BOOK REVIEWS AND NOTICES*

*Harry Gershenson, *Measurement of Mortality*, pp. 340, Society of Actuaries, Chicago, 1961.

As stated in the Society of Actuaries' preface to this excellent book, "exposure formulas have frequently appeared to be surrounded by an aura of obscurity and difficulty, dispelled only by considerable study and analysis of papers written by experts for others who are, themselves, already experts."

Here at last is a book prepared primarily for the long-suffering students and other nonexperts. It is based on the author's study notes, which have been included in the Part 5 syllabus for several years, and will replace these notes as the primary reference for this part of the examination syllabus.

The author is eminently qualified to deal with the topic of exposure formulas, having been active for many years in teaching this subject in courses sponsored by the Actuaries' Club of New York. In addition to displaying a clear and original approach to the elusive subject of exposure formulas, the book also reflects the author's distinctive and effective style of teaching. This style is characterized by a logical presentation of material in an order designed to best suit the needs of the student, by a "do it yourself" approach that leads the student to develop many important results in an excellent series of numerical and algebraic exercises, and by the effective use of original pedagogical devices such as the intriguing "toll road" concept. This concept is used not only to introduce the subject, but also throughout the later chapters as a simple and clear pictorial representation of many different kinds of exposure formula problems.

With the exception of Chapter Six, the book places considerable emphasis on the practical solution of practical problems; this should be welcomed by students and practicing actuaries alike.

In Chapter One, the "toll road" idea is introduced in a simplified form. A unit interval is used (*i.e.*, cars are allowed to enter and leave only at booths one mile apart), and various single interval and continuous formulas are developed to measure "exposure" (*i.e.*, car-miles and passenger-miles traversed between various booths). While the chapter does not include any material relating directly to mortality measurement, it provides an excellent numerical introduction to the basic concepts underlying all exposure formulas.

In Chapter Two, the "toll road" idea is amplified to cover entry and exit at intermediate points (fortunately this is accomplished by setting up subsidiary toll booths rather than by allowing wholesale violation of traffic laws). These intermediate transactions are handled through the concept of dispersal to end points; *e.g.*, it is shown that cars entering $\frac{1}{3}$ of the way through a unit interval

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* Books and other publications noted with an asterisk (*) may be borrowed from the library of the Society of Actuaries under the rules stated in the *Year Book*.

can be treated as if $\frac{2}{3}$ of them entered at the beginning of the interval and $\frac{1}{3}$ entered at the end of the interval.

The student is then introduced to the actual determination of the mortality rate and force of mortality for a unit age interval through the analysis (based on "toll road" concepts) of the "ons" and "offs" within that age interval. In keeping with the author's step-by-step teaching style, the mortality analysis is preceded by a simpler analogous derivation of an interest rate and a force of interest.

In this chapter, it is clearly shown that, if there are any transactions at points other than the end points of the unit interval, it is necessary to make some assumption as to the value of $_{1-t}q_{x+t}$, i.e., the mortality rate for the fractional part of the year between age $x + t$ and age $x + 1$, where t is less than 1. As would be expected, the formula developed makes use of the usual assumption that $_{1-t}q_{x+t} = (1 - t)q_x$. It is pointed out that this is a convenient rather than a necessary assumption, and one which is of dubious applicability when q_x approaches 1.

It is also clearly indicated that, while this assumption leads to treatment of deaths as if they occurred at the end of the unit age interval, it does not imply that all deaths are given a full year of exposure in the year of death. As is also typical of the author's teaching style, this important concept is presented in an exercise rather than in the text.

The clear exposition of the reasons for the use of the above-mentioned fundamental assumption and of its implications should certainly remove one of the major obstacles that has plagued many previous generations of actuarial students. The author is to be commended for his excellent treatment of this topic and for his placement of it at the beginning, where it belongs.

The "meat" of the book is to be found in Chapter Three, which deals with the derivation of exposure formulas based on individual records. The topic is handled precisely and with great clarity. A step-by-step method for the derivation of exposure formulas is presented. With the aid of several instructive diagrams and sample worksheets, the method is applied to a number of different types of problems and situations, and it is demonstrated that it is basically simple and easy to apply. Actually, one finishes the chapter with the somewhat astonished feeling, "Is it really this easy?"

