The Actuary

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THE PROBLEM OF THE INSTALLMENT LOAN

by David M. Good

The example presented by Robert Myers in the February issue of *The Actuary* illustrated the fact that actuaries from time to time tackle some of the nastier problems of compound interest. As Mr. Myers shows, satisfying the desire for a quite accurate result sometimes involves rather sophisticated and lengthy computations. This note presents a general solution to a similar problem of finding the effective annual interest rate commonly arising in finance. Since the solution is fairly easy to apply and gives a surprising degree of accuracy, it may be of use in upholding our reputation as experts in this field.

The Problem

The terms of a commercial loan are usually stated as an initial charge, with the loan to be repaid in installments; for example, a charge of $6 per $100 in advance, the loan to be repaid in twelve monthly installments. The effective annual interest rate is of course neither 6% nor 6.383% (from 6/94), since on the average only about half the loan is outstanding. The usual procedure of multiplying by $2n/(n+1)$ gives only a crude approximation.

The Solution

The following is an improved approximation for the interest rate on a loan to be repaid in twelve monthly installments. Let z equal the ratio of the initial charge to the amount initially received (the 6/94 of the above example). Then the better result, in form for computing,

$$i = (1.8439 + 1.09139z)z$$

This formula is to be used in the range of i from about 3% to about 24%,

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SINGLE PREMIUM DECREASING TERM USING CONTINUOUS FUNCTIONS

by William H. Lewis

It is likely that most of the decreasing term insurance policies which are designed to cover a typical mortgage loan are on an annual premium or a monthly premium basis, so that the premium payments may be geared to the level mortgage loan payments and the combination considered a package type of payment by the mortgagor-policyholder.

In some instances, however, it may be desirable to use a single premium decreasing term policy for this type business. This type policy may have particular appeal to a bank or savings and loan institution which holds the mortgage and pays the single premium to the life insurance company while lending the same to the borrower. The amount of the single premium is added to the regular mortgage loan and is amortized by level monthly payments along with the regular mortgage loan payments.

Method Limited

This method of providing life insurance benefits does not work too well in a situation where the borrower is anxious to make a minimum down payment and hence obtain the maximum amount of mortgage, but may well fit a situation where the collateral is substantial as compared with the amount of mortgage loan. In such a case the fact that the amount of mortgage loan the borrower has in mind needs to be increased by a relatively small amount to accommodate the borrowed single premium is of no great concern to him.

If it is assumed that mortgage payments are made on a continuous basis, using the force of interest which corresponds with the monthly effective mort-

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A VIEW OF PLANNING — SORCERY TO COMPUTERS

by James C. Hickman

John Maynard Keynes said that he was only interested in the short term, for in the long term we are all dead. Despite Keynes' concentration on the short term, the future and the possibility of its control have always fascinated man. The Romans diligently studied the pattern of the intestines of sacrificed animals in an attempt to lift the veil from the future. The scriptures leave no doubt but that the three kings learned of the impending birth of Jesus by a study of the stars. Alexander thought it prudent, before embarking on his memorable trip of conquest, to inquire about the probability of success from the oracle of Delphi.

Because of the successes of Alexander, the legions of Rome, and of the search of the three kings, it is not immediately apparent that scientific and rational attempts at perceiving and modifying the future are superior to sorcery. Let us acknowledge that the superiority of planning over luck is a matter of faith and not a verified fact.

Difficult to Verify

Few industries, except perhaps life insurance, have had much experience with other than short term plans. Consequently, it is difficult to empirically verify that long term planning is superior to a more myopic view (plus a mystical faith in Adam Smith's "invisible hand") in making sure that economic enterprises are guided to success. In fact such verification may be impossible. In the course of human affairs the social, political, and sometimes even the physical and moral environments in which plans are realized change so frequently that it is

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EDITORIAL

RECENT and current columns have shown that our readers have an unusual interest in "The Actuary in Fiction (or Literature)." Perhaps there are more literary references to the profession than might be expected from our relatively small size. And perhaps there are more references in books that entertain than in periodicals that inform.

In the last-mentioned group, the *Fortune* (December 1965/January 1966) article comes to mind as being the only major example; we have no means of measuring its effect upon *Fortune's* readers. An article in a local rather than a national publication has been brought to our notice and we bring it to our readers' attention in the hope that it will suggest new avenues of publicity.

