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New Edition

ACTEX ACADEMIC SERIES:

6th Edition

Mathematics of Investment and Credit

An Official Reference for **SOA Exam FM** and **EA-1**

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"The Mathematics of Investment and **Credit** book is an excellent textbook. The minute I started reading it, I knew it was exactly what I needed for my mathematics of finance class which I usually teach at American University in Cairo. Broverman's book suits a purely actuarial audience as well as non-specialists. Many of the exercises at the end of every chapter are versatile and comprise both theory and computations. This book is clearly written and concise and offers much more information than I expected. Thank you, Samuel, for a job well done and I am looking forward to using your book again." — Rachid Belhachemi

Financial Mathematics

2015 580 pages, 6" x 9" \$115.00 SOFTCOVER ISBN: 978-1-62542-485-3

Solutions Manual: 978-1-62542-486-0

The New Sixth Edition includes updates driven by the upcoming changes in the learning objectives for exam FM, updated examples and exercises and some exposition improvements. The topic of duration has been revamped in Chapter 7 and there is expanded treatment of determinants of interest rates in chapter 8. Mathematics of Investment and Cressing Sixth Edition



Contents:

Chapter 1: Interest Rate Measurement Chapter 2: Valuation of Annuities Chapter 3: Loan Repayment Chapter 4: Bond Valuation

Chapter 5: Measuring the Rate of Return of An Investment

Chapter 6: The Term Structure of Interest Rates Chapter 7: Cashflow Duration and Immunization Chapter 8: Additional Topics in Fixed Income Investments Chapter 9: Adv. Topics in Equity Investments and Financial Derivatives Chapter 10: Options



"My goal is to have students understand the methods I use to arrive at solutions so that they learn how to think about and master the material. I teach what works and why, so that students have the tools they need to succeed." - Samuel A. Broverman

athematics of Investment and Credit is a leading textbook covering the topic of interest theory. It is the required or recommended text in many college and university courses on this topic, as well as for Exam FM. This text provides a thorough treatment of the theory of interest, and its application to a wide variety of financial instruments. It emphasizes a direct-calculation approach to reaching numerical results, and uses a gentle, thorough pedagogic style. This text includes detailed treatments of the term structure of interest rates, forward contracts of various types, interest rate swaps, financial options, and option strategies. Key formulas and definitions are highlighted. Real world current events are included to demonstrate key concepts. The text contains a large number of worked examples and end-of-chapter exercises.

"Thank you for writing a quality textbook that covered the material for Exam FM/2. I was able to study independently for, and pass the second exam without any foreknowledge of financial mathematics due to the quality of your textbook. Many thanks for the time and effort you put into writing it." - Jason Hedrick

CHAPTER 9

ADVANCED TOPICS IN EQUITY INVESTMENTS AND FINANCIAL DERIVATIVES

"... derivatives are financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal."

> - Warren Buffett, Chairman of Berkshire Hathaway, in the 2002 "Chairman's Letter" to shareholders

9.1 THE DIVIDEND DISCOUNT MODEL OF STOCK VALUATION

When equities are actually bought and sold on a market, the trading takes place with buyers and sellers offering "bid" and "ask" prices, respectively, with an intermediate settlement price eventually found. The amount by which the ask price exceeds the bid is the "spread." This is the difference in price between the highest price that a buyer is willing to pay for an asset and the lowest price for which a seller is willing to sell it. This terminology applies to investments of all types, bonds (Chapter 4), equities, derivative investments (Chapter 9), etc.

ACTEX ACADEMIC SERIES:

Models for Quantifying Risk

6th Edition

An Official Reference for **EA-1** and addresses all the Learning Objectives for **SOA Exam MLC**

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"I selected Models for Quantifying Risk as the text for my class. Given that the syllabus had changed quite dramatically from prior years, I was looking for a text that would cover all the material in the new syllabus in a way that was rigorous, easy to understand, and would prepare students for the MLC exam. To me, the text with the accompanying solutions manual does precisely that."

— Jay Vadiveloo, PH.D., FSA, MAAA, CFA, Math Department, University of Connecticut

> Actuarial Mathematics 2014 524 pages, 7" x 10" \$95.00 SOFTCOVER ISBN: 978-1-62542-347-4 Solutions Manual: 978-1-62542-348-1



Contents:

Chapter 1: Review of Interest Theory Chapter 2: Review of Probability Chapter 3: Review of Markov Chains Chapter 4: Characteristics of Insurance and Pensions Chapter 5: Survival Models Chapter 6: The Life Table Chapter 7: Contingent Payment Models Chapter 8: Contingent Annuity Models Chapter 9: Funding Plans for Contingent Contracts Chapter 10: Net Level Premium Reserves Chapter 11: Reserves as Financial Liabilities Chapter 12: Models Dependent on Multiple Survivals Chapter 13: Multiple Decrement Models (Theory) Chapter 14: Multiple Decrement Models (Applications)

Chapter 15: Models with Variable Interest Rates Chapter 16: Universal Life Insurance Chapter 17: Profit Analysis Stephen J. Camilli, FSA Ian Duncan, FSA, FIA, FCIA, MAAA Richard L. London, FSA



"I found that the exposition of the material is thorough while the concepts are readily accessible and well illustrated with examples. The book was an invaluable source of practice problems when I was preparing for the Exam MLC. Studying from it enabled me to pass this exam." - Dmitry Glotov, Math Department, University of Connecticut

There are several areas of expanded content in the Sixth Edition, due to the revised format of SOA Exam MLC. The additional written-answer examples will better prepare students for this question format. Additional treatment of multi-state models, Thiele's Equation, profit testing, and Universal Life Insurance has been added. This book is specifically focused on the North American market and actuarial profession. The notation and terminology fully conform to that being used on Exam MLC, thus offering a seamless transition from textbook study to exam day.

