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BOOK REVIEWS AND NOTICES

Patrick Carroll, *Pension Age in a Changing Society*, published by Pension and Population Research Institute, London, England, March 1990.

This 43-page report presents some very interesting information about the United Kingdom dilemma of different Normal Retirement Ages (in the pamphlet termed as "pension age" or "pensionable age") for men and women in both the Social Security program and private pensions ("occupational schemes"). Equalizing the NRA to the higher of the two NRAs will be unpopular with those who had the lower NRA. On the other hand, equalization downward will result in significant cost increases. Adding further to the dilemma is the fact that the European Economic Community, in its various requirements and provisions, strongly supports equality of treatment for men and women, although this is not compulsory for national pensions under social security schemes.

The report describes the Social Security and private pension situation in the U.K. For Social Security, the NRA is 65 for men and 60 for women, and the former are required to have a longer contribution record to receive the full-rate pension.

Until recently, the retirement earnings test applied after the NRA, but this has now been eliminated. Persons who work beyond the NRA and do not draw benefits receive increases for the first five years of deferral—at a rate of 1/7 percent for each weekly benefits foregone (that is, at an annual rate of about 7.4 percent, which is about the actuarial-equivalent basis). Naturally, after age 65 for women and age 70 for men, the benefit is automatically taken.

Formerly in the U.K., the legally permissible age for compulsory retirement ("retirement age") was 65 for women and 70 for men, but it has now been equalized at 70 for all persons.

Private pension plans have different treatments of the NRA by sex and also of early-retirement provisions at reduced rates (which is not possible under the Social Security program). However, as the report brings out, there is a growing movement toward equalization by sex in all provisions of private pension plans. In fact, some plans provide "bridges," so that men who retire before age 65 receive temporary pensions up to age 65 that are equal to the Social Security benefit payable at age 65. This latter provision can be viewed in two completely different ways—either as equal treatment between the sexes or as an additional benefit favoring men.

A valuable part of the report is a brief description of the retirement-age provisions in the social security systems of the other 11 EEC countries and also in a few other countries around the world. Rather surprisingly, only five EEC countries have equal treatment by sex for the NRA (Denmark, France, Ireland, Netherlands, and Spain). Further, of these five countries, only Denmark and France have completely equal treatment for all benefit provisions, such as survivor pensions. This section of the report also gives interesting summary information about benefit levels, qualifying conditions, and contribution rates (which are as high as 35 percent of payroll, in Portugal).

Another section of the report presents the results of a survey of managers of large private pension plans in the U.K. for NRA and compulsory retirement ages. As the result of the legislation and directives of the EEC, the vast majority of private pension plans have either formally or informally established equal ages by sex. A significant trend has developed toward having age 65 as both the NRA and the compulsory retirement age, with reduced pensions available from age 60 on (generally with actuarial reductions, but sometimes at subsidized rates). It seems very strange that the requirements of the EEC seem to have more influence on private pension plans in the U.K. than on the Social Security system, probably because individuals who believe that they are aggrieved can and do bring their private-pension cases before the High Court of the EEC.

It has of course been a simple matter for private pension plans to establish equality of treatment by sex for the maximum permissible age at entry into the plan and also for minimum ages at entry or for length of service before entry.

The author strongly favors equal treatment of men and women in both social security programs and private pension plans—as does also this reviewer. However, at this point our paths diverge. The author believes that equalization in the U.K. should occur by having the NRA be 60 for both sexes, thus involving significantly increased costs over the long range. As a way for meeting this much higher cost initially, if the change should be made all at once instead of being gradually phased in, the author suggests that the Social Security program use the current balance of £7.7 billion in the National Insurance fund as of April 1991. This balance is, in fact, relatively small, because it represents only about three months' outgo. For private pension plans, the author states that they tend to show large surpluses that could be used for such a liberalization of benefits. To this reviewer, such a temporary financing procedure does not seem prudent when costs after the initial years are so much higher.

In contrast, this reviewer believes that the NRA in the U.K. (as well as in other countries) should be increased from its present level, rather than decreased. Certainly an age of 65 would not be unreasonable, and quite probably a higher age should be contemplated eventually. What is needed in our modern society is more production rather than less. Efficient management can enable the proper use of the work abilities of people aged 60 and over. More and more in the future, this category will be in good health and will have marketable work skills. Further, from the standpoint of intergenerational equity, it is by far more desirable for leisure to be spread around among the many workers of all ages, rather than providing complete leisure to those over age 60, with the high cost thereof to be met by younger workers, who will thus have less leisure.

Quite obviously, the change to a uniform NRA for both men and women would require a gradual phasing up of the NRA for women, such as by three or four months every year, beginning perhaps a few years from now. At the same time, it might be desirable to eliminate completely any compulsory retirement age and to give management the opportunity of retiring workers who are beyond the NRA on the basis of their work ability and performance.

It will be most interesting over the next few years to see how the U.K. solves the retirement-age dilemma now confronting its Social Security program. Certainly, this report will add much to the lively discussion that will occur on this topic.

ROBERT J. MYERS

Hans U. Gerber, *Life Insurance Mathematics*, pp. 131, published by Springer-Verlag, Berlin Heidelberg, 1990.

Life Insurance Mathematics was first published in German in 1986. This translation by Walter Neuhaus appeared in 1990, bringing English-language students a second excellent account of the modern probabilistic approach to life contingencies. *Life Insurance Mathematics* is briefer than *Actuarial Mathematics* and should be especially useful to North American universities and colleges for introducing students to actuarial science. The Swiss Association of Actuaries sponsored Dr. Gerber's work on this monograph, in which he acknowledges the value of the experience of working with Drs. Bowers, Hickman, Jones, and Nesbitt on *Actuarial Mathematics*.

The value to the actuarial profession of good textbooks, such as Chester W. Jordan's *Life Contingencies* [5] and *Actuarial Mathematics*, has been enormous. The Society of Actuaries and the Swiss Actuarial Association have shown a great deal of wisdom in sponsoring textbook development. Sponsorship alone is not enough, however. Academic actuaries with enthusiasm and talent for such projects are required, too. The lack of such a combination has been a problem in other areas of actuarial science, especially the casualty area, where the long-awaited, but recently published *Foundations of Casualty Actuarial Science* [4] is disappointing by comparison to [2] or [5]. The existence of good textbooks in life contingencies has made it possible for colleges and universities to offer actuarial courses, which introduced many students to the profession. I cannot help thinking that the problems in the health and casualty areas are a direct result of a lack of good texts. Fortunately, in the life contingencies area, we have had good texts. And *Life Insurance Mathematics* will strengthen this area even more.

Life Insurance Mathematics should play a very important role in actuarial education. Indeed, this text is excellent for a one-semester course in a college or university statistics or mathematics department that wants to introduce the actuarial profession to its students. Even universities with actuarial programs might find this text useful as an introduction to life contingencies, rather than starting with *Actuarial Mathematics*. The Casualty Actuarial Society might find this book suitable because the current CAS Part 4 examination topics are covered. This relatively small book is briefer (and much lighter) than *Actuarial Mathematics*, yet manages to introduce the topics in its Chapters 3 through 9.

