
SOCIETY OF ACTUARIES

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# The Actuary

The Newsletter of the Society of Actuaries

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## ON THE SUBJECT OF SPECIALIZATION

*by Arthur Pedoe*

It was at a meeting of the Society of Actuaries in June 1955, during a discussion on *Selection, Education and Training of Actuarial Students,* that I held forth against specialization in the qualifying Fellowship actuarial examinations. I was against qualifying a man as "a pension actuary, a fraternal actuary, or other specialty."

Following the meeting, a member buttonholed me with the following story. At a diplomatic gathering watched by an old lady and her niece, a man in blue uniform with an abundance of gold braid was much in evidence. The old lady asked her niece to find out who he was. On her return she told her aunt that he was a Naval Surgeon. "A navel surgeon," exclaimed the old lady, "my, how they specialize these days!"

I was reminded of this incident at a meeting this year of the Younger Actuaries, in Toronto, which appeared to be a continuation of the discussion at the Society meeting in October 1966 on *The Future of the Actuarial Profession as It Appears to the Younger Actuaries.*

The speakers were all out for actuarial students being examined in Operations Research, of which a notable example was the running and designing of buses in London, also sampling techniques, consumer psychology, and particularly management science. One of the openers at the Toronto meeting suggested that a worthy subject for the Education Committee in their choice of reading might be *How to Become President of a Life Insurance Company.*

This was all most intriguing to one of the older members of the Society (I attended my first meeting in New

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## GOVERNMENT HONORS CANADIAN ACTUARIES

Five prominent members of the Canadian Institute of Actuaries—W. M. Anderson, J. G. Beatty, B. T. Holmes, Arthur Pedoe and N. E. Sheppard—were recently honored by the Government of Canada in being awarded Centennial Medals. These Medals were instituted as part of the celebration in 1967 of the Centennial of Confederation and were awarded to outstanding individuals in various walks of life for their contributions to the community.

All five recipients are members of the Society. Messrs. Anderson and Holmes are Past Presidents and Mr. Beatty a Past President of the American Institute of Actuaries. Mr. Pedoe is an actuarial author of renown on both sides of the Atlantic. Professor Sheppard has been for many years in the Department of Mathematics at the University of Toronto and many members of the Society are his former students.

The Society takes a proper pride in this recognition and tenders congratulations to the individuals so honored. □

## HEARINGS ON PROPOSED INTEGRATION RULES

*by E. F. Boynton*

Substantial opposition to the proposed new rules for integration of private pension plan benefits with Social Security was expressed by most witnesses at the hearings on proposed integration rules held on Sept. 16 and 17.

Under discussion were proposed amendments to the Income Tax Regulations, published on July 6, 1968, and a proposed Revenue Ruling which would implement this regulation, released as Announcement 68-49, on July 15, 1968. In addition to the oral testimony, of which no record was made except notes

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## THE HEALTH OF THE MATH OF FINANCE

*by James C. Hickman*

The study of compound interest and annuities certain is a declining activity in North American colleges and universities. The expulsion of the subject from departments of mathematics, except from those that feature work in actuarial science, has proceeded at a rapid pace. Even within collegiate schools of business, the subject is seldom taught as an independent course but instead appears in various disguises within courses in accounting and finance.

The impact of the influential Gordon-Howell report (*Higher Education for Business,* Columbia University Press, 1959), which stamped the subject as being "sub-collegiate", accounts in part for its reduced acceptability to colleges of business. A natural economic consequence of the declining market is that few substantial college text books on compound interest have been published in recent years. As a result of these trends, many actuarial students have found the portion of part 3 of the Society's examinations devoted to compound interest to be one of the most perplexing topics in the early part of the examination series.

### Impact of Technology

In a computer-oriented age, it is appropriate to inquire about the impact of the new technology on the study of compound interest. Traditional courses on the subject discuss two basic problems: (1) the determination of the value of a stream of payments given an interest rate, and (2) the determination of the rate of return defined by a stream of payments purchased by an initial investment.