The really important insight to be gained from this presentation is that it is not necessary to try to solve an exposure problem by leafing through a large compilation of "standard" formulas in an effort to find one which seems to fit the characteristics of the available data. Rather, the characteristics of the data can be made to yield, through a standard scheme of analysis, a formula which will solve the problem at hand.

The author properly emphasizes the fundamental fact that the exposure formula is built up around the deaths and that the method used to tabulate the deaths defines a dissection of the age continuum into unit intervals. In this connection, he indicates that it is important to tabulate the deaths as accurately as possible, although approximate methods are generally satisfactory in com-

puting exposures. For the other categories (starters, withdrawals, etc.) the "central age" approach is used, and the exposure formulas can be written almost mechanically after considering the relationships between these central ages and the age interval represented by the deaths.

Although the "central age" approach is used almost exclusively, one of the strong points of the chapter is a discussion of various other approximation methods (such as dispersal to end points) and their implications.

It has, of course, been almost traditional that any author entering this field will make up his own notation, and Mr. Gershenson is no exception.

Basically, two types of symbols are used:

$\theta_x]_{x-t}^{x-t+1}$ which indicates that the deaths tabulated at age x are assumed to cover the actual age range from $x - t$ to $x - t + 1$, and

s_x^{x+t} which indicates that the starters tabulated at age x are assumed to be age $x + t$ under the "central age" approach (this type of symbol is also used for new entrants, withdrawals and "enders"—Gershenson's term for the "existing").

This system of notation has the merit of simplicity; it also shows explicitly the items needed for derivation of the exposure formula under Gershenson's approach (the age interval for the deaths and the assumed central ages for the other categories). On the other hand, it does not show the basis of the tabulated ages (exact, last birthday, nearest birthday, etc.), but this information does not necessarily have to be specified in the exposure formula.

On balance, therefore, the new notation can be recommended on the grounds that it is clear, helpful and easy to use. However, in order to provide a complete exposition of the "facts of the case," it is also necessary to provide a specific statement of tabulating rules and assumptions. Perhaps this point should receive more emphasis than the one short paragraph in the present text.

Chapter Four deals with exposure formulas based on valuation schedules. The material is well organized, and the student's job is eased considerably by many excellent diagrams, including "toll road" representations. Considerable emphasis is placed on the analogy between valuation schedule formulas and individual card formulas; this helps to tie in Chapter Four material with the basic approaches previously developed. The chapter includes an analysis of the application of valuation schedule formulas in the area of demography.

The chapter closes with an interesting demonstration of the application of a method of undetermined coefficients to derive census formulas. The method is quite flexible, and well suited for instructional as well as practical purposes since, as the author states, it requires a clear understanding of the basic assumptions.

Chapter Five considers the practical aspects of mortality studies, and is based on study material originally prepared by Messrs. November and Winter, and on Marshall's well-known paper on interpretation of mortality statistics (*TASA* XXXIII). The material is well organized, and a good job has been done in updating it to cover current methods and situations.

Chapter Six is based on material that students are urged to read but that is

fortunately not required for examination purposes. It is titled "Analysis of Various Assumptions" and is a sophisticated mathematical treatment of exposure theory. It is primarily concerned with the implications of assumptions other than $_{1-t}q_{x+t} = (1 - t)q_x$. Other topics include an analysis of the "grouping error"—*i.e.*, the error introduced by assumptions such as the central age assumption—and an examination of the meanings of life table functions when the lives represented by the mortality table are assumed to represent a stationary population. This chapter is tough going indeed, but it will be appreciated by those who are interested in going beyond the conventional problems presented in mortality analysis.

One of the most valuable features of this book is the excellent set of problems and exercises that is really an integral part of the text. Actually, the problems (including 90 additional problems presented in no particular order at the end of the book, and 76 pages of clear answers) take up more than half of the total pages in the book. This is ideal for the student, and it should be remembered that this book was prepared primarily for students.