Life Insurance Mathematics requires no actuarial prerequisite; a good understanding of probability (the SOA Course 110 Probability and Statistics is more than adequate) and an interest in applied mathematics form a sufficient prerequisite. Professor Gerber's treatment emphasizes understanding of results and calculations, rather than how to do calculations. This is justified because, as he points out in the preface, the existence of

powerful, affordable computers implies that a recursive algorithm for a solution is as valuable as a solution based on commutation functions. The text begins with a complete, but brief development of compound interest in Chapter 1. The development of life contingencies then proceeds in a manner similar to that of *Actuarial Mathematics*. The following are introduced in Chapters 2 through 8: lifetime random variables, life insurance, life annuities, net premiums, net premium reserves, multiple decrements, and multiple life insurance. The development is parallel to that in Chapters 3 through 9 of *Actuarial Mathematics* in notation and content. The style is a bit more lively, the presentation is more even, and most topics are treated quite briefly relative to that given in *Actuarial Mathematics*. Unfortunately, there are no exercises. The lack of exercises in a mathematics textbook would be a very serious flaw for most subjects. However, hundreds of life contingency problems (for examples, see [1] or [3]) are available for instructors to supplement the text. As an example of the brevity of the treatment, consider the treatment of multiple decrements: The *Life Insurance Mathematics* chapter is seven pages, versus thirty-three for *Actuarial Mathematics*. Of course, such a brief treatment (or none at all) may be quite appropriate for an introductory, one-semester course.

Chapter 8, Multiple Life Insurance, is brief also. However, it is more advanced than the corresponding chapter of *Actuarial Mathematics* because it covers some material on advanced multiple life theory (Chapter 17 of *Actuarial Mathematics*), such as the Schuette-Nesbitt formula.

Chapter 9, The Total Claim Amount in a Portfolio, gives a brief introduction to collective risk theory. It includes the recursive method of calculating the compound Poisson distribution of total claims and the stop-loss reinsurance net premiums. Chapter 10, Expense Loadings, describes the classes of insurance expenses, the expense-loaded premium and expense-loaded reserves. Although only five pages, this chapter conveys the basic idea clearly and hints at their practical importance. Chapter 11, Estimating Probabilities of Death, sketches the method of moments and maximum likelihood method of estimating probabilities of death. Again this is brief, but sufficient to give the student reader an idea of where these probabilities come from. The text ends with appendixes on commutation functions and simple interest and a set of references on life contingencies. The references are valuable because they include European texts that are not well known in North America.

This introduction to life contingencies is a very valuable addition to the English-language texts available to students. It should be especially successful as a textbook for college or university courses in mathematics or statistics departments. Two final items worth noting: Dr. Gerber dedicates this book to Cecil Nesbitt. And the cover has an amusing decomposition of the life insurance net premium.

SAMUEL H. COX

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Anders Hald, *A History of Probability and Statistics and Their Applications before 1750*, pp. 586, published by John Wiley and Sons, New York, 1990.

The introductory chapter promises a study of the development of probability and statistics through problems, methods, and persons. The problems are mainly games of chance, astronomy, demography, and life insurance, and of course it is the inclusion of the latter two topics that makes this book potentially interesting to actuaries. The various proofs are reconstructed in modern notation, which "makes evaluating the contributions of various authors easier and minimizes the danger of attributing too much to an individual author. Furthermore, the importance of the results to the following period and to today becomes evident." This is especially useful when the results of deMoivre and Simpson are stated in International Actuarial Notation. Hald notes that although practical problems provided the impetus, they quickly took on a life of their own as the mathematical community strived for improved proofs and generalizations.

Problems arising from games of chance and the resulting development of combinatorics, multiplication and addition rules, the binomial distribution, the negative binomial distribution, the gambler's ruin problem, and eventually the law of large numbers and the normal approximation to the binomial form the bulk of the book (Chapters 2–6 and 11–24). The lives of the men and the way they advanced the theory through correspondence and challenge problems make fascinating reading. I chose to skip the proofs, saving considerable reading time. For those with time, the problems at the end of most chapters allow the reader to work on some of the interesting problems of the time.

Chapters 7–9 and 25 on demography and the life insurance chapters are well worth reading. (The only ummentioned Chapter, 10, deals with astronomy.) Chapters 7 and 8 deal with the first life table, the one constructed by John Graunt in 1662. His contribution was more than the table itself—this was the first ever descriptive statistical analysis. Graunt investigated the reliability of the data and noted that the reported cause of death was unreliable (the study had been motivated by the need for an early warning system for the onset of plague). Graunt is a good role model for today's actuary. He possessed limited analytical tools and flawed and scanty data, yet he produced a solution that was reasonable and useful.

We next learn that Huygens brothers and Nicholas Bernoulli used the life table to find the median lifetime, the expected lifetime, and some joint life values. A key realization was that the probabilities must come from observation and estimation. This was a radical

change from the analysis of games of chance in which the probabilities could be deduced from the physical structure of the game. Unfortunately, it would be another one hundred years before a theory of errors of measurement would be developed.*

Chapter 9 presents the early history of life insurance mathematics. It was common for governments to sell life annuities as a fund-raising scheme. In 1671 Jan deWitt constructed a table with uniform distribution of deaths over the intervals (3,53), (53,63), (63,73), and (73,80). He then successfully computed a_x using the formula $\Sigma a_{\overline{t}|} d_t / l_x$. (Note that only with the publication of *Actuarial Mathematics* did North American actuarial education return to this as the basic formula for annuity values.) deWitt found that the government was underpricing the annuities by 12.5 percent.

In 1694 Edmund Halley introduced $a_x = \Sigma v^t l_{x+t} / l_x$. Hald also reveals how an English astronomer was called on to analyze data from Breslau. His data consisted of deaths and births, and he was astute enough to realize that the population was not stationary and so adding the deaths would not give the correct l_x. Halley was able to determine that the English government was also underpricing annuities (by 45 percent) and that having the price be independent of age was foolish. He also did joint life calculations.

Finally, in 1725, Abraham deMoivre used $l_x = 86 - x$ for $x \geq 10$ to obtain a simple formula for a_x.

With two exceptions, Hald's history does not return to insurance matters until the final chapter. One is a discussion of Nicholaas Struyck, who in books published in 1740 and 1753 constructed eight tables based on data from annuitants. He did some graduation and interpolation and again found that his government was selling annuities too cheaply. There is also a discussion in Chapter 17 of the first attempts at a test of a statistical hypothesis. It was a demographic problem: $H_0: p = 0.5$ *vs.* $H_1: p > 0.5$ where p is the probability that a newborn is male. A key question of the day was also the stability of p over time (if it was, this was thought to confirm the creation of man by God).

The final chapter covers the work of deMoivre, who generalized his mortality "law" to include piecewise linear l_x. In 1742 Thomas Simpson published a book that duplicated deMoivre and corrected some of deMoivre's joint life formulas. It also began a running battle between the two over the accuracy of various approximations and the merits of an experience table versus an idealized law. Neither did much with life insurance, and deMoivre was unable to correctly obtain A^1_{xy} (making an error that is often duplicated by today's students). Simpson was able to obtain the correct UDDYA approximation.