The May issue of *Dallas*, the monthly magazine of the Dallas Chamber of Commerce, has an article entitled "Actuarially Speaking." The author is Bill Razo, the editor of the *Life Insurance Journal.* His report on actuarial activities covers all the fields that we can think of and does it well. The business community of Dallas will now have a greater knowledge of and perhaps a greater respect for the individual Mr. Razo describes as "an almost unknown, usually misunderstood professional."

The style of the article is excellent and we wish we had space to quote more than one example. The opening paragraph reads: "When a Central American head of state wanted a revolution proof social security system, naturally he retained an actuary. Who else?" This item, based on actual experience, is an obvious incentive to continue reading.

Interlarded are some of the more snide definitions of an actuary such as, "Give an actuary an inch and he'll measure it" and, "An insurance agent once defined an actuary as one who speaks English but thinks in Chinese."

In the Presidential election year there are frequent references to Grass Roots. We close with the suggestion that the individual members of the Society and the Actuarial Clubs might seek more publicity at the Grass Roots level.

—A.C.W.

LETTERS

Psychology and the Actuary

Sir:

Among 100 multiple-choice questions composing a second-year psychology examination given in April at this university (the University of Toronto), number 31 was "Gordon W. Allport has argued that:

"a. Meehl has demonstrated the superiority of the actuarial or cookbook method in diagnosis and prediction to the extent that we should leave this field to statisticians and concentrate on psychotherapy.

"b. We can, in principle, only be scientific about what is general, and not what is individual or unique.

"c. We have made good headway in understanding general laws, but have neglected the study of the unique individual.

"e. Only the general laws lead to comprehension of the individual."

In conversation with the examiner, I learned that the term "actuarial" is now popularly used by U.S.A. psychologists in describing a completely mechanistic method of prediction, with no elements of intuition or judgment involved. I assured him that this was a distortion of the way actuaries really operate.

There may be other actuaries who will be as surprised as I was to see ourselves being so blithely misrepresented by a supposedly well-informed profession.

Donald C. Baillie

* * * *

More Actuaries in Fiction

Sir:

Further to the correspondence following Edward Lew's research into "The Actuary in Fiction", I feel sure that many of your readers will be relieved to hear that actuaries do feature in at least one work of science fiction (and naturally, as one would expect, the very highest quality of science fiction at that!).

In John Wyndham's book "Trouble with Lichen", two scientists discover an antidote to old age, or "antigerone", which raises the expectation of life to between 200 and 300 years. Owing to the great scarcity of the lichen from which it is derived (only enough to preserve a few thousand people) they do

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Letters

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not make their discovery public.

However, in the course of the action described in the book, news of the discovery eventually leaks out, and very soon after the first rumours start to fly, the Threadneedle and Western Assurance Company declares a moratorium on the payment of annuities and guaranteed incomes until further notice. They describe the step as "a purely temporary measure undertaken with regret pending legal opinion upon the obligations of the company in cases where means have been employed to extend the normal expectation of life."

It seems that the actuaries of the Threadneedle and Western Assurance Company decided to take this unusual step when they discovered that the wife of the Chairman of the Board of the company had been taking the antigerone for a number of years, and that the process of aging certainly appeared to have slowed down in her case.

The reaction of a prominent lawyer to this whole affair was that "neither God, nor the law, was aware of any obligation to justify an actuary's figures for him." And while the term "his natural life" might raise some speculation regarding the nature of "unnatural life", life continued, for the reasonable man, to mean that life had not been terminated by death.

All of which raises sobering thoughts for us young actuaries who are busy working out rates for annuities and pension plans! However, it is at least comforting to know that here is one author who does seem to have some understanding of actuaries and their problems.

B. L. Burnell

* * * *

Sir:

I wondered if you were aware that the expression "actuary" occurs in Gibbons' *Decline and Fall of the Roman Empire?* Rather than have you read the entire Gibbons work in order to find it, I will tip you off that it occurs in a footnote in Chapter XI where it is reported that one Victarinus died at the hands of jealous husbands. The footnote states that, among other things, "He ravished the wife of Attitianus an actuary or army agent."

