

# Solutions Actuarial Mathematics For Life Contingent Risks

to Actuarial Mathematics by A. K. Gupta Bowling  
Green State University, Bowling Green, Ohio, U. S.  
A. and T. Varga National Pension Insurance Fund.  
Budapest, Hungary SPRINGER-

SCIENCE+BUSINESS MEDIA, B. V. A C. I. P.

Catalogue record for this book is available from the  
Library of Congress. ISBN 978-90-481-5949-9 ISBN  
978-94-017-0711-4 (eBook) DOI 10.

1007/978-94-017-0711-4 Printed on acid-free paper  
All Rights Reserved © 2002 Springer

Science+Business Media Dordrecht Originally  
published by Kluwer Academic Publishers in 2002

No part of the material protected by this copyright  
notice may be reproduced or utilized in any form or  
by any means, electronic or mechanical, including  
photocopying, recording or by any information  
storage and retrieval system, without written

permission from the copyright owner. To Alka, Mita,  
and Nisha AKG To Terezia and Julianna TV TABLE  
OF CONTENTS PREFACE. . . . .

. . . . . ix CHAPTER 1.  
FINANCIAL MATHEMATICS . . . . .  
. . . . . 1 1. 1. Compound Interest . . . . .  
. . . . .

# Online Library Solutions Actuarial Mathematics For Life Contingent Risks

..... 1	1. 2. Present Value.....	
.....		
..... 31	1. 3. Annuities.....	
.....		
..... 48	CHAPTER 2. MORTALITY.....	
.....		
..... 80	2. 1 Survival Time.....	
.....		
..... 80	2. 2. Actuarial Functions of Mortality.....	
84	2. 3. Mortality Tables.....	
.....		98
	CHAPTER 3. LIFE INSURANCES AND ANNUITIES	
..... 112	3. 1. Stochastic Cash Flows.....	
.....		
..... 112	3. 2. Pure Endowments.....	
.....		
..... 130	3. 3. Life Insurances.....	
.....		
..... 133	3. 4. Endowments.....	
.....		
..... 147	3. 5. Life Annuities.....	
.....		
..... 154	CHAPTER 4.	
	PREMIUMS.....	
.....		194
..... 194	4. 1. Net Premiums.....	
.....		194
..... 194	4. 2. Gross Premiums.....	

# Online Library Solutions Actuarial Mathematics For Life Contingent Risks

.....	215 VII
CHAPTER 5. RESERVES .....	
.....	
.. 223 5. 1. Net Premium Reserves .....	
.....	223 5.
2. Mortality Profit. ....	
.....	272 5. 3.
Modified Reserves .....	
.....	286
ANSWERS TO ODD-NuMBERED PROBLEMS . . . .	
.....	

This volume aims to collect new ideas presented in the form of 4 page papers dedicated to mathematical and statistical methods in actuarial sciences and finance. The cooperation between mathematicians and statisticians working in insurance and finance is a very fruitful field and provides interesting scientific products in theoretical models and practical applications, as well as in scientific discussion of problems of national and international interest. This work reflects the results discussed at the biennial conference on Mathematical and Statistical Methods for Actuarial Sciences and Finance (MAF), born at the University of Salerno in 2004.

Must-have manual providing detailed solutions to all exercises in the required text for the Society of Actuaries' (SOA) LTAM Exam.

This book teaches multiple regression and time series and how to use these to analyze real data in

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

risk management and finance.

This textbook aims to fill the gap between those that offer a theoretical treatment without many applications and those that present and apply formulas without appropriately deriving them. The balance achieved will give readers a fundamental understanding of key financial ideas and tools that form the basis for building realistic models, including those that may become proprietary. Numerous carefully chosen examples and exercises reinforce the student's conceptual understanding and facility with applications. The exercises are divided into conceptual, application-based, and theoretical problems, which probe the material deeper. The book is aimed toward advanced undergraduates and first-year graduate students who are new to finance or want a more rigorous treatment of the mathematical models used within. While no background in finance is assumed, prerequisite math courses include multivariable calculus, probability, and linear algebra. The authors introduce additional mathematical tools as needed. The entire textbook is appropriate for a single year-long course on introductory mathematical finance. The self-contained design of the text allows for instructor flexibility in topics courses and those focusing on financial derivatives. Moreover, the text is useful for mathematicians, physicists, and engineers who want to learn finance via an approach that builds their

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

financial intuition and is explicit about model building, as well as business school students who want a treatment of finance that is deeper but not overly theoretical.