In summary, Hald succeeds in his mission. For those of us whose idea of early actuarial history is "Graunt and Halley made tables and deMoivre proposed a mortality law," there is much to learn and admire about those who started our profession. But lest we get too full of ourselves, Hald explains why the latter seventeenth century saw an explosion in mathematics (particularly the development of calculus) but not probability:

*Stigler (*The History of Statistics: The Measurement of Uncertainty before 1900,* The Belknap Press of the Harvard University Press, 1986) provides an excellent discussion of the development of the theory of errors of measurement. His book is also more appropriate for readers who are interested in the history of statistics and data analysis rather than a history of probability.

"...probability theory did not yet have any important applications in science, only in life insurance."

STUART A. KLUGMAN

Edward A. Lew, Project Director and Co-Editor, and Jerzy Gajewski, Co-Editor, *Medical Risks: Trends in Mortality by Age and Time Elapsed*, published by Praeger Publishers, New York, 1990, $195.

This monumental reference work is sponsored by the Association of Life Insurance Medical Directors of America (ALIMDA) and the Society of Actuaries (SOA). It is a sequel to *Medical Risks: Patterns of Mortality and Survival*, which had the same joint sponsorship, and is about double the size of this previous work.

This work comprises 14 chapters in two volumes. The first two chapters deal with methodology and interpretation. The next two chapters cover lifestyle and occupational hazards. The final ten chapters pertain to diseases categorized by bodily system, with one large chapter devoted to cancer and two to cardiovascular diseases. There are also complete Author and Subject Indexes.

As stated in the Introduction, "This volume represents a unique compendium of useful quantitative information on mortality and survival in a wide variety of medical risks, based on recent medical literature as well as investigation of mortality among insured lives and epidemiologic studies of special groups."

Chapter 1 describes the methodology, which was "to translate the wide variety of summarized observations into a life table pattern showing observed and expected deaths, mortality ratios, death rates and survival rates." These summarized data were presented in abstracts for those studies from which meaningful mortality ratios could be derived, preferably by sex, age group, and time elapsed. Wherever feasible, expected deaths were calculated by using death rates among ostensibly healthy persons such as individuals insured under group life insurance contracts. Using expected deaths based on general population death rates may seriously understate the relative mortality, particularly for persons with mild to moderate impairments.

Chapter 2 on interpretation of results is very important. The reliability of the available records, the manner in which the study population had been selected, the accuracy and completeness of the observations, the measure of comparative mortality used, and the effects of possible confounding factors all have an important bearing on interpreting the results. The extent to which the results are supported by those in other studies is also very important.

In discussions about interpretations of results, Mr. Lew brings up two particularly salient issues: first, that for many impairments, there is a very wide range of mortality results in studies made under different circumstances. This may be attributed to the disparate characteristics of various studies, particularly the different ways in which impaired lives were selected, the presence and nature of other impairments (including smoking habits) in the lives studied, and differences in socioeconomic status.

The second salient issue is the marked effect of the length of time covered by a mortality study on the overall mortality level. For impairments for which the incidence of extra mortality decreases with duration, short-term studies (which include most clinical studies) tend to overstate the relative mortality. On the other hand, where the incidence of extra mortality increases with time elapsed (for example, overweights), the relative mortality can be understated in a short-term study.

Chapters 3 and 4 deal with lifestyle and occupational hazards. Lifestyle hazards include social class, smoking, alcoholism, drug abuse, stress, physical activity, health habits, and social network. In the health habits abstract, persons were classified according to the number of their good health habits, such as not smoking, regular physical activity, moderate or no use of alcohol, 7–8 hours of sleep, proper weight, eating breakfast, and not eating between meals. In the social network abstract, persons were classified by social connections (marriage, church, social groups, contact with friends). The results are surprising only in the wide differences in mortality between the best and worst classes. The occupational abstracts include those on prominent men and women, physicians and anesthesiologists, and insulation, asbestos, refining and chemical workers.

Chapters 5–14 deal with diseases and other medical conditions by bodily system. Chapter 5 presents considerable information on cancer: trends in death rates; incidence and 5-year survival rates; variations in mortality by age, sex, race, ethnic group, social class, and lifestyle: as well as information on prevention, research and treatment.

Chapters 6 and 7 cover cardiovascular diseases, including coronary heart disease, coronary bypass surgery, valve replacement, cardiac transplantation, heart surgery, electrocardiographic abnormalities, and hypertension.

Chapters 8–11 deal with diseases of the respiratory, gastrointestinal, genitourinary, and endocrine-metabolic systems. Chapter 12 is divided into 3 subchapters on neurological diseases, cerebrovascular disorders, and psychiatric diseases. Chapter 13 deals with overweight and underweight. Chapter 14 covers systemic and miscellaneous diseases including connective tissue disease, arthritis, blood disorders, blindness, and deafness.

Although most of the abstracts are derived from U.S. studies, a number are from studies in other parts of the world, primarily Canada, Europe, Japan, and Australia. As would be expected, a number of abstracts are derived from the Framingham study. In these abstracts, the data were analyzed separately for nonsmokers, light smokers, and heavy smokers. The abstracts derived from life insurance data come primarily from the 1983 Medical Impairment Study.

Each chapter includes an overview that provides general information about the subject matter and a list of references. In addition to general information, the text provides specific information about studies that do not lend themselves to abstract presentation. The general information includes mortality prognosis and information about the aspects of impairments that are unfavorable or favorable in the overall prognosis. The conclusions are generally derived from information in the references but are obviously colored by the author's own experience and opinion. However, it is usually clear from the text

whether the information is factual or speculative. In some cases, the text provides information about tests that can be conducted to help determine the severity of the disease.

The abstracts follow an organizational pattern that assists greatly in identifying the characteristics of each study. This information is followed by the tables, which, except for Chapters 3 and 4, are in a standardized life table form. An innovation in the abstract tables is the computation of 25-year temporary life expectancies where warranted by the data. This was largely limited to studies of insured lives, such as the 1983 Medical Impairment Study.

The size of the book, which had the objective of assembling data that could be translated into a life table format for as many impairments as reasonably possible, makes it difficult to obtain an overview of the extent and depth of the information available. The Subject and Abstract Indexes are excellent tools to assist in locating a specific subject, and a separate Abstract Index for each chapter follows the chapter text.

One limitation of a tome of this nature is that it is by definition incomplete; the authors had to be selective in choosing studies for the abstracts. The selection is largely those studies that were the gold standard of useful information at the time the chapters were written. Unfortunately, the book can remain current only for a short period of time.

The primary fault following publication of the previous volume (*Medical Risks I*) was that, when new information became available, there was no mechanism for updating. Hopefully, this will be corrected by publishing new and updated abstracts in the *Journal of Insurance Medicine.* Volunteers are needed for this current work.

The current volume (*Medical Risks II*) will be a valuable tool for many years, as was *Medical Risks I.* All those who contributed deserve plaudits for devoting considerable time and effort toward producing an invaluable reference work for the medical profession and the insurance industry.

HARRY A. WOODMAN

Robert J. McKay, *Canadian Handbook of Flexible Benefits,* pp. 453, published by John Wiley & Sons, Rexdale, Ontario, 1990, $125 Cdn.