In the Author's Preface, Mr. Gershenson says, "Despite the grim nature of the subject matter, I had a lot of fun writing this book." While this indicates that the book may be a labor of love, it is a labor which few would have the inclination or ability to undertake, and fewer yet could accomplish in such an outstanding manner.

The Society and many future generations of actuarial students owe Mr. Gershenson a debt of gratitude for an excellent and definitive work that will deservedly become a classic in its field.

WALTER N. MILLER
CHARLES M. STERNHELL

*J. E. McNulty, Jr., *Decision and Influence Processes in Private Pension Plans*, pp. xiv, 128, Richard D. Irwin, Inc., Homewood, Illinois, 1961.

This is the third book to appear as a result of the recent series of studies on benefit expectations under private pension plans undertaken by the Pension Research Council of the Wharton School of Finance and Commerce, University of Pennsylvania, with Professor Dan McGill as Project Director.[1] Like its predecessors, the basic study was under the chairmanship of a university professor, in this case Professor McNulty of the Wharton School, who was assisted by a task force composed of members with industry, union, pension agency or related affiliations.

The approach followed in the study is an attempt to bring together and analyze the administrative and operational phases of pension activity, as distinguished from actuarial and legal aspects, from the standpoint of their effects on pension security. The principal method used by the author is stated as being

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[1] The first volume, *Legal Protection of Private Pension Expectations*, by Professor E. W. Patterson, was reviewed in *TSA* XIII, 45, and the second, *Legal Status of Employee Benefit Rights under Private Pension Plans*, by Professor B. Aaron, in *TSA* XIII, 652.

a series of forty-eight depth interviews conducted solely by him in firms with pension plans, funding institutions and service agencies, during the course of which information was obtained indirectly about other pension plans and agencies. Understandably, but nevertheless unfortunately, the reader is given only sketchy details as to the numbers and characteristics of the firms whose pension plans were studied, and the insurance companies, banks and other funding agencies, as well as the consultants, actuaries and independent administrators interviewed. In view of the nature and scope of the research objective, however, this is probably not too important.

The first area of decision influences discussed involves the role of top management in the employer's pension plans, where the author devotes principal attention to single-employer plans. As to the decisions bearing on the initiation of pension plans, he finds great interest on the part of employers and with it a potentially serious criticism from the standpoint of pension security, in that on occasion consultants are not put in a position to take fullest advantage of relevant information available within the company. In general, however, he finds a high sense of responsibility on the part of top management. This interest tends to diminish in scope with the passage of time, and later influences on pension security tend to originate in pension boards or administrators in middle management. The author found no abuses of authority at these levels.

Turning to the operational problems, he discusses various current practices on such matters as keeping of records, audit controls, and benefit administration, and the part played by unions in these processes. For the most part, he found little to criticize in the attitudes of employers towards implementing pension promises, although he notes the need for better control of record-keeping procedures in some areas. Perhaps the continuing trend to more mechanization of data processing will alleviate this problem in the future.

An entire chapter is devoted to consideration of what the author terms "financial integration," which he explains as the attitude and practices developed from the employer's consideration of the financial aspects of the pension plan in conjunction with his broader enterprise financial planning. Included here are topics familiar to actuaries, such as the choice of funding agency, amount of annual contributions to the plan, revision of actuarial procedures in valuations, and tax considerations. The treatment of the problems is concise and well balanced in an area where many pitfalls can be tempting to an author. It will make interesting and worth-while reading to students of pension administration.

Professor McNulty finds some strengths and also some weaknesses in the structuring and operation of multi-employer plans as they affect pension security. He discusses the influences exerted by unions, pension trustees and outside consultants and the interplay of their diversities of viewpoint in relationship to what he finds as a diminution of interest in ultimate pension security on the part of some employers as a result of the collective bargaining process.

The material included on funding agencies contains a good summary of the operations of banks, insurance companies, investment counselors and mutual

funds as they affect pension funding, together with a timely and well written treatment of the impacts of competition among them. Although he finds some disadvantageous developments on pension security as a result of the competitive pressures generated, he believes that the net effect of new funding choices has brought about more suitable pension arrangements than heretofore available.