Student Solutions Manual to Accompany Loss Models: From Data to Decisions, Fourth Edition. This volume is organised around the principle that much of actuarial science consists of the construction and analysis of mathematical models which describe the process by which funds flow into and out of an insurance system.

This book provides a thorough understanding of the fundamental concepts of financial mathematics essential for the evaluation of any financial product and instrument. Mastering concepts of present and future values of streams of cash flows under different interest rate environments is core for actuaries and financial economists. This book covers the body of knowledge required by the Society of Actuaries (SOA) for its Financial Mathematics (FM) Exam. The third edition includes major changes such as an addition of an 'R Laboratory' section in each chapter, except for Chapter 9. These sections provide R codes to do various computations, which will facilitate students to apply conceptual knowledge. Additionally, key definitions have been revised and the theme structure has been altered. Students studying undergraduate courses on financial mathematics for actuaries will find this book useful.

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

This book offers numerous examples and exercises, some of which are adapted from previous SOA FM Exams. It is also useful for students preparing for the actuarial professional exams through self-study.

This class-tested undergraduate textbook covers the entire syllabus for Exam C of the Society of Actuaries (SOA).

Tom Miller recognized the need to write this book a few years ago, after reviewing postings on popular discussion pages frequented by actuaries. He was surprised and troubled by the magnitude of misinformation posted on these websites. Clearly actuaries and actuarial students posting this information are only trying to be helpful to one another, but they frequently lack the necessary experience and expertise to offer sound advice. Tom seeks to provide readers of his career guide with valuable insights regarding the actuarial employment market, covering topics such as choice of product specialization, how to conduct effective job searches, switching successfully from insurance to consulting and inside tips on what clients are really looking for when they interview you. Armed with deep knowledge and a unique perspective on the actuarial profession, Tom expects that this book will be a resource that will help you make better career decisions and “Achieve Your Pinnacle.”

In classical life insurance mathematics the obligations of the insurance company towards the

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

policy holders were calculated on artificial conservative assumptions on mortality and interest rates. However, this approach is being superseded by developments in international accounting and solvency standards coupled with other advances enabling a market-based valuation of risk, i.e., its price if traded in a free market. The book describes these approaches, and is the first to explain them in conjunction with more traditional methods. The various chapters address specific aspects of market-based valuation. The exposition integrates methods and results from financial and insurance mathematics, and is based on the entries in a life insurance company's market accounting scheme. The book will be of great interest and use to students and practitioners who need an introduction to this area, and who seek a practical yet sound guide to life insurance accounting and product development. A text that quantifies and provides new or improved actuarial notation for long recognized pension cost concepts and procedures and, in certain areas, develops new insights and techniques. With the exception of the first few chapters, the text is a virtual rewrite of the first edition of 1977. Among the major additions are chapters on statutory funding requirements, pension accounting, funding policy analysis, asset allocation, and retiree health benefits. How can actuaries best equip themselves for the products and risk structures of the future? Using the

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

powerful framework of multiple state models, three leaders in actuarial science give a modern perspective on life contingencies, and develop and demonstrate a theory that can be adapted to changing products and technologies. The book begins traditionally, covering actuarial models and theory, and emphasizing practical applications using computational techniques. The authors then develop a more contemporary outlook, introducing multiple state models, emerging cash flows and embedded options. Using spreadsheet-style software, the book presents large-scale, realistic examples. Over 150 exercises and solutions teach skills in simulation and projection through computational practice. Balancing rigour with intuition, and emphasising applications, this text is ideal for university courses, but also for individuals preparing for professional actuarial exams and qualified actuaries wishing to freshen up their skills.

A modern perspective on life contingencies that uses the powerful framework of multiple state models to develop and demonstrate a theory that can be adapted to changing products and technologies.

Balancing rigor and intuition, and emphasizing applications, this modern text is ideal for university courses and actuarial exam preparation.