Traditional employee benefit programs in the 1960s were designed for a family unit typically consisting of a working male, a homemaker female, and two children. But such a traditional family represents only 17 percent of today's workforce, compared to 65 percent in the 1960s.

Flexible benefits are transforming the delivery of employee compensation and benefits in Canada; 50 flexible benefit programs have been implemented. The financing is under the control of the plan sponsor; the plan members decide how to allocate their allowance. Up to 40 percent of payroll can be in the flexible benefits area.

This book of 22 chapters plus appendix, glossary and index gives a thorough account of all aspects of flexible benefits, including generation of flexible credits, pricing of benefit options, legal and tax issues, communication and testing, high and low options, visioncare and pharmacare, reenrollment and areas of choice, time off with pay and

retirement choices, four pricing and credit approaches, short-term and long-term benefits, winners and losers analysis, adverse selection and controls, training the trainer, software and hardware, and cost/benefit analysis. Also included are case studies for Cominco, American Express Canada, Prudential Insurance and Potash Corporation.

Large employers will wish to give serious consideration to the concept of flexible benefits. A less ambitious route would be to enlarge the number of employee classes in order to cater to the modern needs of all employees.

In addition to information on flexible benefits, this text provides continuing education in a broad area of great value to all Canadian actuaries.

WILLIAM H. AITKEN

Franklin Reynolds, *Canadian Insurance Practices*, pp. 691, published by Reynolds, Thorvardson, Ltd., Waterloo, Ontario, 1990.

Canadian Insurance Practice was developed from course notes by Professor Reynolds over the past six years. It is used as a text by first-year actuarial students, among others, in an eight-month course at the University of Waterloo.

The early chapters include some interesting history and important principles of insurance. The text covers the areas of life insurance, casualty insurance, group insurance and pensions. It covers the concepts of premiums, cash values, policy provisions, dividends, and supplemental benefits.

While the emphasis is on breadth, the book has more than a little depth in the areas of disability, underwriting, commissions, taxation, investments, and financial reporting.

Reynolds' occasional use of humor and personal opinion adds interest to the material. For example, the actuary's role is modestly mentioned on page 216: "... the raison d'etre for establishing an insurance company is to distribute the actuary's expertise...."

The treatments of premium and reserve calculations are based upon realistic interest, mortality and expense assumptions, rather than on the net premium plus loading approach. The effects of varying the assumptions underlying premium and reserves are illustrated.

Tables of census, insurance, and annuity mortality rates by age and sex are included.

The text is up to date on an amazing number of recent developments, but, of course, obsolescence will creep in as the months go by and a new edition will certainly be needed every three or four years.

This book would be an excellent gift for a new Associate.

WILLIAM H. AITKEN

Lynn Arthur Steen, editor, *On the Shoulders of Giants (New Approaches to Numeracy)*, pp. 232, published by National Academy Press, Washington, D.C. 20418, 1990, $17.95.

The actuarial profession is dependent on a good supply of young people interested in mathematics and the abilities of our school systems in providing them with solid

educations including exposures to new ideas and techniques in mathematics. Because of this dependence, we should be interested in this collection of essays that show how the concepts of change, dimension, quantity, shape, and uncertainty can be incorporated in exciting ways into the curricula for young children through college-age people.

The title of the book comes from Isaac Newton's comment "If I have seen farther than others, it is because I have stood on the shoulders of giants." He made this statement in crediting his developing the calculus to the earlier efforts of his predecessors.

The book comprises six chapters. The leading one, entitled "Pattern," was authored by Lynn Arthur Steen, the editor for the volume. Successive chapters are "Dimension" by Thomas F. Banchoff, "Quantity" by James T. Fey, "Uncertainty" by David S. Moore, "Shape" by Marjorie Senechal, and "Change" by Ian Stewart. The authors are mathematics professors at St. Olaf College, Brown University, University of Maryland (College Park), Purdue University, Smith College, and University of Warwick, respectively.

This review does not present digests of the six chapters, but mentions some ideas and sentences that seemed noteworthy.

The concept of computer graphics is mentioned in several essays. On page 50, "X-ray tomography uses computer graphics in the reconstruction of three-dimensional objects from planar sections. Topographers and geologists construct and analyze contour maps showing the elevations of different configurations above and below the surface of the earth."

The chapter on uncertainty offers glimpses into how students can be introduced to probability and statistics in an excellent manner. Included are sections on data analysis, a basic development of probability, statistical designs, statistical thinking, and Bayesian inference versus classical inference. The author provides some convincing reasons for the greater inclusion of statistics in curricula; for example, from page 134: "Statistics has some claim to being a fundamental method of inquiry, a general way of thinking that is more important than any of the specific facts or techniques that make up the discipline. Reasoning from uncertain empirical data is a ... powerful and pervasive intellectual method."

Like the other chapters, the "Shape" essay provides some fascinating reading. In "Using Symmetry" is a brief description by James Watson and Francis Crick of their discovery of the structure of DNA. An exciting frontier of biology is the geometry of the dissection, compartmentalization, and subdivision of cells. Nine methods that map-makers use to project the globe to create flat maps are illustrated on page 162. A ten-page essay within an essay closes the chapter by discussing the curricular issues of designing programs of study that include more times and innovative methods for learning about shape.

Within the final chapter on "Change," population dynamics is one of three subjects that can be usefully considered from grade school through college. A yeast population can be described verbally as growing slowly at first, then increasing exponentially, and then levelling off. This type of growth pattern is then described through a discrete model.

Its difference equation is ideal for computer calculation. Finally, the model can be described through the calculus and leads to the logistic curve of population growth.

An early reader of this book was Johnnetta Cole, President of Spelman College. She stated that: "*On the Shoulders of Giants* presents a fascinating vision of the teaching of deep, rich mathematical ideas from early childhood through college. Its wealth of beautiful examples of important mathematics forecasts an exciting change in the teaching of this crucial discipline."

This reviewer agrees completely with Dr. Cole's assessment. These six essays offer much potential for helping to increase the supply of mathematically interested students and to enhance their intellectual breadth and depth.

JOHN A. BEEKMAN

Marvin Snyder, *The Value of Pensions in Divorce: What It Is and How to Use It*, pp. 132, published by Professional Education Systems, Inc., Eau Claire, Wis., 1989.

The accelerated growth in the divorce industry has forced family lawyers to deal with retirement plans at a level for which the law school curriculum does not prepare them. An urgent need exists for a retirement plan primer directed to family law practitioners. Snyder's book is the first by a divorce retirement expert to make up for the missing curriculum, for which he deserves much credit.

The book's index illustrates the educational scope of the text, with entries such as accrued benefits, bad-boy clauses, cliff vesting, defined contribution plan, target benefit plan, unit benefit, vesting, window benefits, and so on. The text does not have to be read from beginning to end, but rather can be referred to as needed.

Snyder's text, however, is more than a primer on pension plans. It gives equal emphasis on how to value the marital (community) interest in such plans. But understanding the valuation of retirement benefits is not as easy as understanding retirement benefits themselves.

It is difficult to teach valuation of pension benefits in a text, if you first have to include a course in pension benefits. It is unlikely that family lawyers will have mastered the preparatory material before going on to read the advanced material on marital interest valuations.