Robert G. Espie

Single Premium

(Continued from page 1)

gage interest rate, it is possible with the aid of calculus to arrive at a fairly compact formula for net single premiums and cash values. Cash values are simply dependent on attained age and remaining term for each $1,000 initial amount of indebtedness. The formula for the net single premium is as follows:

$$\frac{1{,}000}{1-u^{12n}}\cdot\bar{A}^{1}_{x:\overline{n}|} - \frac{1{,}000u^{12n}}{1-u^{12n}}\cdot\bar{A}'^{1}_{x:\overline{n}|}$$

Where the first $\bar{A}$ is based on 58 CSO at the valuation interest rate, the second $\bar{A}'$ is based on 58 CSO at a special interest rate which is a function of the valuation interest rate and the monthly mortgage interest rate,

x = the issue age
n = the original term of the mortgage in years
j = the nominal annual interest rate of the mortgage and

$$u = \frac{1}{1+\frac{j}{12}}$$

Gross single premiums may be obtained by an appropriate loading formula applied to the net single premium.

A Comparison

It is interesting to compare net single premiums covering a mortgage based on continuous functions with net single premiums using various modifications of curtate functions. The various modifications used by the author are as follows:

(A) Payment of the death benefit at the end of the policy year of death for the amount of mortgage at the end of the policy year. This method is not desirable, particularly because the amount of cash value at the beginning of the final policy year is zero.

(B) Payment of the death benefit at the end of the policy year of death for the amount of mortgage at the end of the policy month of death. This method assumes a uniform distribution of deaths and is analogous to the method applied in Jordan's *Life Contingencies* to single premium cash refund annuities (see page 144).

(C) Payment of the death benefit at the end of the policy month of death for the amount of mortgage at the end of the policy month of death. This method appears to be more realistic than the one in (B) above, but the author does not recall having seen it used in practice.

(D) Immediate payment of the death benefit for the amount of mortgage at the beginning of the policy month of death increased by one-half month's interest at the mortgage interest rate. The method used here involves multiplying the mortgage amount at the month-end prior to death by

$$\left(1+\frac{j}{24}\right)$$

and discounting the payment by

$$v^{\frac{2m-1}{24}}$$

where m is the policy month of death.

The numerical results for 5 and 20-year term mortgages at issue ages 20 and 50 with a nominal annual mortgage interest rate of 6.6% and 58 CSO at 3% interest are as follows. The values denoted by K were obtained by using the method of continuous functions covered in this paper.

NET SINGLE PREMIUMS

	Age 20		Age 50	
Method	5-Yr.	20-Yr.	5-Yr.	20-Yr.
A	3.66	18.60	18.19	130.51
B	4.44	19.33	22.37	136.83
C	4.51	19.60	22.70	138.73
K	4.59	19.69	23.11	139.48
D	4.67	19.81	23.56	140.44

The author has a limited supply of complete copies of this paper and will be happy to furnish a copy to those interested while the supply lasts. □

Sir:

Further on the subject of the actuary in literature, there was a short story by Kipling entitled *The Janeites*, laid in World War I, in which the narrator casually mentions that one of the characters had been an actuary in civil life. This fact had no bearing on the plot of the story.

I also remember a movie (the name of which I have forgotten — it might have been *Double Indemnity*) in which a claim investigator posed as an actuary, exhibiting his credentials by quoting expectancies at the drop of every hat.

James E. Hoskins

A View of Planning—from Sorcery to Computers

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often manifest why the objectives of an initial plan are not attained.

However, I have faith, which is in part based on the success of rational activity in the natural sciences, that organized intellectual thought will, in the long run, prevail over blind chance. Therefore, we will proceed on the assumption that, because businesses do not live for the moment but rather are continuing enterprises, an examination of the possible consequences of current business decisions is preferable to blindly avoiding such an examination.

What do we mean by planning? In some conservative circles the very term is charged with emotion. It conjures up the grisly bureaucratic spectre of the Soviet Five Year Plans. We will define planning as the operation of tracing the possible consequences of current decisions on the future course of an enterprise with a view toward modifying the decisions so as to achieve a preferred course. Planning is a tool of individuals, businesses, and of governments.

Next we need to differentiate between planning and forecasting. Forecasting is a static operation. It is the process of predicting future events. Planning on the other hand is dynamic; it is concerned with modifying decisions to achieve future goals. Forecasts may be part of the input to a planning operation, but a good plan recognizes the essential uncertainty in forecasts and provides for the modification of actions as experience unfolds and trends are revealed. (1)

Planning in Modern Business

John Kenneth Galbraith (2) in his popular book, *The New Industrial State*, claims that long term planning is the inevitable result of modern technology. The complexity of modern business means that projects cannot be completed in a short time. Consequently, long term commitments of both men and capital, neither readily available, are required. The rigidity of these commitments implies that a searching analysis be made before making the commitments and that, during the course of the development of the project, modifications be made in the objectives as new information becomes available.