Modern mortality modelling for actuaries and actuarial students, with example R code, to unlock the potential of individual data.



## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

The 1922 volume was, in turn, created as the replacement for the Institute of Actuaries Textbook, Part Three.

This book provides a comprehensive introduction to actuarial mathematics, covering both deterministic and stochastic models of life contingencies, as well as more advanced topics such as risk theory, credibility theory and multi-state models. This new edition includes additional material on credibility theory, continuous time multi-state models, more complex types of contingent insurances, flexible contracts such as universal life, the risk measures VaR and TVaR. Key Features: Covers much of the syllabus material on the modeling examinations of the Society of Actuaries, Canadian Institute of Actuaries and the Casualty Actuarial Society. (SOA-CIA exams MLC and C, CSA exams 3L and 4.) Extensively revised and updated with new material. Orders the topics specifically to facilitate learning. Provides a streamlined approach to actuarial notation. Employs modern computational methods. Contains a variety of exercises, both computational and theoretical, together with answers, enabling use for self-study. An ideal text for students planning for a professional career as actuaries, providing a solid preparation for the modeling examinations of the major North American actuarial associations. Furthermore, this book is highly suitable reference for those wanting a sound introduction to the subject,

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

and for those working in insurance, annuities and pensions.

This must-have manual provides solutions to all exercises in the authors' groundbreaking text.

Solutions Manual for Actuarial Mathematics for Life Contingent Risks Cambridge University Press

4LTR Press solutions give students the option to choose the format that best suits their learning preferences. This option is perfect for those students who focus on the textbook as their main course resource. Extensively revised and reorganized, OM6 content includes a new integrative case that moves from chapter to chapter 35 related questions; a new treatment of value chain networks; greater emphasis on supply chain design; an all-new chapter devoted to supply chain management and logistics; and many new feature boxes and cases. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

This text covers life tables, survival models, and life insurance premiums and reserves. It presents the actuarial material conceptually with reference to ideas from other mathematical studies, allowing readers with knowledge in calculus to explore business, actuarial science, economics, and statistics. Each chapter contains exercise sets and worked examples, which highlight the most important and frequently used formulas and show how the

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

ideas and formulas work together smoothly. Illustrations and solutions are also provided. Understand Up-to-Date Statistical Techniques for Financial and Actuarial Applications Since the first edition was published, statistical techniques, such as reliability measurement, simulation, regression, and Markov chain modeling, have become more prominent in the financial and actuarial industries. Consequently, practitioners and students must ac This self-contained module for independent study covers the subjects most often needed by non-mathematics graduates, such as fundamental calculus, linear algebra, probability, and basic numerical methods. The easily-understandable text of Introduction to Actuarial and Mathematical Methods features examples, motivations, and lots of practice from a large number of end-of-chapter questions. For readers with diverse backgrounds entering programs of the Institute and Faculty of Actuaries, the Society of Actuaries, and the CFA Institute, Introduction to Actuarial and Mathematical Methods can provide a consistency of mathematical knowledge from the outset. Presents a self-study mathematics refresher course for the first two years of an actuarial program Features examples, motivations, and practice problems from a large number of end-of-chapter questions designed to promote independent thinking and the application of mathematical ideas Practitioner friendly rather than academic Ideal for self-study and as a reference source for readers with diverse backgrounds entering programs of the Institute and Faculty of

# Online Library Solutions Actuarial Mathematics For Life Contingent Risks

Actuaries, the Society of Actuaries, and the CFA Institute  
This groundbreaking text has been augmented with new material and fully updated to prepare students for the new-style MLC exam.

This manual is written to accompany Mathematical Interest Theory, by Leslie Jane Federer Vaaler and James Daniel. It includes detailed solutions to the odd-numbered problems. There are solutions to 239 problems, and sometimes more than one way to reach the answer is presented. In keeping with the presentation of the text, calculator discussions for the Texas Instruments BA II Plus or BA II Plus Professional calculator is typeset in a different font from the rest of the text.

This very readable book prepares students for professional exams and for real-world actuarial work in life insurance and pensions.

A wide range of topics to give students a firm foundation in statistical and actuarial concepts and their applications.