The textbook presents a variety of stochastic models for the actuary to use in undertaking the analysis of risk. It is designed to be appropriate for use in a two or three semester university course in basic actuarial science. Specifically written with SOA Exam MLC in mind, models are evaluated in a generic form with life contingencies included as one of many applications of the science. Students will find this book to be a valuable reference due to its easy-to-understand explanations and end-of-chapter exercises.

- This edition offers additional written-answer examples in order to better prepare the reader for the new SOA exam format.
- Fully incorporates all standard notation and terminology for exam MLC, as detailed by the SOA in their document "Notation and Terminology Used on Exam MLC."
- Extension of multi-state model representation to almost all topics covered in the text.
- Written specifically for the multi-disciplinary needs of the North American market. This is reflected in both content and terminology.
- Expanded treatment of Profit Testing, Participating Insurance, and Universal Life Topics.
- Additional applications of Thiele's Equation are presented, to more fully prepare the reader for exam day.

10.7 WRITTEN-ANSWER QUESTION EXAMPLES

EXAMPLE 10.10

Consider a 5-year fully discrete unit endowment insurance issued to (50). Using the mortality rates given in Appendix A and interest rate i = .06, the net level premium is .16902. (The reader should verify this calculation.) Suppose 100,000 identical contracts are issued. Then if the premium assumptions are realized (i.e., if 6% interest is earned and the survival pattern follows the table exactly), the aggregate NLP reserve fund at time t = 5 should be the exact amount needed to pay the unit pure endowment benefit to each survivor at that time. Show that this is so.

SOLUTION

We use the recursive method for determining the reserves. The calculations are shown in the following table:

t	Survivors $(2)_t = (2)_{t-1} - (4)_{t-1}$	Premiums $(3)_t = .16902(2)_t$	Failures $(4)_t = (2)_t \cdot q_{50+t}$	NLP Reserve Fund $(5)_t = [(5)_{t-1} + (3)_t](1.06) - (4)_t$
0	100,000	16,902	356	17,560
1	99,644	16,842	392	36,074
2	99,252	16,776	431	55,590
3	98,821	16,703	469	76,162
4	98,352	16,623	512	97,840
5	97,840			

Thus we see that there are 97,840 survivors at age 55, and the aggregate NLP reserve fund holds the exact amount needed to pay the unit pure endowment benefit to the survivors, as expected. $\hfill \Box$

WRITTEN-ANSWER EXAMPLES



"Probability for Risk Management is the most readable mathematics text on the market. The explanations and examples are clearly explained with supplementary problems at the end of each chapter to assist in learning the material. An excellent text for any interested student of mathematics and probability."

- Andrew McKenna, Probability Student

"The book is well written and easily understandable."

— **Thomas S. Tredway,** Retired Associate Professor, Georgia State University

"I wanted to thank Dr. Hassett and everybody at ACTEX who helped me pass this exam. Dr. Hassett's textbook prepared me very well for the exam. In fact it was the only book I used. Considering the fact that I am coming back to mathematics after a hiatus of 13 years, I was really apprehensive about my preparation techniques and math acumen. Dr. Hassett's book came in very handy – it is so well tailored to the Exam P syllabus that I did not have to look anywhere else for theory and introductory problems. I passed Exam P with a grade of 8."

- S. Baskaran, Exam P Student

ACTEX ACADEMIC SERIES: Probability for Risk Management

Matthew J. Hassett, PH.D. | Donald G. Stewart, PH.D.

2nd Edition

An Official Reference for SOA Exam P

his unique text differs from most intermediate probability texts in that it focuses the theory directly on applications in the general field of financial risk management, including insurance, economics and finance. It is appropriate for a first course in probability for students having already had two semesters of calculus.

This text was designed for several audiences, including students of actuarial science, mathematical economics, finance and risk management. It assumes prior knowledge of calculus in the presentation. Past actuarial exam questions are included at the end of each chapter.

This book can serve as an excellent background text for the more advanced probability material included on Exam MLC of the Society of Actuaries, Exam LC of the Casualty Actuarial Society, and the EA-1 exam of the Joint Board for the Enrollment of Actuaries.

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Mathematics 2009

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Mathematics 2015, 600 pages, 7" x 10"

An Official Reference for **SOA Exam P** and **CAS Exam ST**

\$119.00 SOFTCOVER ISBN: 978-1-62542-472-3 Solutions Manual: 978-1-62542-473-0

CHAPTER 8

A PROBABILITY POTPOURRI

8.1 THE DISTRIBUTION OF A TRANSFORMED RANDOM VARIABLE

On a number of occasions in earlier chapters we have looked into the properties of a random variable Y that is given by a transformation Y = g(X) of a known random variable X, Deriving the distribution of Y from that of X can be challenging in general, but there are a number of techniques available that can be used to determine various properties of Y such as its moments or its density function.

One procedure, familiar from earlier work with continuous distributions, is the cumulative distribution function (CDF) method. The idea is to derive the CDF $F_y(y)$ of Y using the CDF $F_X(x)$ of the random variable X and the functional relationship Y = g(X). The basic setup for starting this procedure is,

$$F_Y(y) = \Pr[Y \le y] = \Pr[g(X) \le y],$$

with subsequent steps depending on the specific nature of g(X). In the continuous case the density function for *Y*, $f_Y(y)$, can then be found by differentiating $F_Y(y)$. Specific examples of this technique can be found in Subsection 6.2.2 in the derivation of the exponential distribution as the waiting time random variable for a Poisson process, and in Subsection 6.5.5 in the derivation of χ^2 as the distribution for $g(Z) = Z^2$ (*Z* being the standard normal random variable). Here is another example.