It may seem to many businessmen that Mr. Galbraith has used a mop for a brush in painting a picture of business in the last third of this century and that the resulting portrait is imprecise. Nevertheless, even a casual observer of the passing business parade must grant that advanced technology has forced a much wider horizon on business planning.

Within the life insurance industry examples abound. The installation of EDP equipment was a long term project that required the investment of substantial sums of capital and men. The success of the project varied directly with the imagination and vision with which the plans were conceived. The development of equity based insurance and annuity contracts provide another example of a project which will force life insurance companies to invest massive amounts of talent and capital and which will compel planning.

A Paradox

It seems paradoxical that at the very time that technology is forcing long term planning, the prerequisite conditions for successful planning seem to be disappearing. For example, many planning projects of interest to actuaries involve the orderly accumulation of assets and their disbursement to meet some defined individual needs. When such a plan is defined in terms of monetary units and when we observe the time trend toward depreciating the value of such units, it may seem that long term financial planning is worthless. In our planning, perhaps for lack of acceptable alternatives, we usually assume the existence of a stable government, the absence of social disorder, and success in avoiding nuclear war. It is positively probable that one, two, or all of these assumptions might be wrong, in which event planning is an academic exercise.

My first answer to these potentially fatal criticisms of planning is that it seems better to study the possible consequences of current decisions based on shaky assumptions than not to consider these consequences at all. Secondly, I ask the critics when that golden era existed in which plans materialized with mechanical certainty?

I do not consider myself an old man, yet I have lived through a great depression, a world war, a three-year international police action, an extended cold war, a population explosion, creeping inflation and a major conflict in southeast Asia. I do not yet detect the dawn of an age of stability.

Actuary's Responsibility

We must recognize that change is a fact of human life and that an actuary's professional responsibility to the institutions that he guides is to be continually alert to trends that may prevent the attainment of the institution's goals, and to recommend appropriate modifications of existing plans. Indeed, it is this managerial responsibility, this required alertness, that makes actuarial science a profession rather than simply a part of applied mathematics.

If we assume the necessity for long range planning, the next question concerns the techniques of planning. Besides the classical tools of economics, statistics, and mathematics, sharpened by common sense, what tools does the new technology provide for accomplishing planning?

(1) It offers computers. Computation and data handling is now 1,000,000 times faster and 10,000 times cheaper than it was a generation ago. In so far as we can visualize in some mathematical model the essentials of a business process, the computer can now flash out the consequences of potential decisions for any conceivable blend of parameters.

(2) It offers subjective probability and Bayesian statistics. Now it is intellectually respectable to quantify opinion and past experience concerning a business event in the form of a distribution of probability. Guides to enforcing consistency in these probability assign-

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1. Collins, Russell M., and Hill, J. S. "Simulation Models for Life Insurance", to appear in the *Transactions*, 18th International Congress of Actuaries.
2. Galbraith, John Kenneth. *The New Industrial State*, Houghton Mifflin.
3. Hogan, John. "Long Range Planning", *TSA* Vol.18 (1966), pp.D305-D327.
4. Sanders, Douglas O. "Some Methods of Simulating the Random Components of Life Insurance Company Financial Results", to appear in the *Journal of Risk and Insurance*.

A View of Planning

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ents have been developed. Once these assignments are fixed, the vast machinery of statistics is available to help trace the possible consequences of alternative decisions and to place indices of reliance on estimated consequences.

(3) It offers more statistical data. A function of the federal government is to collect and summarize statistics which are useful in planning. For example, the Office of Business Economics of the Commerce Department estimates the components of national income; demographic facts come from the Census Bureau; price and employment indices are produced by the Bureau of Labor Statistics; and health information flows from the National Center for Health Statistics and other agencies of the Public Health Service. If this information is used to produce more rational and efficient plans, it would seem that such statistical work is a very productive investment of public funds.