Financial Mathematics for Actuarial Science: The Theory of Interest is concerned with the measurement of interest and the various ways interest affects what is often called the time value of money (TVM). Interest is most simply defined as the compensation that a borrower pays to a lender for the use of capital. The goal of this book is to provide the mathematical understandings of interest and the time value of money needed to succeed on the actuarial examination covering interest theory Key Features Helps prepare students for the SOA Financial Mathematics Exam Provides mathematical

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

understanding of interest and the time value of money needed to succeed in the actuarial examination covering interest theory Contains many worked examples, exercises and solutions for practice Provides training in the use of calculators for solving problems A complete solutions manual is available to faculty adopters online A new textbook offering a comprehensive introduction to models and techniques for the emerging field of actuarial Finance Drs. Boudreault and Renaud answer the need for a clear, application-oriented guide to the growing field of actuarial finance with this volume, which focuses on the mathematical models and techniques used in actuarial finance for the pricing and hedging of actuarial liabilities exposed to financial markets and other contingencies. With roots in modern financial mathematics, actuarial finance presents unique challenges due to the long-term nature of insurance liabilities, the presence of mortality or other contingencies and the structure and regulations of the insurance and pension markets. Motivated, designed and written for and by actuaries, this book puts actuarial applications at the forefront in addition to balancing mathematics and finance at an adequate level to actuarial undergraduates. While the classical theory of financial mathematics is discussed, the authors provide a thorough grounding in such crucial topics as recognizing embedded options in actuarial liabilities, adequately quantifying and pricing liabilities, and using derivatives and other assets to manage actuarial and financial risks. Actuarial applications are emphasized and illustrated with about 300 examples and 200 exercises. The book

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

also comprises end-of-chapter point-form summaries to help the reader review the most important concepts. Additional topics and features include: Compares pricing in insurance and financial markets Discusses event-triggered derivatives such as weather, catastrophe and longevity derivatives and how they can be used for risk management; Introduces equity-linked insurance and annuities (EIAs, VAs), relates them to common derivatives and how to manage mortality for these products Introduces pricing and replication in incomplete markets and analyze the impact of market incompleteness on insurance and risk management; Presents immunization techniques alongside Greeks-based hedging; Covers in detail how to delta-gamma/rho/vega hedge a liability and how to rebalance periodically a hedging portfolio. This text will prove itself a firm foundation for undergraduate courses in financial mathematics or economics, actuarial mathematics or derivative markets. It is also highly applicable to current and future actuaries preparing for the exams or actuary professionals looking for a valuable addition to their reference shelf. As of 2019, the book covers significant parts of the Society of Actuaries' Exams FM, IFM and QFI Core, and the Casualty Actuarial Society's Exams 2 and 3F. It is assumed the reader has basic skills in calculus (differentiation and integration of functions), probability (at the level of the Society of Actuaries' Exam P), interest theory (time value of money) and, ideally, a basic understanding of elementary stochastic processes such as random walks.

The book gives a comprehensive overview of modern non-life

# Online Library Solutions Actuarial Mathematics For Life Contingent Risks

actuarial science. It starts with a verbal description (i.e. without using mathematical formulae) of the main actuarial problems to be solved in non-life practice. Then in an extensive second chapter all the mathematical tools needed to solve these problems are dealt with - now in mathematical notation. The rest of the book is devoted to the exact formulation of various problems and their possible solutions. Being a good mixture of practical problems and their actuarial solutions, the book addresses above all two types of readers: firstly students (of mathematics, probability and statistics, informatics, economics) having some mathematical knowledge, and secondly insurance practitioners who remember mathematics only from some distance.

Prerequisites are basic calculus and probability theory.

A Hands-On Approach to Understanding and Using Actuarial Models Computational Actuarial Science with R provides an introduction to the computational aspects of actuarial science. Using simple R code, the book helps you understand the algorithms involved in actuarial computations. It also covers more advanced topics, such as parallel computing and C/C++ embedded codes. After an introduction to the R language, the book is divided into four parts. The first one addresses methodology and statistical modeling issues. The second part discusses the computational facets of life insurance, including life contingencies calculations and prospective life tables. Focusing on finance from an actuarial perspective, the next part presents techniques for modeling stock prices, nonlinear time series, yield curves, interest rates, and portfolio optimization. The last part explains how to use R to deal with computational issues of nonlife insurance. Taking a do-it-yourself approach to understanding algorithms, this book demystifies the computational aspects of actuarial science. It shows that even complex computations can usually be done without too much trouble. Datasets used in the text are

# Online Library Solutions Actuarial Mathematics For Life Contingent Risks

available in an R package (CASdatasets).