Example 8.1-1 The CDF Technique

Let X be the random variable whose density function is given by $f_X(x) = 2x$; $0 \le x \le 1$. Find the density function $f_Y(y)$ of $Y = e^X$.

Solution

Here $g(X) = e^X$ and the random variable Y lives on the interval $[g(0), g(1)] = [e^0, e^1] = [1, e]$. The CDF for X, determined from its given density function, is $F_X(x) = \int_0^x 2t \, dt = x^2$; $0 \le x \le 1$. Now, for any y, $1 \le y \le e$,

$$F_Y(y) = \Pr[Y \le y] = \Pr[g(X) \le y] = \Pr[e^X \le y] = \Pr[X \le \ln y] = F_X(\ln y) = (\ln y)^2.$$

Next, we find $f_Y(y) = F'_Y(y) = \frac{2\ln y}{y}$; $1 \le y \le e$.

Probability and Statistics with Applications, Chapter 8, page 365

Probability and Statistics with Applications is an introductory textbook designed to make the subject accessible to college freshmen and sophomores concurrent with Calc II and III, with a prerequisite of just one semester of calculus. It is organized specifically to meet the needs of students who are preparing for the Society of Actuaries qualifying Examination P and Casualty Actuarial Society's new Exam S.

Sample actuarial exam problems are integrated throughout the text along with an abundance of illustrative examples and 870 exercises.

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Mathematics



371



Applications of Monte Carlo Methods to Finance and Insurance

Thomas N. Herzog, Ph.D., ASA | Graham Lord, Ph.D., ASA

Monte Carlo methods are useful in solving a wide range of problems, both stochastic and deterministic, that cannot easily be solved using analytic methods. The authors of this text discuss several variance reduction methods aimed at improving the efficiency and the robustness of the simulation process.

The text illustrates the application of such methods to practical problems in finance and insurance by presenting several in-depth case studies, including a model for generating stochastic interest rates and issues having to do with the important concept of value at risk, a measure for assessing the risk and/or performance of assets and/or liabilities. This text is a valuable reference for continuing education. Actuarial Mathematics 2002 264 pages, 6"x 9" \$95.00 SOFTCOVER ISBN: 978-1-56698-433-1

Solutions Manual: 978-1-56698-443-0



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ACTEX ACADEMIC SERIES: Introduction to Credibility Theory, 4th Edition

Thomas N. Herzog, PH.D., ASA | Study Preparation for SOA Exam C

This text presents a wide variety of credibility models in an easy-to-read style and, in so doing, traces the historical development of the subject. Because the Bayesian approach is emphasized, the book can serve as a useful foundation for practicing actuaries desiring to become proficient in applying Markov chain Monte Carlo methods to solve real-world problems.

The text concentrates on basic statistical concepts, leaving both practical issues and more sophisticated theoretical concepts for a more advanced treatment elsewhere. It contains worked examples, a large number of end-of-chapter exercises and an extensive bibliography.

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Stephen G. Kellison, FSA, EA, MAAA | Richard L. London, FSA

This text has been adopted by a number of universities for the courses preparing students for **SOA Exam C**.

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AVAILABLEActuarial MathematicsISBN: 978-1-56698-770-72011, 560 pages, 7" x 10"Solutions Manual: 978-1-56698-771-4Contact ACTEX For Details\$95.00 SOFTCOVER

Much of actuarial science deals with the analysis and management of financial risk. In this text we address the topic of loss models, traditionally called risk theory by actuaries, including the estimation of such models from sample data. The

theory of survival models is addressed in other texts, including the ACTEX work entitled *Models for Quantifying Risk* which might be considered a companion text to this one. In *Risk Models and Their Estimation* we consider as well the estimation of survival models, in both tabular and parametric form, from sample data.



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THIRD EDITION

Timothy F. Harris, FSA, MAAA Albert E. Easton, FSA, MAAA Noel J. Abkemeier, FSA, MAAA

Life Insurance 2014 342 pages, 7" x 10" \$95.00 SOFTCOVER ISBN: 978-1-62542-212-5

ctuarial Aspects of Individual Life Insurance and Annuity Contracts provides a comprehensive overview of the features and financial aspects of traditional, indexed, and variable products and their related rider benefits. Product development, pricing, financial reporting methods, and regulatory requirements are addressed for all products, including those with derivative-based guarantees. This book provides an introduction to actuarial techniques and the relationships among various financial values for the student and provides a comprehensive summary of current practices on more recent products for the experienced actuary.

Spreadsheets are available to demonstrate profit testing alternatives.

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Douglas J. Bennett, FSA, Walter H. Zultowski, Ph.D.

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With all of this as background, the book continues with more detail and discusses the various functions performed by distribution, and how distribution systems are managed today. It also goes into more specifics regarding the compensation and the economics of distribution. The text concludes with a discussion of managing distribution channel conflict, and how distribution of life insurance is expected to evolve in the near future. An Official Reference for the **SOA ILA Life Pricing Exam**

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Insurance

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SIXTH EDITION

William F. Bluhm Principal Editor

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This text is listed in the Course of Reading for SOA Fellowship study in the **Group & Health Track** and the **Life and Health Qualifications Seminar** of the American Academy of Actuaries. THE BAROUP INSURANCE



Associate Editors Daniel D. Skwire Stephen J. Kaczmarek Kristi M. Bohn

This text is a comprehensive treatment of all aspects of group insurance in the United States and Canada. It addresses life and health insurance as well as government programs and more specialized forms of insurance. Emphasis is placed on the actuarial aspects of this important field of insurance including pricing, regulation, underwriting, financial reporting, and modeling.