An additional problem is that the judicial and legislative valuation instructions followed by Snyder in his Pennsylvania-centered practice conflict with the instructions appropriate for other states, California, in particular.

Specifically, California law on assumed retirement age calls for using the earliest age of retirement eligibility. If the employee is eligible now, we in California determine the marital interest as if the employee were to retire now. If the employee is not eligible to retire now, the marital interest is calculated as if the employee were to retire at the earliest retirement eligibility age.

In contrast, Snyder devotes many pages to selecting the assumed retirement age, which is appropriate for his practice but wholly inappropriate for practice in California.

Some choices exist, however, that valuation experts view differently and that do not represent differences in judicial and legislative law. These come under the rubric of "acceptable differences in professional judgment." Snyder uses Pension Benefit Guarantee Corporation (PBGC) annuity rates, whereas few divorce pension experts that I encounter use PBGC annuity rates. He makes no mention of the many arguments presented by colleagues against using PBGC rates in divorce assignments.

In summary:

1. Family lawyers need a national publication that explains retirement/pension/deferred compensation principles, practices, procedures, and regulations. Such a publication should be universal and separate from a treatment of valuation procedures for arriving at the marital (community) interest in such benefits.
2. Snyder's text is not the long-needed pension fundamentals text for family lawyers. A second edition, devoted to pension fundamentals alone, separate from valuation procedures, would fulfill this long-time need.
3. I do not recommend the current edition to pension actuaries. We already have pension know-how; the marital interest valuation material is not valid nationally; and the issues in such valuations are not always presented in an evenhanded way.

MURRAY PROJECTOR

The Social Security Technical Panel Report to the 1991 Advisory Council on Social Security, pp. 91, Washington, D.C., 1990.

The Social Security Act mandates the appointment of an Advisory Council on a quadrennial basis to review the programs and their financing. Successive councils, in turn, have traditionally appointed a group of actuaries and economists to a technical panel to review the methodology and assumptions used in the projections of the future financial status of the programs and other related economic and actuarial matters.

The 1991 Council appointed a distinguished technical panel of five economists and four actuaries to review the old-age, survivors, and disability insurance (OASDI) financial projections. The panel's report is thoughtful and thoroughgoing. Its most important conclusions include the following:

- "That a contingency reserve equal to at least 100 percent of annual expenditures be built and maintained throughout the 75-year projection period.
- That the Board of Trustees of the OASI and DI trust funds adopt tests of the soundness of the funds, both for the short and long range. Failure of the system to meet these tests would alert policymakers and the public to the need for action to improve the financial status of the system.
- That three of the most critical economic assumptions used in making financial forecasts be changed; namely, that the assumed ultimate real interest rate be increased, the assumed ultimate real wage differential be decreased, and the assumed ultimate rate of inflation be increased.

- That the projection methodology appears reasonable; it has no discernible pattern of bias.
- That the projection methodology be externally reviewed and validated."

The recommended contingency reserve of 100 percent of annual expenditures is somewhat more conservative than previous analysts felt necessary. This recommendation is supported by a study performed by Richard S. Foster, Deputy Chief Actuary, SSA, which is included in the report as an appendix. Foster projected the difference in trust fund levels that would occur if the "most likely" assumptions for the 1990 Trustees' report were replaced by worst-case economic assumptions based on the actual experience of 1973–77. He also assumed that it would take Congress 5–10 years to take corrective action.

The test that should be used to measure the soundness of the trust funds has received a great deal of attention in recent years, including that of committees of the Society of Actuaries and the American Academy of Actuaries. The consensus appears to be that the traditional tests have not been adequate. In recent years, the financing of OASDI has been said to be in actuarial balance if the effective payroll tax revenues fell within 5 percent of the average benefits and expenses over the 75-year projection period as a percentage of covered payroll. More recently, this has been done on a present-value basis. The adequacy of short-range, that is, five years, financing was judged on the basis of the year-by-year projections of trust fund balances. These projections are all done under "best estimate" assumptions.

The panel report recommends several changes to the long-range test: there should be provision for the build-up of the recommended contingency reserve, and the test should become one-sided—that is, the program would be out of actuarial balance only if the income rate falls short of the cost rate by the 5 percent tolerance level, not when it exceeds the cost rate by that level. This recommendation recognizes that the financing of the program has adopted a partial reserve system under present legislation and anticipated experience.

The panel recommends that the Trustees' report include four additional measures of the system's financial strength:

- "The year in which the trust funds are projected to exhaust their reserves, as well as the first year in which the reserves fall below a fund ratio of 50 percent.
- The amount of any tax or benefit changes needed to bring the system back into long-range actuarial balance.
- The amount of transfers to and from federal general revenues needed as special treasury obligations are purchased and redeemed.
- The size of any difference between the cost rate and the income rate in the 75th year of the projection period, which is a measure of ultimate balance in the system."

The panel recommends extending the short-range test to ten years, which would require (1) the fund ratio at the beginning of each year to be at least 50 percent or (2) the fund

ratio to exceed 50 percent within five years and remain at or above that level and the fund at the beginning of each month to exceed the benefits for that month.

Incidentally the report recommends eliminating projections in the annual Trustees' reports using the so-called "alternative II-A" economic assumptions that are based on federal budget assumptions and returning to the earlier practice of three sets of projections based on "low-cost," "best-estimate," and "high-cost" assumptions. This would be regrettable in light of political realities in the choice of assumptions. Unless there is an independent board of actuaries and economists setting the assumptions, I would be loath to abandon the present policy of projecting based on four sets of economic assumptions.

In a related matter, the report recommends that the projection methodology be externally reviewed and validated. The periodic technical panels have filled this function; however, they are appointed only once every four years and, even then, do not always review the OASDI projections. A decade or more could conceivably transpire between reviews.

The report does not address the current controversy about whether OASDI should be financed essentially on a "pay-as-you-go" basis or on a temporary or permanent trust fund build-up basis. It simply notes that the program can be financed in any of these ways. Decisions about financing method should be based on considerations of the economic impact of trust fund build-up rather than on any actuarial consideration. The report recommends further study of the broader question. Unfortunately a lack of consensus on this question makes more difficult decisions about what are the most appropriate tests of the financial soundness of the program. The recommendation that the program is to be described as being out of actuarial balance only if revenues fall 5 percent or more short of projected expenditures, and not in the case of excess, seems to suggest the acceptance of pay-as-you-go type of financing.

The report recommends that highlighted from the projections should be the transfers to and from federal general revenues that may be needed as special treasury obligations are purchased and redeemed. This appears to ignore the fact that the interest payments on the special treasury obligations that form the assets of the trust funds are also a drain on federal general revenues.

The panel recommendation for the long-range test also calls for application of the test to subintervels of the projection, but with the tolerance level that is set at 5 percent for the full 75-year period being graded uniformally to 0 at the beginning of the first projection period. This reflects the greater reliability of shorter-term projections.

The panel recommends several changes in the economic and demographic assumptions. It recommends that the ultimate best estimate of the real wage growth assumption be decreased from a 1.3 percent per year to 1.0 percent. This change reduces projected income more than projected benefits because of the lag effect on the determination of benefits based on wage histories and also the indexing of benefits currently being paid using the usually lower increase in the CPI rather than wages. On the favorable side, the panel recommends an increase in the ultimate best estimate real interest rate assumption from 2.0 to 2.8 percent and the ultimate inflation rate from 4 to 5 percent annually.