Loss Models: From Data to Decisions, Fifth Edition continues to supply actuaries with a practical approach to the key concepts and techniques needed on the job. With updated material and extensive examples, the book successfully provides the essential methods for using available data to construct models for the frequency and severity of future adverse outcomes. The book continues to equip readers with the tools needed for the construction and analysis of mathematical models that describe the process by which funds flow into and out of an insurance system. Focusing on the loss process, the authors explore key quantitative techniques including random variables, basic distributional quantities, and the recursive method, and discuss techniques for classifying and creating distributions. Parametric, non-parametric, and Bayesian estimation methods are thoroughly covered along with advice for choosing an appropriate model. Throughout the book, numerous examples showcase the real-world applications of the presented concepts, with an emphasis on calculations and spreadsheet implementation. Loss Models: From Data to Decisions, Fifth Edition is an indispensable resource for students and aspiring actuaries who are preparing to take the SOA and CAS examinations. The book is also a valuable reference for professional actuaries, actuarial students, and anyone who works with loss and risk models.

The focus of this book is on the two major areas of risk theory: aggregate claims distributions and ruin theory. For aggregate claims distributions, detailed descriptions are given of recursive techniques that can be used in the individual and collective risk models. For the collective model, the book discusses different classes of counting distribution, and presents recursion schemes for probability functions and moments. For the individual model, the book illustrates the



## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

three most commonly applied techniques. Beyond the classical topics in ruin theory, this new edition features an expanded section covering time of ruin problems, Gerber–Shiu functions, and the application of De Vylder approximations. Suitable for a first course in insurance risk theory and extensively classroom tested, the book is accessible to readers with a solid understanding of basic probability. Numerous worked examples are included and each chapter concludes with exercises for which complete solutions are provided.

From the reviews: "The highly esteemed 1990 first edition of this book now appears in a much expanded second edition. The difference between the first two English editions is entirely due to the addition of numerous exercises. The result is a truly excellent book, balancing ideally between theory and practice. ....As already hinted at above, this book provides the ideal bridge between the classical (deterministic) life insurance theory and the emerging dynamic models based on stochastic processes and the modern theory of finance. The structure of the bridge is very solid, though at the same time pleasant to walk along. I have no doubt that Gerber's book will become the standard text for many years to come. *Metrika*, 44, 1996, 2

This 2006 book introduces and develops the basic actuarial models and underlying pricing of life-contingent pension annuities and life insurance from a unique financial perspective. The ideas and techniques are then applied to the real-world problem of generating sustainable retirement income towards the end of the human life-cycle. The role of lifetime income, longevity insurance, and systematic withdrawal plans are investigated in a parsimonious framework. The underlying technology and terminology of the book are based on continuous-time financial economics by merging analytic laws of mortality with the dynamics of equity

## Online Library Solutions Actuarial Mathematics For Life Contingent Risks

markets and interest rates. Nonetheless, the book requires a minimal background in mathematics and emphasizes applications and examples more than proofs and theorems. It can serve as an ideal textbook for an applied course on wealth management and retirement planning in addition to being a reference for quantitatively-inclined financial planners. This must-have manual provides detailed solutions to all of the 200+ exercises in Dickson, Hardy and Waters' Actuarial Mathematics for Life Contingent Risks, Second Edition. This groundbreaking text on the modern mathematics of life insurance is required reading for the Society of Actuaries' Exam MLC and also provides a solid preparation for the life contingencies material of the UK actuarial profession's exam CT5. Beyond the professional examinations, the textbook and solutions manual offer readers the opportunity to develop insight and understanding, and also offer practical advice for solving problems using straightforward, intuitive numerical methods. Companion spreadsheets illustrating these techniques are available for free download.

[Copyright: 39e804acda784ad5638ebb9f9c37ddf3](https://www.stuvia.com/doc/39e804acda784ad5638ebb9f9c37ddf3)