Since its original publication in 1992, Group Insurance has become the resource of choice for experts as well as beginners. The Society of Actuaries has adopted portions of the text within several parts of its education program, making it required reading for those who wish to practice in the group benefits field.

Life Insurance, 2012 887 pages, 7" x 10" \$175.00 HARDCOVER ISBN: 978-1-56698-932-9

New Edition

ACTEX PROFESSIONAL SERIES: Individual Health Insurance 2nd Edition

Hans K. Leida & William F. Bluhm

This text is listed in the Course of Reading for SOA Fellowship study in the **Group & Health Track.**



This second edition of Individual Health Insurance has been updated for the vast—and still-unfolding—tapestry of changes made by the Affordable Care Act. At the same time, it also features updated and expanded material on many other topics, such as Medicare Advantage and Part D. The authors are internationally known experts on individual health insurance, and their knowledge was supplemented with specialized expertise from several colleagues.

This book covers the history of the individual marketplace, the role of government health policy, products currently available, regulation, and all aspects of the development and management of this business. It is a valuable comprehensive resource for those working in the field, whether they are actuaries, managers of payors or providers, or policymakers.

Insurance, 2nd Edition 585 pages, 6" x 9"

\$150.00 HARDCOVER ISBN: 978-1-62542-484-6

Contents:

Chapter 1 Introduction Chapter 2 The Products Chapter 3 Policy Forms Chapter 4 Managing Antiselection Chapter 5 Setting Premium Rates Chapter 6 Reserves & Liabilities Chapter 7 Financial Reporting & Solvency Chapter 7 Forecasting & Modeling Chapter 9 Regulation Chapter 10 Other Insurer Functions Chapter 11 Managing the Business Appendices

Authors:

Hans K. Leida is a Principal and Consulting Actuary with Milliman. He joined the firm in 2006 after completing a P.h.D. in mathematics at the University of Wisconsin-Madison. Hans is a Fellow of the Society of Actuaries and a Member of the American Academy of Actuaries.

Hans has extensive experience with group and individual commercial major medical coverage, as well as Medicare Supplement and Medicare Advantage plans.

William F. Bluhm recently retired as a Principal and Consulting Actuary with Milliman in Minneapolis. Bill joined that firm in 1983, when he opened the Albany office, and had been in Minneapolis since 1987.

Bill spent his career in the health insurance field, working with insurers, health benefit providers, and governments. Bill is a past Board Member for the Society of Actuaries, the Conference of Consulting Actuaries, and the American Academy of Actuaries, as well as Past President of the latter two.

ACTEX PROFESSIONAL SERIES: Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance, 4th Edition

Robert L. Brown, Ph.D., FSA, FCIA, ACAS | W. Scott Lenoox, FSA, FCIA, FCAS

This text is listed in the Course of Reading for the **Fundamentals of Actuarial Practice Course of the SOA.**



Insurance, 2015, *220 pages*, 6" x 9" \$83.00 SOFTCOVER, ISBN: 978-1-62542-474-7 Solutions Manual: ISBN: 978-1-62542-475-4

This text provides a basic foundation of knowledge concerning two fundamental building blocks of property/ casualty actuarial work: ratemaking and loss reserving. Although the material is of property/casualty origins, the methods presented have potential application in other insurance areas including health insurance and risk management. The text contains a number of worked examples and end-of-chapter exercises.

The fourth edition reverses the order of chapters three and four from previous editions. The estimation of the ultimate claim payments is a necessary first step in both the loss reserving process and ratemaking process. Determining the ultimate losses is more comprehensively covered in the loss reserving chapter, and the ratemaking process often relies on the estimates of ultimate losses determined in the loss reserving process. As a result, the loss reserving chapter now comes before the ratemaking chapter.

The frequency and severity section of the loss reserving chapter has been revised to more fully demonstrate the closure method of estimating ultimate losses.

The chapter on intermediate topics has been updated to include deductible pricing, as this alternative approach to the ratemaking in chapter four is typically used for pricing various deductible options.

Finally, the fourth edition has been updated to reflect industry changes and includes additional exercises to improve students' comprehension..

Contents:

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Fourth Edition

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ife, Health & Annuity Reinsurance addresses the many issues and considerations involved in reinsurance for life, health and annuity companies. Although written by actuaries, it may be read by anyone interested in the topic and does not require an actuarial background.

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Insurance, 2015, 700 pages, 7" x 10" \$175.00 HARDCOVER ISBN: 978-1-62542-476-1

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Jeff Blacker, Editor Mary Yang, Associate Editor



Insurance, 2015, 306 pages, 6"x 9" \$49.00 SOFTCOVER, ISBN: 978-1-62542-602-4 \$39.00 EBOOK VERSION, ISBN: 978-1-62542-603-1

Chapter topics include an overview of microinsurance (MI), how to find MI opportunities, data sources, regulation, credit life, health MI, homeowners MI, crop insurance, and microtakaful. Countries discussed include: Mexico, South Africa, Brazil, India, Fiji, Benin, Vietnam, Malaysia and more. Microinsurance, insurance designed for underserved populations, is a growing market with an increasing need for actuarial knowledge, interest and expertise. *Actuaries in Microinsurance* aims to help develop the actuarial capacity in the MI market, improve the relevance and sustainability of products, and ultimately assist individuals, families, and communities escape poverty. This groundbreaking book intersperses technical chapters and short anecdotes. The personal anecdotes give first-hand account of what it is like to work in developing regions while the technical chapters cover a wide variety of topics directly relevant to actuaries interested in this field.