The most controversial of the demographic assumptions in recent years has been the ultimate total best-estimate fertility rate, which is currently 1.9 children per woman. One panelist dissented, believing that 1.7 births would be more appropriate. Such a change would significantly reduce the long-range actuarial balance of the program. However, the report recommends no change in the demographic assumptions other than a small change in the number of immigrants assumed in the low-cost projections.

The effect of the changes in the three economic assumptions made by the panel as well as the inclusion of the provision for the build-up of the contingency reserve to 100 percent, would be to improve the long-range actuarial balance by 0.21 percent of the payroll, an amount a little more than 1 percent of the cost of the program itself over 75 years.

The report concludes with an extensive series of recommendations for further research and study. Noteworthy in this list are research directed at improving the integration of the methodologies for the short-range and the long-range projections, using stochastic simulations to judge projection sensitivity, improving the consistency of relationships between assumptions, and considering the appropriate balance between complexity and simplicity in the projections. Also recommended is the development of a systematic approach for comparing projection results with subsequent actual experience. Among the actuarial assumptions recommended for study are fertility rates particularly as they relate to other changes in our society, and mortality rates as they are influenced by smoking habits by sex.

Consistent with its lengthy recommended research agenda, the panel recommends that additional in-house resources be made available to the Office of the Actuary and the Office of Research and Statistics, SSA. As one who had responsibility for the Office of the Actuary for a short period of time, I strongly support that recommendation, but I am aware of the difficulty of recruiting, training, and maintaining a highly competent staff in spite of hiring freezes, salary caps, and society's generally low regard for government employment. We can be thankful that a few dedicated and highly competent individuals have chosen public service in spite of all the disincentives.

DWIGHT K. BARTLETT, III

Edward P. Brunner and Paul E. Heacock, Co-Chairmen, *Life Insurance Accounting*, pp. xvii + 515, published by Insurance Accounting and Systems Association, Durham, N.C., 27707, 1988.

Life Insurance Accounting is an update of a similar book published in 1977. Twenty-eight authors worked under the direction of an eight-man editorial committee appointed by the president of the Insurance Accounting and Systems Association. Fifty-one others contributed by reading and reviewing.

To quote from the preface, "Chapters are authored by knowledgeable executives with years of hands-on experience." An examination of the list of editors and reviewers indicates that the comment applies to them also.

Again from the preface, "Users of this book will include actuaries, attorneys, CPA's and others in public accounting firms, experienced life insurance accountants and other staff personnel of life insurers, tax specialists, pension consultants, Chartered Life Underwriters and other students of life insurance. Priority has been given to the practical over the theoretical. Intent was that this work not be replete with esoteric terms nor be a technical treatise of use only to insurance accountants." Accounting aspects aside, the book provides a wealth of background information on a variety of topics.

The work comprises 23 chapters spread unevenly over nine major divisions: the evolution of insurance accounting; assets; liabilities, capital and surplus; operations; GAAP (generally accepted accounting principles); planning; reports and consolidations; immunization; and, finally, Canadian contrasts. A 75-page appendix is a copy of the convention blank. An index is 23 pages.

The book is hard-cover, 7 × 9 in. loose-leaf three-ring binder form; this may enable rapid updating, for example, a more current annual statement form. The pages are relatively free of footnotes, which makes for easier reading. A bibliography would be a welcome addition.

In only seventeen pages, the first division gives an excellent thumbnail sketch of life insurance accounting, history and background, and purposes. The purposes and differences between statutory accounting and GAAP accounting are explained particularly well.

Stocks and bonds are covered in the chapter opening the second division, on assets. The usual instruments and some of the lesser-used tools such as puts, calls, repos, and hedges are reviewed. The approach to the subject should prove helpful to those wanting a good background in life insurance investing in general.

Mortage loan assets are treated thoroughly, beginning with a solid historical review followed by a description of the various types of mortgage loans and pertinent governmental regulations. The various sources of loans are described, as well as their internal and external servicing. Students will find the description of mortgage loan underwriting and documentation procedures particularly interesting. For smaller companies the description of systems is helpful.

In spite of being a small percentage of assets, real estate investments and joint ventures can be complicated. The chapter covering these describes various possibilities well. Accounting aspects are kept on a verbal level, but appear quite adequate, being confined to annual statement requirements.

The concluding chapter of the asset division discusses all other assets: policy loans, premium notes, collateral loans, cash, reinsurance ceded, deferred and uncollected premiums, due and accrued interest, plus a handful of others. There is a logical development of the relationship among admitted assets, non-ledger assets, and not-admitted assets. Basket assets are also touched upon. A considerable amount of detail is given on the annual statement location of many items.

The third division treats all of Page 3, including capital and surplus, and reviews Exhibit 4, which traces surplus changes over the year. The leadoff chapter discusses policy and claim reserve liabilities. The material on life insurance reserves, in particular,

is a highlight of the book. For the new accounting person, the fundamental ideas behind reserving for long-term, level-premium life insurance are well presented. The deferred-premium approach, startling to many at first acquaintance, is well presented.

Two additional chapters cover the remaining liabilities line by line. Solid information is given on how some of these liabilities come about, plus their relationship to other parts of the statement. The MSVR is covered lightly. This unique and changing item might warrant a heavier discussion.

A good summarization of capital and surplus accounts winds up the division. Although much of the material may be familiar to the general accounting person, unique features of the life insurance industry are well covered. The discussion of the needs, purposes and measures of surplus adequacy is especially well done and informative.

In the division on operations, Chapters 10 and 11 cover revenues, benefits, commissions, expenses, and taxes on a reasonably detailed basis. The timing of investment revenues recognition has become more difficult with the introduction of more complex investment alternatives. There is some consideration of what to those outside the investment community are unusual transactions. The benefits area has several helpful how-to numerical examples. Reinsurance effects are covered as well as ties between the summary of operations and various exhibits and schedules of the statement.

Chapter 12, a well-written introduction to federal income taxation, contains a wealth of material, from a brief historical coverage of taxation of insurance companies in general to the intricacies of life-nonlife consolidated returns. Some excitement could be added by discussing the current impasse between mutuals and stocks in seeking a unified compromise to present to government revenue-seekers.

Chapter 13 covers reporting by line of business as required by the convention blank. The author points out that company managers may want to go beyond the legal requirements to get a secure handle on the progress of the company. Allocation of federal income tax is treated well. Some mention of the handling of the "surplus tax" on mutuals might have been a good addition.

A chapter on departmental and functional costs winds up the treatment of operations. Laid out therein is the theory and practice of cost accounting applied to life insurance. A lot of material is presented in a highly informative discussion emphasizing practical aspects, potential problems, and possible directions to take. This chapter provides an excellent start for one who is taking up life insurance cost accounting for the first time.

A single-chapter division discusses GAAP accounting. The reviewer found this chapter very informative. It's useful to keep the differences betwen statutory accounting and GAAP accounting in mind while covering this chapter. The author may not have really appreciated the results of the replacement of insurance that took place four or five years ago. The author seems to make some unwarranted assumptions, and this reviewer is not sure that there was a deep understanding of the tremendous cost to the industry of this wholesale replacement.