Insurance Planning

American actuarial literature already contains a delightful essay on planning. I recommend to your re-reading John Hogan's provocative paper. (3)

Actuaries were the first long range business planners and, at least until the present, have probably been the most successful. When most businesses were formulating quarterly plans, actuaries were setting prices for decades in advance. Asset share computations have for generations been an actuarial tool for checking the long term consistency of price and benefit structure decisions. Model office computations of great complexity have been used in setting agency development goals. Gross premium valuations have been a tool in setting surplus and reserve objectives.

Actuaries have traditionally been interested in expected values. Model office, pension fund projections, and asset shares have usually been presented as a single number or set of numbers with no indication of the probable range of variation of these results. This was almost the only possible way to report actuarial results before the advent of cheap computation, and it seemed to some actuaries that to present anything other than a single answer to an actuarial question was unprofessional hedging.

Yet the results of the operations of the financial systems that actuaries guide are not known with certainty, and greater predictive reliance can be placed in certain expected results than on others. Even a crude measure of this reliance can be helpful to a decision maker. Today, by simulation techniques, it is entirely possible to report an approximate distribution for prospective financial results. These distributions will be based on probable lifetimes and other cost variables, all part of the basic assumptions. (4)

Modern technology does more than provide simply another dimension to visualize in considering traditional actuarial problems. It is now possible, and probably it is imperative, to expand the application of actuarial techniques to other aspects of insurance operations. But a few guide posts should be kept in mind.

Guideposts

- Much of the work in planning involves reducing to an operational formula vaguely stated corporate goals. In a word, performance indices are required. In life insurance management, questions such as the following arise: How do you measure the performance of an agent or an agency? How do you measure the comparative performance of an equity fund?

- Do not attempt a total company plan as your first effort. Experience is a great teacher in planning as in most endeavors. By working on local problems before tackling global problems, one can gain such needed experience. Concentrate on an area which has not already been intensively studied in order to achieve the satisfaction of some success in your early efforts.

- Plans are not static but are dynamic guides for action. Robert Burns wrote that, "The best-laid schemes of mice and men gang aft a-gley". The modern business planner should try to improve on the success ratio predicted by the romantic Scot by continually reviewing his plans as the corporate environment and goals shift. Planning is a dynamic operation for achieving defined corporate goals, and it is not a sterile machine for squeezing the human juice from business management. □

Installment Loan

(*Continued from page 1*)

within which its error is no greater than 0.00004 (4/1000 of 1%). It is *not* to be used outside of this range under any circumstances, since the error increases markedly on *either* side. The formula overstates the rate in the center of the range and understates it at each end.

This formula was developed specifically for the range $i^{(12)} = 3\%$ to $i^{(12)} = 24\%$, approximately the range cited above. I chose to express i in terms of this quantity z since the coefficients in the corresponding Taylor series were smaller than in other related expansions. The Taylor series itself was not used, since its error is far greater at the right end of this range than at the left end, and furthermore is of the same sign throughout. Both of these facts indicate that the Taylor series is wasteful of effort. The formula given here is one of "greatest economy" or "minimax" type.

The formula was obtained by fitting a straight line to the function i/z in such a way that the errors were positive at each end of the range and negative in the middle. The straight line was determined by requiring that the errors in i at $i^{(12)} = 3\%$, $i^{(12)} = 18\%$, and $i^{(12)} = 24\%$ be equal in size and alternating in sign. There are several ways of performing the mechanics; a good discussion is given by Cecil Hastings in *Approximations for Digital Computers*, (Princeton University Press).

Consider the example given above. The usual rule gives i as (24/13) (6/94) = 11.78%. The formula of this note gives i as 12.21%, correct to the digits shown (with a possible ± 1 in the last digit due to rounding), a difference of almost one-half a percentage point.

Corresponding formulas for 24 and 36-month loans and the range of 24% to 48% have also been developed.

Since the subject of consumer loan charges is discussed frequently in the press and even is a minor political issue, perhaps such formulas will provide more accurate illustrations of the true effective annual interest rate. And until a universal Truth-In-Lending bill is passed,* they may assist actuaries in calculating the cost of automobile loans. □

*S. 5, *Consumer Credit Protection Act, was signed by the President, May* 29, 1968.

BOOK REVIEW

National Center for Health Statistics, *Synthetic State Estimates of Disability Derived from the National Health Survey*, PHS Publication No. 1759, Washington, D.C., 1968.

by James Hamilton
(Student of the Society)

This paper arises in response to the increasing demand for health statistics on the state level. Currently, the National Center for Health Statistics conducts a continuous poll of the non-institutional, civilian population of the U. S. to produce such statistics for large metropolitan and regional areas and for the entire nation.