This landmark text provides an educational and enjoyable read for actuaries working in traditional markets, young actuaries living in developing regions, and Microinsurance specialists who desire to learn more about the actuarial aspects of this market.

One of the constraints inhibiting the expansion of better insurance services for more low-income households is sufficient technical expertise. The contributors to this valuable publication represent the burgeoning nucleus of this expert cadre, and hopefully their thoughts and experiences will inspire many more actuaries around the world to apply their technical skills to achieve development objectives."

> - Craig Churchill, Team Leader, ILO Impact Insurance Facility, and former Chair of the Microinsurance Network

Most microinsurance services are developed without proper actuarial experience, which can put millions of clients at risk of inadequately priced products and broken contracts. This book will finally shed light on this and help make microinsurance a safer business."

- Véronique Faber, Executive Director of the Microinsurance Network

Actuaries In Microinsurance, Managing Risk for



of U.S.

Insurance, 2014, 536 pages, 7" x 10" \$159.00 HARDCOVER ISBN: 978-1-62542-383-2 Product Code: 423832, WORLD

Tax Basis Assets and Liabilities of **U.S. Life Insurers**

Edward L. Robbins & Richard N. Bush

This innovative textbook, a sequel to US Tax Reserves for Life Insurers published in 2005, provides authoritative guidance and mathematical approaches to calculating both actuarial tax basis liabilities (reserves and related items) and assets (primarily invested assets and deferred taxes).

The text provides an introduction to statutory and tax reserve planning and includes a detailed discussion of the pertinent parts of the authoritative guidance, including extensive references to specific cases and rulings. This sequel provides significant detail on investment tax accounting and offers an introduction to tax aspects of business combinations.

Valuation of Life Insurance iabilities Fourth Edition $A_{x+i} - P_x \cdot \vec{a}_{x+i}$ Louis J. Lombardi

Insurance, 2014, 296 pages, 8" x 10" \$130.00 SOFTCOVER ISBN: 978-1-56698-560-4

ACTEX PROFESSIONAL SERIES: Valuation of Life **Insurance Liabilities**

4th Edition

Louis J. Lombardi, FSA, MAAA

This text is listed in the Course of Reading for SOA Fellowship study in the **Individual** Life & Annuities Track and the Life and **Health Oualifications Seminar of the American Academy of Actuaries.**

his text covers basic principles of statutory life insurance and annuity valuation with primary emphasis on U.S. practice and secondary emphasis on Canadian practice. This book is a concise treatment of valuation for practicing valuation actuaries and those considering a career change into valuation.

The Fourth Edition expands the tie-in to the U.S. Annual Statement. Included with your purchase is access to models demonstrating all of the technical calculations contained in the text.

Insurance

Healthcare Risk Adjustment and Predictive Modeling

Ian Duncan, FSA, FIA, FCIA, MAAA

ealthcare Risk Adjustment and Predictive Modeling provides a comprehensive guide to healthcare actuaries and other professionals interested in healthcare data analytics, risk adjustment and predictive modeling. The book first introduces the topic with discussions of health risk, available data, clinical identification algorithms for diagnostic grouping and the use of grouper models.

The second part of the book presents the concept of data mining and some of the common approaches used by modelers. The third and final section covers a number of predictive modeling and risk adjustment case-studies, with examples from Medicaid, Medicare,

This text is listed in the Course of Reading for SOA Fellowship Study in the **Group & Health Specialty Track.**

disability, depression diagnosis and provider reimbursement, as well as the use of predictive modeling and risk adjustment outside the U.S. For readers who wish to experiment with their own models, the book also provides access to a test dataset.

Healthcare, 2011, *338 pages*, 7" x *10*" \$97.00 SOFTCOVER ISBN: 978-1-56698-769-1





Healthcare, 2014, *422 pages*, 7" x 10" \$110.00 SOFTCOVER ISBN: 978-1-62542-112-8

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Second Edition | Ian Duncan, FSA, FIA, FCIA, MAAA

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are and Disease Management programs have grown to be a significant component of Managed Care in the United States and abroad. While much has been written on the clinical aspects of these programs, this is the first textbook devoted to financial management and evaluation of healthcare intervention programs.

Addressing a new and promising role for healthcare actuaries, this book will become essential reading for those healthcare professionals interested in driving Return on their Investment in care management programs.

The second edition updates the prior text with discussion of new programs and outcomes such as ACOs and Bundled Payments and Medication Management, together with new chapters that include Opportunity Analysis, Clinical Foundations, Measurement of Clinical Quality, and use of Propensity Matching.

ACTEX PROFESSIONAL SERIES: Fundamentals of Retiree Group Benefits 2nd Edition

Dale Yamamoto



"Fundamentals of Retiree Group Benefits is a must read for plan sponsors, health plans, actuaries, researchers, and anyone interested in retiree health benefits. It contains the most comprehensive treatment of retiree health benefits funding and plan design options, as well as legal issues to be considered. Dale has created a resource like no other. I have recommended that my colleagues refer to the 1st edition countless times, and will continue to do so with this new and timely edition."