At the end of the chapter is an interesting numerical example comparing the results of statutory accounting with GAAP accounting for a fictional company—at least in this

example, the major difference producing the different bottom lines is how reserves are established.

The book devotes a three-chapter division to planning including cash management, budgeting, and strategic planning. It is refreshing and perhaps surprising to have material like this in a book entitled *Life Insurance Accounting.* Presumably this material is included because all three areas would probably involve accounting personnel.

Each chapter approaches its topics from an elementary viewpoint. Nevertheless, the most important points are at least touched on. The cash management chapter is no exception. Without going into a lot of detail, the reader is alerted to all kinds of possibilities and avenues that should be fully explored if one is given responsibility for this particular function in the company. The chapter should make all aware that *good* cash management is vital. *Excellent* cash management can provide a further plus to the bottom line. A welcome inclusion is a glossary of cash management terms at the end of the chapter.

Even those involved only marginally in budgeting will probably not find much new in the chapter on budgets, but the author gives a good survey of the purposes and tools of budgeting. Particularly interesting and valid are the author's comments on the importance of human relationships. He emphasizes the importance of maintaining good human relationships so that misperceptions do not destroy the budgeting process. The approach is fairly elementary here; additional leads through a bibliography would help.

Strategic planning is an organized, comprehensive way of creating a company's future. This theme is expanded in a simple and direct way. For those who have never been involved in strategic planning, this chapter is an excellent first step. While obviously not meant to be a how-to manual, the chapter does touch on the several most important aspects of strategic planning and provides direction for those interested in starting a planning process. Again, a bibliography of further leads could be helpful.

Chapter 19 is the first in a three-chapter division on reports and consolidations. It discusses all reporting that might be done except for the statutory blank. Reports to management take up one-third of the chapter, giving leads to types of information on fundamentals of success (mortality, lapses and trends in expenses and interest earnings). A large part of the remainder is devoted to SEC reporting. Detailed listing of required information is given, illustrating what a burdensome and exhausting chore it is. Special reports to the IRS are touched on. The chapter winds up with an informative discussion of the ratios required by the NAIC Insurance Regulatory Information System (IRIS).

Chapter 20 gives a good thumbnail sketch of recent pressures leading to increased merger/acquisition activity. The main part of the chapter concerns (1) determining the value of a target company, (2) choosing an acquisition technique, and (3) accounting for the transaction under GAAP (and considering the complications thereof). Demutualization is touched on briefly. The chapter is fairly long, but the first-time reader may well wish for a heavier discussion of the various choices and options with their pros and cons.

Chapter 21 discusses the consolidation and presentation of financial results after acquisition/merger has taken place. It covers authoritative literature, guiding principles and

practices, concepts and procedures, workpapers and form and content of consolidated statements. There is a good discussion of tax allocation methods and some special issues. The sample financial statements are helpful.

The next to last division in the book is one chapter devoted to asset/liability matching. Such a topic might be considered an unusual adjunct to an accounting text, but after reading the chapter one can see where accounting personnel should not only be interested in the subject but also that they can be intimately involved in assembling information used to establish and track procedures. This short but clearly written chapter discusses asset/liability matching and why such considerations are essential to profit objectives as well as to assure company solvency under a variety of conditions. Both problems and solutions are covered, albeit in a broad-brush way, but sufficiently enough to give the general reader a firm idea of what the problems are and possible solutions. This is a subject perhaps not nearly as deeply appreciated as it should be, even after going through the rather horrendous interest rate climate of the early 1980s. A number of charts are included, which is a definite plus; they give a succinct summary of problems and solutions.

The final division of the book is a single chapter on Canadian life insurance accounting practices. The chapter's ambitious purpose is to provide an overview of the Canadian life insurance industry, the regulatory supervision and reporting process, and an understanding of accounting practices for companies doing business in Canada. This is an appropriate wind-up of the book, reaffirming the closeness of U.S.-Canadian relationships. As the chapter was being written, the author points out that the situation was very much in flux. Here would be a good opportunity to take advantage of the ease of updating this text in its looseleaf form. This reviewer would have been interested in additional, more specific, comments on differences between U.S. and Canadian practices and the perceived reasons therefor.

WILLIAM A. DREW

G.O. Bierwag, *Duration Analysis: Managing Interest Rate Risk*, pp. xvi + 341, published by Ballinger, Cambridge, Massachusetts, 1987.

This book has thirteen chapters, grouped in five parts. Part I, consisting of Chapters 1 to 3, develops the classical theory of duration under the assumption of flat yield curves. Part II, consisting of Chapters 4 and 5, discusses duration-based investment strategies and concepts of risk and return. Part III (Chapters 6 to 9) is on applications of duration analysis; topics discussed are contingent immunization, immunization of multiple liabilities, financial futures and duration gap management. Part IV (Chapters 10 to 12) discusses the concept of the term structure of interest rates, alternative models for yield curve movements, empirical analysis, and simulation. Part V (Chapter 13) is concerned with noninterest rate risk—callability and credit risk. The entire text is interspersed with many examples; theoretical derivations (involving elementary calculus) are usually restricted to the appendixes at the end of the chapters.

Chapter 1 is an elementary introduction to the theory of compound interest leading to Chaper 2, which deals with bonds and mortgages. Most of the concepts discussed in these two chapters are covered in the syllabus of the Course 140 examination. Chapter 3 introduces the concept of duration. The price, p, of a fixed-income security is an inverse nonlinear function of the yield to maturity, i. Duration, which is defined by the formula

$$-(1 + i)\frac{\frac{d}{di}p}{p},$$

gives an approximately linear relationship between yield change and relative price change. Note that the idea of duration is not unfamiliar to actuarial students, as they have encountered formulas such as

$$\frac{d}{di}a_x = -v(Ia)_x$$

and

$$\frac{d}{di}A_x = -v(IA)_x$$

in their course of study; Jordan [22, p. 56, (2.49)] gives the approximation formula

$$a_x^j \approx a_x^i - \frac{j - i}{1 + i}(Ia)_x^i.$$

Part II of this book discusses the relationship between planning period returns and duration. Chapter 4 presents the concepts of portfolio duration, duration window, and immunization. It is proved that, if the portfolio duration is less than the length of the planning period, the reinvestment return incorporated in the realized rate of return will dominate any initial capital gain or loss resulting from yield changes. On the other hand, if the portfolio duration exceeds the length of planning period, capital gains or losses (resulting from initial yield changes) incorporated in the realized rate of return will dominate the reinvestment return over the planning period. It is important to note that these results are obtained under the flat yield curves assumption.

Chapter 5 develops a decision framework for measuring the risks of duration strategies and determining optimal strategies. It presents an analysis based on expected excess returns and variance of returns and develops an efficient frontier associated with durations longer or shorter than the planning horizon.

Part III (Chapters 6 to 9) covers applications based on duration analysis. Chapter 6 presents the method of contingent immunization, which was developed at Salomon Brothers by Liebowitz and Weinberger. Chapter 7 discusses the problem of immunizing multiple liabilities; the results in this chapter can be simplified and strengthened by the theorems in [26].