The Center has expended a great deal of effort in search of methods for deriving credible state estimates from already accumulated national and regional results. The model suggested by the Center in the paper represents a tentative solution — tentative in that it is subject to ". . . further refinement and validation."

Random Variables

Although it would appear to be the authors' intent to apply their model to other health related subjects, they have for various reasons selected long and short term disability for an initial test of the applicability of their model. The random variables "restricted-activity days per person per year", "bed-disability days per person per year", and "work-loss days per currently employed person per year", were selected as measures for short-term disability and "percent with one or more chronic conditions" and "percent with an activity limitation due to chronic conditions" as measures for long term disability.

For each of these random variables the proposed model purports to obtain an estimate of the expected value for individual states, using an estimating equation which is a natural consequence of the authors' fundamental premise: "It is reasonable to assume that the likelihood of a person being disabled varies with a number of factors: age, sex, race, marital status, occupation, industry, urban-rural residence, income, family size, geographic location, and n.e.c. (not elsewhere classified), the latter being a convenient label for 'all other factors, including chance' ".

Let us assume that it is desired to estimate the expected value $\bar{X}s$ of the random variable X for a specified state s. Furthermore, we will assume that the following data are available:

(1) A subdivision of the national population into the subsets dictated by the authors' premise, that is, groups of people of like race, sex, income, age, and so forth. Restricted by the availability of required data, the number of subsets used in practice will be significantly less than the number produced by considering all possible combinations.

(2) P_n the proportion of the population in state s in the nth subset, the subsets determined in (1) having been numbered arbitrarily.

(3) X_n is the expected value of the random variable X for the people from the entire nation who fall into the nth subset.

(4) N, the number of subsets.

On the basis of these known quantities, we can calculate an estimate of $\bar{X}s$ using the equation

$$\bar{X}_s = \sum_{t=1}^{N} P_t \bar{X}_t$$

Based on data collected by the Center in fiscal years 1963 and 1964, the authors divided the national population into 78 subsets. The values of P_n for these years were derived by projecting figures taken from the 1960 census. Finally, it should be noted that while this is not the precise estimating equation employed, it satisfactorily conveys the authors' rationale.

Two Questions

Two questions, it would seem, must be considered in evaluating the proposed model. First, how "good" are the estimates produced by this method? Second, are the results or the model of any specific value to the insurance industry?

As would be expected, the authors, too, were deeply concerned with the first question. Unlike the probability model used by the Center in preparing estimates on a regional and national basis, the model does not produce formally unbiased statistical estimates and the error introduced is not a measurable quantity. However, the estimates have proven remarkably satisfactory in light of the results of tests designed by the Center to determine their consistency and their plausibility.

On this basis, the authors believe the estimates to be useful for very general purposes. They add that caution must be exercised in applying the model or the results in very specific instances. This fact significantly affects the answer to the second question.

The nature of the random variables selected by the authors renders the results *per se* of little value to insurance actuaries in analyzing variations in disability experience by state. One possible exception may be the results shown in Table C for the random variable "number of work loss days per currently employed person per year". It is interesting to note, however, that the value of this variable appears to vary inversely with the tentative level of disability experience reflected in the studies of one company.

While the actual results seem to have little application in the work of insurance actuaries, the proposed model would appear to have a wide degree of applicability in the fields of disability and health insurance. The exacting nature of the variables most frequently measured in these fields and the authors' words of caution seem to require that we await the results of ". . . further refinement and validation". □

'Introducton to Demography' Revised Edition Published

A revised edition of *Introduction to Demography* by Mortimer Spiegelman, F.S.A., has been published by the Harvard University Press, Cambridge, Mass.; price, $15. New features are the plans for the 1970 census of population, the program of the National Health Survey, theories of mortality, and chapters on income and socio-economic status and on education.

Also included are new techniques for detecting and measuring errors in census data and for the projection of fertility. Trends and variations in the demography of the United States and Canada are described. The book has 544 pages, with 124 tables and 20 charts.