- **Paul Fronstin,** Director, Health Research Program, Employee Benefit Research Institute This text is listed in the Course of Reading for SOA Fellowship study in the **Retirement Benefits** and **Group & Health specialties.**

Healthcare 2015, 860 pages, 6" x 9" \$115.00 HARDCOVER ISBN: 978-1-62542-483-9



Retiree group benefits have earned a reputation for being difficult to understand. Half retirement benefit and half group insurance – few professionals have mastered both fields. Complex finances blend the world of pension mathematics and health plan pricing.

The purpose of this textbook is to provide the fundamental basics of all aspects of retiree group benefits—from goals and objectives of providing the benefit to the actuarial considerations of accounting and funding the programs.

This one book contains everything pertaining to the subject of retiree group benefits. Its chapters cover the prevalence of the benefit, Medicare, plan design, funding and legal issues, accounting rules and actuarial methods and assumptions.



Pensions, 1999, 301 pages, 6" x 9" \$95.00 SOFTCOVER ISBN: 978-1-56698-333-4 Solutions Manual: 978-1-56698-348-8



Pensions 2006, 303 pages, 6" x 9" \$94.00 SOFTCOVER Great for introductory or survey course on actuarial science!

Theory of Interest and Life Contingencies, with Pension Applications: A Problem-Solving Approach

3rd Edition | Michael M. Parmenter, PH.D., ASA

This text is listed in the Course of Reading for the EA-1 Examination. It has also been adopted as the required text for introductory actuarial science courses at a number of colleges and universities.

This is an introductory treatment of compound interest and basic aspects of life contingencies. It is the perfect book for colleges and universities that are supportive of actuarial education, but do not have formal actuarial science programs. The theory is illustrated by worked examples and reinforced through numerous exercises. A knowledge of algebra is required. A familiarity with introductory calculus and probability is useful, but not essential.

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Students will find this text to be valuable supplementary reading in preparing for the Exam FM of the Society of Actuaries.

Pension Mathematics For Actuaries, 3rd Edition

Arthur W. Anderson, ASA, FCA, EA

This comprehensive text is addressed to beginners in pension mathematics who have a firm grounding in basic actuarial mathematics, particularly life contingencies. It also presumes a reasonable background in general college-level mathematics, including calculus and probability, and familiarity with international actuarial notation.

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ISBN: 978-1-56698-559-8 Solutions Manual: 978-1-56698-582-6 This text has been the principal reference for the pension mathematics topic on the SOA examination program for more than 20 years. It is currently listed in the Course of Reading for the EA-2F Examination and SOA Fellowship study in the Retirement Benefits Track in Canada.



A Problem-Solving Approach to Pension Funding and Valuation

2nd Edition | William H. Aitken, FSA, FCIA, EA

This work differs from other texts on pension mathematics by presenting the topic through a very large number of worked examples, rather than in a conceptual, formula-oriented approach.

This text contains 169 worked examples, discussion questions intended to stimulate further understanding of the subject, and numerical end-of-chapter exercises. Most of the examples and exercises are taken from examinations of the Joint Board for the Enrollment of Actuaries.

This text is listed in the Course of Reading for the EA-2F Examination.

Pensions

1996, *405 pages, 6" x 9"* \$89.00 SOFTCOVER ISBN: 978-1-56698-200-9

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The text is intended for several audiences, including university students, pension practitioners and candidates for various pension actuarial exams.

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ACTEX P Study Manual

2015 Edition

<u>178</u>

SECTION 6 - FREQUENTLY USED DISCRETE DISTRIBUTIONS

Binomial distribution with parameters n and p(integer $n \ge 1$ and $0 \le p \le 1$)

Suppose that a single trial of an experiment results in either success with probability p, or failure with

probability 1 - p = q. If *n* independent trials of the experiment are performed, and *X* is the number of successes that occur, then *X* is an integer between 0 and *n*. *X* is said to have a binomial distribution with parameters *n* and *p* (sometimes denoted $X \sim B(n, p)$).

$$p(x) = \binom{n}{x} p^x (1-p)^{n-x}$$
 for $x = 0, 1, 2, ..., n$, where $\binom{n}{x} = \frac{n!}{x!(n-x)!}$.

p(x) is the probability that there will be exactly x successes in the n trials of the experiment. The average number of successes in the n trials is

E[X] = np, the mean of the binomial distribution,

and the variance is

Var[X] = np(1-p), the variance of the binomial distribution .

The moment generating function is $M_X(t) = (1 - p + pe^t)^n$. Note that since $Var[X] = E[X^2] - (E[X])^2$, it follows that the second moment of X is $E[X^2] = np(1 - p) + (np)^2$ for the binomial distribution.

In the special case of n = 1 (a single trial), the distribution is referred to as a **Bernoulli distribution**. If $X \sim B(n, p)$, then X is the sum of n independent Bernoulli random variables each with distribution B(1, p).

For example, if n = 3, $p = \frac{1}{2}$, the binomial random variable has the following distribution:

X:	0	1	2	3
p(x):	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	-

This would describe the distribution of the number of heads occurring in three tosses of a fair coin. The probabilities are found as follows:

$$p(0) = P[X = 0] = {3 \choose 0} \frac{1}{2}^{0} (1 - \frac{1}{2})^{3-0} = \frac{1}{8}, \ p(1) = P[X = 1] = {3 \choose 1} \frac{1}{2}^{1} (1 - \frac{1}{2})^{3-1} = \frac{3}{8}, \text{ etc.}$$

The mean is $np = 3(\frac{1}{2}) = \frac{3}{2}$ and the variance is $np(1-p) = 3(\frac{1}{2})(\frac{1}{2}) = \frac{3}{4}$.