Chapter 8 extends the duration targeting concept to interest rate futures. By taking a short position in interest rate futures, the duration of a portfolio can be shortened. On the other hand, taking a long position in interest rate futures lengthens the portfolio duration. The question of interest is: How many futures contracts should be bought or sold to bring the portfolio duration to target? Unfortunately, this book does not show how futures are priced by arbitrage. Actuaries wanting to learn more about interest rate futures may consult [8], [9] and [18].

Chapter 9 extends the concepts of immunization and duration targeting to duration gap management. Conditions for immunizing net worth, immunizing the capital/asset ratio, immunizing net economic income, and immunizing net return on assets are derived. The analysis allows for yield differences between assets and liabilities.

Part IV of the book is entitled "Empirical Estimation and Simulation." This is the advanced portion of the book. The flat yield curve assumption is abandoned. The exposition here is notably weaker than in the first nine chapters. Chapter 10 discusses the concept of the term structure of interest rates and methodologies for term structure estimation. It also covers topics such as coupon biases and effects of differential taxation. Duration measures corresponding to certain nonparallel interest rate shocks (additive, multiplicative, logarithmic, and so on) are developed in Chapter 11, which is entitled "Duration and Stochastic Processes of the Term Structure." The term "stochastic process" is used to describe an instantaneous interest rate shock; this is not normally what a stochastic process means in probability theory. Modern no-arbitrage term structure theories ([7], [20], [28]) are conspicuously absent in this chapter; duration measures arising from such models ([1], [5], [6]) are not discussed. In this book, immunization theory is not developed in the context of a general equilibrium term structure model.

Chapter 12 gives a survey of many empirical studies of immunization and term structure analysis. The purpose of this chapter is to demonstrate the effectiveness of duration-based strategies. The first paper that systematically criticized duration analysis on theoretical grounds is [21]. The papers [14] and [19] demonstrated the deficiencies of duration-matching strategies using empirical data. Some quotes from [14] and [19] can be found in the discussions [24, p. 278] and [25, p. 134] in *TSA*. Indeed, Gultekin and Rogalski [15] claimed that "business people are wasting time and effort implementing duration-based analysis." This chapter and the papers [2, 3] are attempts to answer such criticisms.

It is perhaps of interest to note the following result in [27]. Consider a company that issues single premium immediate annuity policies and invests all the premiums that it receives for the annuities in a noncallable and default-free bond. It is proved in [27] that, by matching the asset duration with the liability duration, the company will guarantee itself that it will lose money under any parallel shift of the yield curve.

Chapter 13 concludes the book with a discussion on the caveats in using duration analysis due to the presence of call options and credit risk.

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Donald R. Anderson, *Actuarial Evidence: Valuing Past and Future Income,* Second Edition, pp. 103, published by Carswell Legal Publication, Toronto, Canada, 1986.

Donald Anderson has prepared a new, expanded version of his book *Actuarial Evidence.* The organization of the second edition is the same as the first. It begins with an introduction to the actuarial profession, proceeds to a discussion of basic actuarial principles and procedures, and continues with a consideration of the many contingencies that could affect the value of a stream of income. Among the contingencies considered at length are mortality, disability, employment, divorce, and remarriage. The book closes with chapters on actuarial reports and testimony and the possible future evolution of actuarial evidence.

Although there is much discussion of selecting actuarial assumptions and sources of data, this is not a handbook for the practicing actuary. It does provide an excellent review of the factors to consider in calculations for legal cases, and it does give a view of how the actuary's role might be perceived by the other parties involved. Its greatest value might be for attorneys and others in the legal system in helping them to understand what the actuary can and cannot do.

WILLIAM B. FRYE

SOCIAL SECURITY NOTES

Harry C. Ballantyne, *Long-Range Estimates of Social Security Trust Fund Operations in Dollars,* pp. 4, Actuarial Note No. 130, Social Security Administration, Baltimore, Md., April, 1987.

Presents long-range estimates of the operations of the combined Old-Age and Survivors Insurance (OASI) and Disability Insurance (DI) Trust Funds. Long-range trust fund operations typically are not shown in dollar amounts because inflation makes such amounts noncomparable over time. But in view of the interest that continues to be expressed in long-range dollar values, this note presents those values, together with several indices which can be used to convert current dollars into constant (1987) dollars.

Roy A. Ferguson, *Maximum Primary Insurance Amounts in 1988,* pp. 4, Actuarial Note No. 131, Social Security Administration, Baltimore, Md., December, 1988.

Presents the maximum Primary Insurance Amount (PIA) in 1988 for old-age, disability, and survivor benefits. The PIA is shown for (1) ages from 62 to 92 for old-age benefits, (2) every fifth age from 20 to 55, and 59 and over, for disability benefits, and (3) every fifth age from 20 to 90 for survivor benefits.

Francisco R. Bayo, *A Simple Evaluation of Projections in OASDI Trustees Reports,* pp. 12, Actuarial Note No. 132, Social Security Administration, Baltimore, Md., June, 1990.

Evaluates the projections in the 1983–90 annual reports of the OASDI Board of Trustees, under the intermediate set of assumptions. Simple comparisons show that the OASDI projections presented by the Board of Trustees in 1983–90 have generally been pessimistic from the point of view of the annual cost rate as well as of the contingency fund ratio.

SOCIAL SECURITY STUDIES

John C. Wilkin, *OASDI Long-Range Beneficiary Projection: 1987,* pp. 36, Actuarial Study No. 100, Social Security Administration, Baltimore, Md., February, 1988.

Describes the methods used to project the beneficiary population that underlies the long-range cost estimates for the OASDI system. Many recent improvements are included in the detailed beneficiary projections.

Stephen C. Goss, Milton P. Glanz, and Esperanza Lopez, *Economic Projections for OASDHI Cost and Income Estimates: 1987,* pp. 99, Actuarial Study No. 101, Social Security Administration, Baltimore, Md., May, 1988.

Describes the economic assumptions and projections of the 1987 Trustees Report. This is an update of *Actuarial Study No. 98* released a year earlier. Newer data are included, and methods and assumptions have been slightly modified.

Alice Wade, *Social Security Area Population Projections: 1988,* pp. 46, Actuarial Study No. 102, Social Security Administration, Baltimore, Md., June, 1988.

Describes the population projections that underlie the long-range cost estimates for the Old-Age, Survivors, and Disability Insurance (OASDI) program, which are included in the 1988 Report of the OASDI Board of Trustees to Congress.

Steven F. McKay, *Short-Range Actuarial Projections of the OASDI Program, 1988,* pp. 192, Actuarial Study No. 103, Social Security Administration, Baltimore, Md., January 1989.

Describes the methodology used to estimate the future financial operations of the Old-Age, Survivors, and Disability Insurance program in the short range. Although actuarial studies have been available for some time describing the development of the corresponding long-range estimates, this is the first time that this information has been presented in detail for the short range.

Alice Wade, *Social Security Area Population Projections: 1989,* pp. 48, Actuarial Study No. 105, Social Security Administration, Baltimore, Md, June, 1989.

Describes the population projections that underlie the long-range cost estimates for the Old-Age, Survivors, and Disability Insurance (OASDI) program, which are included in the 1989 Report of the OASDI Board of Trustees to Congress.