnings, price-sales, price-book, price-cash flow b. Relationship between the dividend discount model and the price-earnings (P-E) ratio c. Relationship between the abnormal earnings valuation model and the price-book value (P-BV) ratio
READINGS	
Goldfarb	

C. Enterprise Risk Management

Range of weight for Section C: 45-55 percent

This section introduces the candidate to the concepts and basic techniques of Enterprise Risk Management (ERM). ERM seeks to integrate the entire landscape of risk that confronts a business. Topics include value of risk management and basic modeling concepts.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Demonstrate how insurance and financial risk can be analyzed quantitatively. Range of weight: 10-14 percent	a. Currency risk b. Credit risk c. Spread risk d. Interest rate risk e. Equity risk f. Hazard/insurance risk
READINGS	
Brooks et al. IAA Venter Financial	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Describe the use of enterprise-wide risk modeling and aggregation techniques. 3. Evaluate and select appropriate models to handle diverse risks, including stochastic approaches. Range of weight: 10-14 percent	a. Incorporating the use of correlation b. Evaluation and selection of appropriate copulas as part of the process of modeling multi-variate risks c. Alternatives to copulas d. Scenario analysis e. Stress testing f. Extreme value theory g. Tail distributions and tail correlations h. Low frequency/high severity events i. Model and parameter risk
READINGS	
Brooks et al. Embrechts et al. Feldblum IAA Venter Copulas	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Demonstrate the properties of various risk measures and their limitations. 5. Describe how risk measures and risk modeling, including allocation, can affect strategic management. Range of weight: 5-8 percent	a. (Semi) standard deviation b. VaR and TVaR c. Expected policyholder deficit and default put option d. Risk-adjusted TVaR e. Distortion measures and probability transforms
READINGS	
IAA Venter and Underwood Venter Non-tail Measures Venter Strategic Management	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Describe the rationale for, methods for, and effect of managing insurance and financial risks. Range of weight: 8-12 percent	a. Selection of appropriate degree of risk b. Risk optimization and value impact c. Retention including estimated costs compared to benefits of risk transfer, value of specific risk, costs of financial distress, taxation, firm value, financing costs, and risk attitudes of debtholders, customers, employees, etc.
READINGS	
IAA Venter and Underwood	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Describe operational risk and demonstrate possible mitigation and quantification methodology. Range of weight: 3-5 percent	a. Types of operational risk b. Examples c. Quantification d. Mitigation
READINGS	
Mango and Venter McNeil et al.	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. Evaluate best practices in risk measurement, modeling, and management of various financial and non-financial risks faced by an entity. Range of weight: 5-8 percent	a. Economic capital b. Extreme events c. Risks d. Model structure
READINGS	
Brooks et al.	

Complete Text References for Exam 7

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Brooks, D.; Care, R.J.; Chaplin, M.B.; Kaufman, A.M.; Morgan, K.A.; and Roberts, D.N., "Actuarial Aspects of Internal Models for Solvency II," draft paper presented to the Institute of Actuaries, 23 February 2009, Chapters 1, 4, 9, and 14-28.	Brooks et al.	C1, C2, C3, C8	W
Brosius, E., "Loss Development Using Credibility," CAS Study Note, March 1993.	Brosius	A1	W
Clark, D.R., "LDF Curve Fitting and Stochastic Reserving: A Maximum Likelihood Approach," Casualty Actuarial Society <i>Forum</i> , Fall 2003.	Clark	A2, A3	W