Although the first edition (1955) was designed primarily for students of the Society, it found a wide market among demographers, sociologists, and business statisticians. □

BOOK REVIEW

E. Johnson and D. S. Grubbs, Jr., *The Variable Annuity*, pp. xi, 152, The Research and Review Service of America, Inc., Indianapolis, 1967.

by Abraham Hazelcorn

This book may well become the primer for students and for interested readers approaching the field from a layman's point of view or from a general insurance background. For those who have grown up with the various changes in the life insurance industry, *The Variable Annuity* retraces the developments and highlights. The book can also be used for its references. The bibliography may well serve the readers who wish to look deeper into the subject.

The Variable Annuity portrays the almost complete change in attitude of the life insurance industry in recent years. The comfort and safety of the fixed dollar benefit are shown to be false and the authors attribute to the variable annuity a greater potential safety. In the former case, safety means the reliability of receiving an exact dollar amount. In the latter case, safety refers to the probability of receiving an amount which will more closely approximate constant buying power based on an index rather than on a fixed dollar.

Graph Compares

A graph indicating the changes in common stock prices, cost of living and wage levels is used to stress the fact that wage levels have risen more sharply than the cost of living and that the common stock prices have moved much more closely to the wage level pattern than to that of the cost of living. The authors use this relationship later in the paper in discussing the guarantees of a varying pension benefit. It is stated that pensions which are related to wages require a limitation of the amount of increase that will be credited to a greater extent than pensions which are related to consumer prices.

Varied Designs

The various designs to grant partial or total varying benefits are extremely interesting. The partial aspect, for example, refers to the participants' payments which may be split into a portion for purchase of a fixed annuity and a portion for a variable annuity. Payments during the accumulation period may be subject to varying interest earned, while pensions may be based on a fixed interest rate. Somehow, the design of the product has to be modified to conform to the regulatory requirements emanating from several sources.

In heralding the wave of the future, Messrs. Johnson and Grubbs recount the short but bumpy history in the design of the variable annuity. The regulation of variable annuities is traced and hopefully will serve those interested in this product. A long term rise in common stock prices is discussed as a virtual certainty. It echoes many statements currently being made. This includes that of the recent "Report of the Special Committee on Insurance Holding Companies" for the Superintendent of Insurance for the State of New York:

> "Further, it is now recognized that, over the long pull, common stocks, on the average, do considerably better than fixed income investments. . . .".

Position too Glib

One may want to take issue with several statements in the book. I, for one, feel that in the discussion of the effect of variable annuities upon common stock prices, the authors have stated their position too glibly. They do this, in part, by quoting a study. Their conclusion is that the common stock investments of variable annuity plans represent a substitute or replacement for common stock investments that would have been made in other investment institutions, which include mutual funds and trusteed pension plans.

Messrs. Johnson & Grubbs still think this to be so, despite the accelerated entry of life insurance companies into the mutual fund business. It is difficult to say that what the combined effect of the insurance industry's participation in variable annuities and mutual funds will be on common stock prices, but it is also difficult to accept a minimizing of such effect.

This reader found the authors' expositions clear and interesting. The questioning of the need for special contingency reserves to establish variable annuities was well stated. It was felt that in addition to favoring the larger companies, a special contingency reserve, such as the one in New York, is anomalous. Also, the repayment of surplus borrowed for establishing the contingency reserve was given as another practical limitation of the use of the separate account for variable annuity business.

The book is recommended, especially for those actuaries and insurance executives who have not lived through the variable annuity evolution first hand. Taken together with recent articles, such as Mr. Rolland's in *The Actuary* last month, *The Variable Annuity* can serve as a basic reference. □

Data Wanted!

PENDING WORKSHOP ON CLAIMS OFFERS QUESTIONS FOR STUDY

by Cecil J. Nesbitt

The Society's Committee on Research is organizing a workshop for the Annual Meeting in Washington to explore in a preliminary but detailed fashion the topic of fluctuations in claims.

The discussion will center on: the annual number of ordinary (i.e. excluding group and industrial) life insurance claims for a company; the distribution *by net amount at risk* of the ordinary life insurance claims occurring in a company in a year; the annual aggregate amount of ordinary life insurance claims *by net amount at risk* for a company.

To Validate Models

A major objective is to work toward the validation of risk theory models which should be based on the net amount at risk. These in turn can be used to determine the retention limits on individual policies.

To help direct the discussion of these matters, a set of questions has been prepared for the workshop. In order to achieve the workshop's objectives, it is expected that participants will gather data and prepare discussions in advance for some of these questions.