The chapter on consultants, actuaries and independent administrators traces the principal stages in development of the nature and extent of pension services performed by these agencies. Some material is also included on the effects of competition among them. A similar chapter follows on the functions fulfilled by accountants and attorneys in the pension field.

The final chapter summarizes the author's findings and recommendations. He finds three problem areas, which might be termed as (1) administrative "gaps" in implementation, (2) conflicts of interest, and (3) "financial integration" (discussed above). His solution for the first two includes more auditing, interchange of information, frankness in presenting the facts of pension implementation, and perhaps more self-restraint on the part of agencies working in the pension field. The third area appears more difficult, not only because there are pros and cons in the development of financial integration, but because of pragmatic considerations. The book closes with some rather general observations on the desirability of establishing rules with regard to minimum funding, considerations which the author states as being "in a sense ex cathedra from the standpoint of the main direction of the research of this report," but which he believes follow the results of the research. The general conclusion reached by the author is that the solution of the problem areas in the decision and influence processes of American private pension plans "does not seem to call for anything approaching a radical revision of our arrangements and we have assumed this."

Professor McNulty is to be commended for his thoughtful and informative book on a phase of the pension field not previously emphasized in the literature.

ROBERT M. DUNCAN

*M. Lukaczer, *Economic Assumptions Underlying the Medium-Range Projections of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds, 1966–1975*, pp. vi, 40, Division of Program Research, Social Security Administration, Washington, 1961.

For the first time in the history of the Social Security System, tax rates are now approaching the minimal levels sufficient to maintain long-range actuarial balance as indicated by the Chief Actuary's long-range estimates extending over some 90 years into the future. The Advisory Council on Social Security Financing[2] consequently felt that ". . . decisions about the imposition of further rate increases, if needed, should be guided largely by estimates covering a period of 15 or 20 years." It also felt that such "medium-range" estimates should give heed, as the long-range estimates do, to demographic factors, but that, to a

[2] Reviewed in *TSA* XI, 286.

much greater extent than with the long-range estimates, the operative *economic* factors will also be significant.

Mr. Lukaczer considers five main economic assumptions:

1. Proportionately fewer men will be "covered" by 1975 in the two age brackets 15–24 and 65-and-over and fewer women within ages 15–19, but proportionately more women will be "covered" within ages 20–69, with the other sex and age categories assumed to have stable covered proportions.
2. Annual earnings per worker will increase 3% per year, compounded.
3. Either (i) the present maximum earnings base will remain unchanged *or* (ii) benefits and the maximum earnings base will increase in line with earnings.
4. Prices will be constant.
5. Relatively minor recessions will occur, but there will not be a major depression before 1975.

Mr. Lukaczer has tapped the experience and advice of others, and diligently sought out sound and appropriate sources for his economic building blocks. His objectives, work, and results are presented interestingly with a direct, concise, and clear style.

However, actuaries may wonder whether perhaps Mr. Lukaczer has not been a trifle premature in one or two of the "lessons" he has attempted to derive from these projections. For example, he asserts:

... The relation of income to disbursements (Table 2) in the medium-range years may have a bearing on whether the scheduled rate increases are needed, insofar as the *safety* and *stability* of the old-age and survivors insurance trust fund in those years is concerned.

On the basis of no change in the existing law, the projections show the income of the trust fund in 1965 as almost 109 percent of disbursements in the same year. As a result of the scheduled contribution rate increases in 1966 and 1969, the ratio of income to disbursements would be about 138 percent in 1970 and 141 percent in 1975. The excess of income over outgo would be considerably less during this period if the law should be amended to keep pace with changes in earnings levels. (Emphasis added.)

Actuaries might also wish to see some measure of the *adequacy* of the trust fund in relation to the projected *liabilities* of the System before even contemplating reductions in scheduled taxes. In any case, Table 2 shows that, in 1975, in terms of *dollars*, with the present law, OASI income will exceed disbursements by $8,327 million, whereas with the law "continuously changed to keep pace with earnings" income will exceed disbursements by $6,126 million—a net difference of $2,201 million in the dollar addition to the trust funds for the one year. The corresponding net difference in the trust fund totals as at the end of 1975 is projected to be $6,192 million, the assumption of "no change in the present law" giving rise to the larger fund. Perhaps these net dollar differences would appear less decisive if presented alongside the aggregate benefit liabilities.