Citation	Abbreviation	Learning Objective	Source
Embrechts, P.; Resnick, S.I.; and Samorodnitsky, G., "Extreme Value Theory as a Risk Management Tool," <i>North American Actuarial Journal</i> , Volume 3, Number 2, April 1999, Society of Actuaries.	Embrechts et al.	C2, C3	W
England, P.D., and Verrall, R.J., "Stochastic Claims Reserving in General Insurance," Institute of Actuaries and Faculty of Actuaries, 28 January 2002.	England and Verrall	A5, A6, A7	W
Feldblum, S., "Dependency Modeling," CAS Study Note, September 2010.	Feldblum	C2, C3	W
Goldfarb, R. "P&C Insurance Company Valuation," October 2010.	Goldfarb	B1, B2, B3	W
International Actuarial Association, "A Global Framework for Insurer Solvency Assessment," a research report of the Insurer Solvency Assessment Working Party, 2004, Chapters 1, 2, 5, 7, 8, and 9; Appendices B, D, E, H, and I.	IAA	C1, C2, C4, C5, C6	OE
Mack, T., "Measuring the Variability of Chain Ladder Reserve Estimates," <i>Casualty Actuarial Society Forum</i> , Spring 1994.	Mack (1994)	A2, A3	W
Mack, T. "Credible Claims Reserve: The Benktander Method," <i>ASTIN Bulletin</i> , 2000, pp. 333-337.	Mack (2000)	A1	W
Mango, D.F.; and Venter, G.G., "Operational Risk," <i>Enterprise Risk Analysis for Property & Liability Insurance Companies</i> , Brehm, P.; Gluck, S.; Kreps, R.; Major, J.; Mango, D.; Shaw, R.; Venter, G.; White, S.; and Witcraft, S., Guy Carpenter, Section 4.1.	Mango and Venter	C7	SK
McNeil, A.J.; Frey, R.; and Embrechts, P., <i>Quantitative Risk Management</i> , Princeton University Press, 2005, Section 10.1, "Operational Risk in Perspective," pp. 463-470, excluding "Notes and Comments" on page 470.	McNeil et al.	C7	SK
Patrik, G.S., "Reinsurance," <i>Foundations of Casualty Actuarial Science</i> (Fourth Edition), Casualty Actuarial Society, 2001, Chapter 7, pp. 434-464 (section on Reinsurance Loss Reserving).	Patrik	A8, A9, A10	W
Siewert, J.J., "A Model for Reserving Workers Compensation High Deductibles," <i>Casualty Actuarial Society Forum</i> , Summer 1996, pp. 217-244.	Siewert	A4	W
Teng, M.T.S.; and Perkins, M.E., "Estimating the Premium Asset on Retrospectively Rated Policies," <i>PCAS LXXXIII</i> , 1996, pp. 611-647, excluding Section 5. Including discussion of paper: Feldblum, S., <i>PCAS LXXXV</i> , 1998, pp. 274-315, Sections 1 and 2 only. Candidates will not be held responsible for specific Annual Statement notation but will be responsible for concepts presented.	Teng and Perkins	A11	W

Citation	Abbreviation	Learning Objective	Source
Venter, G.G., “Advances in Modeling of Financial Series,” Society of Actuaries, 2010. Final edited version posted on 29 December 2010.	Venter Financial	C1	W
Venter, G.G., “ERM for Strategic Management—Status Report,” Society of Actuaries, 2008. Corrected version posted on 28 February 2011.	Venter Strategic Management	C4	W
Venter, G.G., “Non-tail Measures and Allocation of Risk Measures,” CAS Study Note, 1/11/2010.	Venter Non-tail Measures	C4	W
Venter, G.G., “Tails of Copulas,” <i>PCAS LXXXIX</i> , 2002, pp. 68-113.	Venter Copulas	C2	W
Venter, G.G., “Testing the Assumptions of Age-to-Age Factors; <i>PCAS LXXXV</i> , 1998, pp. 807-847.	Venter Factors	A2, A3	W
Venter, G.G.; and Underwood, A., “Value of Risk Reduction,” CAS Study Note, 2010.	Venter and Underwood	C5, C6	W
Verrall, R.J., “Obtaining Predictive Distributions for Reserves Which Incorporate Expert Opinion,” <i>Variance</i> , Vol. 1, Issue 1, 2007, Casualty Actuarial Society.	Verrall	A5, A6,A7	W

Source Key

- OE** Represents material that is available online exclusively.
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Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; Web site: www.casact.org.

Institute and Faculty of Actuaries, Staple Inn Hall, High Holborn, London WC1V 7QJ, United Kingdom; telephone: +44 (0)20 7632 2111; Web site: www.actuaries.org.uk.

International Actuarial Association, 150 Metcalfe Street, Suite 800, Ottawa, Ontario K2P 1P1, Canada; telephone: (613) 236-0886; fax: (613) 236-1386; Web site: www.actuaries.org.

McNeil, A.J.; Frey, R.; and Embrechts, P., *Quantitative Risk Management*, 2005, Princeton University Press, 41 William Street, Princeton, NJ 08540; telephone: (609) 258-4900; fax: (609) 258-6305; Web site: <http://press.princeton.edu/>.

North American Actuarial Journal, Society of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173; telephone: 847.706.3500; Web site: www.soa.org.

SlideRule Books, P.O. Box 69, Greenland, NH 03840; telephone: (877) 407-5433 or (605) 845-5580; fax: (877) 417-5433 or (605) 845-7627; Web site: www.sliderulebooks.com.

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