A written record of the workshop will not be published, but it is hoped that the Committee on Research will be furnished with data and ideas that will help to guide its further exploration of the topics. The set of questions and brief explanatory notes concerning them have been prepared and may be obtained by writing to my office. □

W. A. Poissant, Chief Actuary, Veterans Administration, submitted this mortality experience of Servicemen's Group Life Insurance as being of interest to Companies writing military business.

Table 1 — Non-Viet Nam Experience for Calendar Years 1966 and 1967 Combined by Branch of Service and Age[a]

Branch of service	Age, years								
	All ages	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50 & over
Deaths, number									
All branches	8,796	750	3,916	1,101	768	889	517	441	414
Army	3,424	322	1,646	397	199	312	204	166	178
Navy	2,123	189	983	336	205	177	110	63	60
Air Force	2,302	86	757	281	301	343	179	193	162
Marine Corps	831	143	487	67	49	43	19	17	6
Coast Guard	103	10	43	18	14	10	4	2	2
Public Health[b]	13	0	0	2	0	4	1	0	6
Annual death rate per 1,000, total									
All branches	1.51	0.82	1.42	1.45	1.39	1.89	2.48	3.49	8.17
Army	1.52	1.00	1.44	1.43	1.14	1.79	2.69	3.32	6.08
Navy	1.51	0.75	1.44	1.74	1.97	1.62	2.58	3.41	7.42
Air Force	1.38	0.43	1.11	1.15	1.26	2.15	2.24	3.66	13.66
Marine Corps	1.91	1.08	2.31	1.94	2.03	2.04	2.49	4.65	7.72
Coast Guard	1.44	0.91	1.42	1.59	1.70	1.60	1.74	1.52	3.64
Public Health[b]	1.09	0	0	1.05	0	3.82	2.61	0	65.22
Annual death rate per 1,000, accidental[c]									
All branches	1.09	0.70	1.23	1.22	0.99	0.95	0.97	0.79	2.19
Army	1.05	0.87	1.19	1.14	0.76	0.81	0.87	0.52	1.44
Navy	1.17	0.66	1.27	1.54	1.47	0.87	1.08	0.76	1.11
Air Force	0.95	0.38	1.00	0.96	0.89	1.17	0.99	1.00	4.89
Marine Corps	1.59	0.87	2.11	1.65	1.57	1.00	1.18	1.64	1.29
Coast Guard	1.19	0.82	1.42	1.41	1.33	0.48	0.87	0.76	0
Public Health[b]	0.42	0	0	1.05	0	1.91	0	0	10.87

[a] Excludes all Viet Nam and 4 months post-separation exposure and deaths. The two years were combined because there was no significant variation between them.
[b] Includes Environmental Science.
[c] Includes all accidents, whether on or off duty.

Table 2 — Viet Nam Experience for Calendar Years 1966 and 1967 Separately, All Ages Combined[a]

Branch of service	Number of deaths				Annual rate per 1,000			
	Total		Hostile		Total		Hostile	
	1966	1967	1966	1967	1966	1967	1966	1967
All branches	5,989	10,972	4,930	9,305	20.2	24.0	16.6	20.3
Army	3,635	6,265	2,988	5,403	20.9	22.1	17.2	19.1
Navy[b]	299	572	147	310	9.3	13.1	4.6	7.1
Air Force	235	318	147	171	6.2	4.4	3.9	2.4
Marine Corps	1,820	3,817	1,648	3,421	34.1	64.5	30.9	57.8

[a] Death claims in this experience are based on actual claims received by the SGLI primary insurer. Previously published figures for calendar year 1966 were based on claims as reported by the Department of Defense.
[b] Includes Coast Guard. The exposure for the Navy has been adjusted to make it correspond as closely as possible with the allocation of deaths to the Viet Nam area.

Table 3 — Four Months Post-Separation Experience for Calendar Years 1966 and 1967, All Ages Combined[a]

Branch of service	Number of deaths			Annual rate per 1,000[b]		
	Both years	1966	1967	Both years	1966	1967
All branches	1,247	571	676	3.29	3.39	3.21

[a] The SGLI policy provides for a continuation of the active duty coverage for 120 days after separation from service without premium payment.
[b] The 4 month post-separation experienced for all ages combined is a little over double that of non-combat active duty because of the inclusion of many physically impaired lives, mostly service-disabled lives.