Actuaries might also wish to know what would happen if the assumptions were varied. Would the impact on the final results be great or small?

As Mrs. Ida C. Merriam, Director of the Division of Program Research of the Social Security Administration, says in the Foreword, "These first economic

projections are highly preliminary." It is therefore pleasing that she adds "Further work is now under way to refine and extend the concepts and methodology." Mr. Lukaczer deserves an important share in such work.

JAMES L. CLARE

Railroad Retirement Board, *Eighth Actuarial Valuation of the Assets and Liabilities under the Railroad Retirement Act as of December 31, 1959*, pp. xiii, 118, Chicago, January 1962.

The Eighth Actuarial Valuation of the Railroad Retirement system contains statements of the Railroad Retirement Board and the Actuarial Advisory Committee. An extensive technical supplement is available in mimeographed form. This supplement contains a wealth of actuarial and statistical data pertaining to the Railroad Retirement system. A special feature is the inclusion of all tables and actuarial factors that were used in the valuation.

Although the valuation is made as of the end of 1959, it relates to the law in effect at the end of 1960. Supplementary calculations have been made to reflect the effects of the Social Security Amendments of 1961, principally the 10% increase in the widow's benefit and the $\frac{1}{4}$% increase in the combined employer-employee tax rate. The long-range effect of considering these amendments is an estimated reduction in the actuarial deficiency of the Railroad Retirement system by 0.02% of taxable payroll.

As of the end of 1959, the actuarial deficiency of the Railroad Retirement system is estimated at 1.69% of payroll, contrasted with 4.18% as of the end of 1958 and 3.25% as of the end of 1956. The reduction resulted largely from the provisions of the 1959 Amendments, which increased both the tax rates and the maximum wage base in an attempt to finance liberalizations enacted in 1956, 1958, and 1959. These amendments were estimated to reduce the actuarial deficiency to 0.61% of payroll; the subsequent rise to as much as 1.69% is attributed to the substantial decrease in railroad employment that has occurred recently.

It is of interest to note that the normal cost of Railroad Retirement benefits for new entrants is estimated at 8.92% of payroll, as compared with an ultimate employee tax rate of $9\frac{1}{3}$% in 1968 and after. However, the 8.92% figure does not include the value of any OASDI benefits resulting from railroad compensation (the wage record of employees with less than 10 years of railroad service is transferred to the OASDI system for benefit purposes). Taking this factor into account, it is likely that the normal cost of both Railroad Retirement and OASDI benefits based on railroad earnings is at least as large as the ultimate employee tax rate.

The Railroad Retirement Board expresses concern about the actuarial deficiency growing out of the decline in railroad employment, and suggests that it be reduced through an increase in the interest rate on investments (now set at 3% for special issues, which constitute the bulk of the investments), appropriations being made for payments due with respect to military service, and particularly an increase in payroll taxes through increasing either the tax rate or taxable compensation, or both.

ROBERT J. MYERS

SELECT CURRENT BIBLIOGRAPHY

In compiling this list, the Committee on Review has digested only those papers which appear to be of direct interest to members of the Society of Actuaries; in doing so, the Committee offers no opinion on the views which the various articles express. The digested articles will be listed under the following subject matter classifications: 1—Actuarial and other mathematics, statistics, graduation; 2—Life insurance and annuities; 3—Health insurance; 4—Social security; 5—Other topics.

References to allied subjects will be found in the following publications: *Mathematical Reviews*, published by the American Mathematical Society—Subjects: Probability, statistics, econometrics, various other mathematical topics; *Monthly Labor Review*, published by Bureau of Labor Statistics—Subjects: Cost and standards of living, employment and employment services, fringe benefits, handicapped, industrial hygiene, industrial relations, labor organization and activities, manpower, older workers and the aged, personnel management, social security (general); *Population Index*, published by Office of Population Research, Princeton University, and Population Association of America —Subjects: Mortality, fertility, marriage, divorce, the family, various other demographic topics; *Social Security Bulletin*, published by Social Security Administration— Subjects: Retirement and old age, employment, maternal and child welfare, health and medical care, various other topics in social security; *Journal of the Institute of Actuaries*—The review section contains digests in English of articles appearing in foreign actuarial journals.