As another example, if n = 3 , p = .2 , the distribution is

X:	0	1	2	3
p(x):	.512	.384	.096	.008

As an example of a probability calculation, $P[X = 2] = {3 \choose 2} (.2)^2 (1 - .2)^{3-2} = .096$. The mean is np = 3(.2) = .6 and the variance is np(1 - p) = 3(.2)(.8) = .48. Alex B: "I loved using the ACTEX Exam P Manual. I had two manuals at the time, but I never used the other one because yours was so thorough! The manual even helped lay out material for some of the later exams I have taken."

Study Manual for

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Probability for Risk Management, (see page 8) M. Hassett, PH.D. & D. Stewart, PH.D.

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Section 2.9

Increasing Annuities with Terms in Arithmetic Progression

Calculator knowledge will help on some problems, but to prepare for Exam FM we must review the specialized interest theory formulas for increasing and decreasing annuities. The use of these formulas is often required on exam problems.

An annuity whose *n* payments are 1, 2, ..., *n* is called a **unit increasing immediate annuity**. If payments are made at the end of each period, the annuity is immediate and is denoted by $(Ia)_{\overline{n!}}$. Clearly,

 $(Ia)_{\overline{n}} = v + 2v^2 + 3v^3 + \ldots + nv^n.$



It can be shown that

(2.39)

$$(Ia)_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{i}$$

Example (2.40)

Let i = 5% and n = 4. Then the annuity payments are 1, 2, 3, 4 and

$$(Ia)_{\overline{4}|} = \frac{\ddot{a}_{\overline{4}|} - 4v^4}{0.05} = 8.6488$$

This can be checked on the BAII Plus Professional by using the NPV function on the cash flow sequence 1, 2, 3, 4 (where CF1=1 and I=5).

Exercise (2.41)

Find $(Ia)_{\overline{15}}$ for *i* = 0.06.

Answer:

 $(Ia)_{\overline{15}|} = \frac{10.295 - 6.259}{0.06} = 67.2668$

Shuhua L: "The strategy is easily known when studying this manual, and that is a reason why I, as a foreign student and someone who has no mathematical background at all, admire this manual so much... Thank you so much for helping me pass FM!"



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This manual is comprehensive and written in an easy-tounderstand style. Concepts are introduced in a clear way so that students can quickly understand new topics. It goes beyond an outline and thoroughly explains the more difficult topics. Among the many features of this manual are detailed review examples and exercises embedded into the text, additional practice problems at the end of each unit, a key formulas summary and calculator assistance. The manual concludes with eleven sample practice exams. The authors have also created more detailed solutions to the sample financial economics questions posted on the SOA website.

In this guide, the traditional interest theory material is covered in Modules 1 - 7 and the financial mathematics material is covered in Modules 8 - 15. Modules 8 - 15 contain lecture notes on the required chapters of the financial mathematics textbook, *Derivatives Markets*, and solutions to the odd-numbered homework problems in that text. Answers to the even-numbered problems are available in the student solution manual which can be purchased with the text. Also included are mid-term exams at the end of major topics and a presentation of the financial mathematics material that is less dependent on the textbook than in past editions. It is published in two separate spiral bound volumes.

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ACTEX MLC Study Manual

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Chapter 14: Universal Life Insurance

Any interest that the account value earns is credited back to the account value and invested, so essentially, the policyholder's money is earning money. You may therefore view a universal life policy as a mixture of life insurance and an investment product.

Let us begin with a description of how the account value is accumulated.



C14-2

14.1 Basic Policy Design

We define the following notation:

- P_t Premium for the t^{th} time period, paid at time t-1
- EC_t The total expense charge (also called MER, for Management Expense Rate) for the t^{th} time period, deducted from the account value at time t 1
- CoI_t The cost of insurance for the tth time period, deducted from the account value at time t 1
- AV_t The account value at time *t*, before premium and deductions
- i_t^c The credited rate of interest for the t^{th} time period (i.e., from time t 1 to time t)

The accumulation of the account value over the t^{th} time period (i.e., from time t - 1 to time t) is illustrated in the following diagram:



Chris R: "I found the ACTEX Exam MLC Study Manual to be very helpful at simplifying difficult concepts, and it also provided lots of examples for practice."



Johnny Li, PH.D., FSA & Andrew Ng, PH.D., FSA



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- 150 written-answer questions. Eight mock exams, written in exactly the same format as that announced in SOA's Exam MLC Introductory Note, are also provided. Many of the writtenanswer questions in our mock exams are highly challenging!
- · Full solutions to the April and October 2015 Exams.
- In this study manual, the authors teach (and drill) readers on how to prove or derive important formulas. This is in stark contrast to some other exam prep products in which proofs and derivations are downplayed, if not omitted.
- · The authors have paid special attention to the topics that are newly introduced in the recent two syllabus updates. Seven full-length chapters and two sections are devoted to these topics.
- · The chapter on participating insurance has been significantly expanded; questions that are similar in style to the actual exam questions are added.
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ACTEX MFE Study Manual

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Module 3 : The Black-Scholes Formula Lesson 2: Greeks Letters and Elasticity

- Calls and puts with the same strike and time to expiration have the same value of Γ .
- For long positions of calls and puts, Γ must be positive. Recall that a function is said to be convex if its second derivative is always non-negative. European calls and puts are hence called convex derivatives.

M3-27

- Since Δ does not change much (it reaches either 0 or $\pm e^{-\delta(T-t)}$) when a call / put is deeply OTM or ITM, Γ is close to 0 when S is very low or very high.

Properties of θ



- The value of θ can be positive or negative. It is usually negative because call and put prices tend to drop as time passes.

One exception is a deeply in-the-money European put on a nondividend-paying stock. When a put is very ITM, we expect that the final payoff from the put would be K - S(T), and hence $V \approx Ke^{-r(T-t)} - S$. This means $\theta \approx rKe^{-r(T-t)} > 0$.

Another exception is a deeply in-the-money European call on a currency with a very high interest rate.

- The theta of a European call on a nondividend-paying stock is always negative.
- The theta of a deeply OTM option is close to zero, while the theta of an at-the-money option is large and negative.

The Delta-Gamma-Theta Approximation

Apart from quantifying the risk of a derivative, delta, gamma and theta can also be used to approximate the price of a derivative when t or S changes by a small amount.

Suppose that at time *t*, the price of the derivative is V(S, t). If the stock price suddenly changes to $S + \varepsilon$, how would the price of the derivative change? By Taylor's theorem, we have

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LM-124

MODELING SECTION 10 - POLICY LIMITS

Example LM10-2:

Find the pdf, cdf and expected value and variance of the cost per loss when there is a policy limit of u in each of the following cases.

- (a) X is exponential with mean θ .
- (b) X has a uniform distribution on $(0, \theta)$, and $u < \theta$.

Solution:

(a) $f_Y(y) = \begin{cases} f_X(y) & y < u \\ 1 - F_X(u) & y = u \\ 0 & y > u \end{cases} = \begin{cases} \frac{1}{\theta} e^{-y/\theta} & y < u \\ e^{-u/\theta} & y = u \\ 0 & y > u \end{cases}$ Note that $f_Y(u) = e^{-u/\theta}$ is the probability P(Y = u), but for y < u $f_Y(y) = \frac{1}{\theta} e^{-y/\theta}$ is a density.

$$F_Y(y) = \begin{cases} F_X(y) & y \le u \\ 1 & y > u \end{cases} = \begin{cases} 1 - e^{-y/\theta} & y \le u \\ 1 & y > u \end{cases}.$$

$$E[Y] = E[X \land u] = \int_0^u [1 - F_X(x)] \, dx = \int_0^u e^{-x/\theta} \, dx = \theta(1 - e^{-u/\theta})$$

(the Exam C table of distributions gives limited expected value formulations).

Note that we could use the formulation $E[Y] = \int_0^u x f(x) dx + u \cdot [1 - F_X(u)]$, but this would require an integration by parts.

We formulate the variance of Y as $Var[Y] = E[Y^2] - (E[Y])^2$.

 $E[Y^2] = E[(X \wedge u)^2] = \int_0^u x^2 \cdot f(x) \, dx + u^2 \cdot [1 - F_X(u)] = \int_0^u x^2 \cdot \frac{1}{\theta} e^{-x/\theta} \, dx + u^2 \cdot e^{-u/\theta} \, .$ The antiderivative of $x^2 \cdot \frac{1}{\theta} e^{-x/\theta}$ is found by integration by parts to be

$$\begin{split} & -x^2 e^{-x/\theta} - 2x\theta e^{-x/\theta} - 2\theta^2 e^{-x/\theta} \text{ , so that} \\ E[Y^2] &= \int_0^u x^2 \cdot \frac{1}{\theta} e^{-x/\theta} \, dx + u^2 \cdot e^{-u/\theta} \\ &= \left(-x^2 e^{-x/\theta} - 2x\theta e^{-x/\theta} - 2\theta^2 e^{-x/\theta} \right) \Big|_{x=0}^{x=u} + u^2 \cdot e^{-u/\theta} = 2\theta^2 - 2u\theta e^{-u/\theta} - 2\theta^2 e^{-u/\theta} \end{split}$$

Then $Var[Y] = 2\theta^2 - 2u\theta e^{-u/\theta} - 2\theta^2 e^{-u/\theta} - [\theta(1 - e^{-u/\theta})]^2$.

(b)
$$f_Y(y) = \begin{cases} f_X(y) & y < u \\ 1 - F_X(u) & y = u \\ 0 & y > u \end{cases} = \begin{cases} \frac{1}{\theta} & y < u \\ 1 - \frac{u}{\theta} & y = u \\ 0 & y > u \end{cases}$$

The same comment regarding $f_Y(u) = 1 - \frac{u}{\theta}$ being a probability and $f_Y(y)$ being a density apply here as in part (a).

$$F_{Y}(y) = \begin{cases} F_{X}(y) & y \le u \\ 1 & y > u \end{cases} = \begin{cases} \frac{y}{\theta} & y \le u \\ 1 & y > u \end{cases}.$$

$$E[Y] = E[X \land u] = \int_{0}^{u} [1 - F_{X}(x)] \, dx = \int_{0}^{u} [1 - \frac{x}{\theta}] \, dx = u - \frac{u^{2}}{2\theta} \, .$$

$$E[Y^{2}] = \int_{0}^{u} x^{2} \cdot f(x) \, dx + u^{2} \cdot [1 - F_{X}(u)]$$

$$= \int_{0}^{u} x^{2} \cdot \frac{1}{\theta} \, dx + u^{2} \cdot [1 - \frac{u}{\theta}] = \frac{u^{3}}{3\theta} + u^{2} \cdot [1 - \frac{u}{\theta}] = u^{2} - \frac{2u^{3}}{3\theta} \, .$$

$$Var[Y] = E[Y^{2}] - (E[Y])^{2} = u^{2} - \frac{2u^{3}}{3\theta} - (u - \frac{u^{2}}{2\theta})^{2} = \frac{u^{3}}{3\theta} - \frac{u^{4}}{4\theta^{2}} \, .$$

C ACTEX 2014

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