LIFE INSURANCE

J. B. Maclean, *Life Insurance*, 9th edition, pp. vii, 617, McGraw-Hill Book Company, New York, 1962.

The 9th edition represents an updated and reorganized version of the standard life insurance book. In addition to including discussions of new practices such as variation of premium rates by size of policy or by sex, guaranteed insurability and variable annuities, the author also discusses the new Federal income tax law and its effect on life insurance companies. Accident and sickness insurance is included in this edition.

The new edition is organized into six sections: Ordinary Insurance; Group and Industrial Insurance; Accident and Sickness Insurance; Insurers Other than Life Insurance Companies; Legal Aspects; and Historical Review. As in earlier editions, the author explains the theory and practice of life insurance and of accident and sickness insurance in clear, nontechnical language.

U.S. National Health Survey, *Evaluation of a Single-Visit Cardiovascular Examination*, pp. 39, Public Health Service, Washington, December 1961.

The objectives were:

"1. To develop an examination procedure which would be carried out on a single visit and which would yield cardiovascular diagnoses in accord with the definitions of the New York Heart Association with certain modifications.

"2. To compare the cardiovascular diagnoses obtained by this examination with those obtained on the same individuals by clinical practice. In the subsequent discussion these two examinations will be referred to as the 'Special' and the 'Clinical' Examination, respectively.

"3. To compare the cardiovascular diagnoses obtained by two independent Special Examinations of the same individuals."

The Special Examination "was found to yield cardiovascular diagnoses comparable to those obtained by a complete medical workup in good clinical practice (the Clinical Examination).

"There was, however, a clear difference in the criteria and standards of the two examinations, as evidenced by a higher level of findings on the medical history and physical examination as administered by the Special Examination and a lower level of electrocardiographic abnormalities than on the Clinical Examination.

"The chief diagnostic discrepancy was in the diagnosis of coronary heart disease. While the Special Examination found more cases of angina pectoris than the Clinical, this was distinctly overbalanced by a greater number of electrocardiographic abnormalities considered to indicate coronary heart disease on the Clinical Examination."

"Replication of 80 Special Examinations demonstrated that the procedure was reliable."

HEALTH INSURANCE

E. B. Tilton and D. E. Yochem, *Guide to Health Insurance Underwriting*, pp. 269, Research & Review Service of America, Indianapolis, 1961.

This is an underwriting guide for individual accident and sickness, especially for the handling of impaired risks. The foreword cautions, "The underwriting opinions which appear are entirely those of the authors and have been developed from personal experience," so that the ratings and riders which appear represent one useful course of action for which there may, in many instances, be equally satisfactory and effective alternatives. The introduction contains not only a general discussion of the underwriting of Special Class risks, but also comments on the use of waivers, extra premiums, coverage limitations, elimination periods, the relationship of ratings to issue limits, nonmedical limits and underwriting reconsiderations. The primary alphabetic section deals with a large and comprehensive group of medical impairments. Many of the listings include medical definitions and comments on particular underwriting problems. The book is extensively indexed.

U.S. National Health Survey, *Duration of Limitation of Activity Due to Chronic Conditions, United States, July 1959–June 1960*, pp. 36, Public Health Service, Washington, January 1962.

According to the definition of chronic conditions used in the National Health Survey, such conditions were reported by 49.3 percent of males and 48.8 percent of females at ages 17 and over who were usually working. However, only 6.1 percent of the usually working persons reported that the chronic conditions either limited the amount or kind of their work or kept them from carrying it on. This proportion rose from 3.8 percent at ages 17–44 years to 8.3 percent at ages 45–64, and further to 18.4 percent at ages 65 and over. Of those among the usually working persons with a major limitation, 21 percent reported that they had had this limitation for less than one year, 30 percent for 1–4 years, 45 percent for 5 years and over, and the rest for unknown durations.