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## 20 Pay 20-Year Mortgage Protection Policy
## 1958 CSO 3% Curtate

AGE 45

| Policy Year | Death Benefit During Year | Yearly Term Cost of Ins. | Conventional Terminal Reserves (P=6.66953) | Alternative Mean Reserves (1) $\left(\frac{P_{t-1}+V_t}{2}\right)+\frac{V}{40}$ | (2) $(1)+\frac{P}{2}$ | (3) $(1)+\frac{C}{2}$ | (4) Recommended In This Note* |
|---|---|---|---|---|---|---|---|
| 1 | $1000 | $5.19 | $1.53 | $4.10 | $4.10 | $4.10 | $4.42 |
| 2 | 973 | 5.51 | 2.79 | 5.50 | 5.50 | 5.50 | 6.14 |
| 3 | 945 | 5.84 | 3.75 | 6.60 | 6.60 | 6.60 | 7.58 |
| 4 | 915 | 6.17 | 4.41 | 7.42 | 7.42 | 7.42 | 8.74 |
| 5 | 883 | 6.52 | 4.73 | 7.90 | 7.90 | 7.90 | 9.60 |
| 6 | 849 | 6.86 | 4.72 | 8.06 | 8.06 | 8.06 | 10.14 |
| 7 | 812 | 7.18 | 4.38 | 7.88 | 7.88 | 7.88 | 10.36 |
| 8 | 774 | 7.48 | 3.70 | 7.38 | 7.38 | 7.38 | 10.26 |
| 9 | 733 | 7.75 | 2.73 | 6.55 | 6.55 | 6.55 | 9.88 |
| 10 | 690 | 7.97 | 1.49 | 5.44 | 5.44 | 5.44 | 9.22 |
| 11 | 644 | 8.13 | .03 | 4.10 | 4.10 | 4.10 | 8.34 |
| 12 | 596 | 8.22 | -1.59 | 2.56 | 4.34 | 4.11 | 7.31 |
| 13 | 544 | 8.21 | -3.27 | .90 | 3.34 | 4.10 | 6.20 |
| 14 | 489 | 8.07 | -4.89 | 0 | 3.34 | 4.04 | 5.10 |
| 15 | 431 | 7.78 | -6.30 | 0 | 3.34 | 3.89 | 4.19 |
| 16 | 369 | 7.29 | -7.27 | 0 | 3.34 | 3.64 | 3.64 |
| 17 | 303 | 6.54 | -7.53 | 0 | 3.34 | 3.27 | 3.27 |
| 18 | 233 | 5.50 | -6.71 | 0 | 3.34 | 2.75 | 2.75 |
| 19 | 159 | 4.10 | -4.39 | 0 | 3.34 | 2.05 | 2.05 |
| 20 | 81 | 2.28 | .00 | 1.14 | 3.34 | 1.14 | 1.14 |

*Based on the following net premiums and terminal reserves:

| Policy Year | Net Premium | Terminal Reserve | Policy Year | Net Premium | Terminal Reserve |
|---|---|---|---|---|---|
| 1 | $6.98 | $1.85 | 11 | $6.98 | $4.37 |
| 2 | 6.98 | 3.44 | 12 | 6.98 | 3.27 |
| 3 | 6.98 | 4.75 | 13 | 6.98 | 2.14 |
| 4 | 6.98 | 5.76 | 14 | 6.98 | 1.09 |
| 5 | 6.98 | 6.46 | 15 | 6.98 | .31 |
| 6 | 6.98 | 6.84 | 16 | 6.98 | 0 |
| 7 | 6.98 | 6.89 | 17 | 6.54 | 0 |
| 8 | 6.98 | 6.65 | 18 | 5.50 | 0 |
| 9 | 6.98 | 6.12 | 19 | 4.10 | 0 |
| 10 | 6.98 | 5.34 | 20 | 2.28 | 0 |

Under certain conditions, where term insurance costs fluctuate substantially from year to year, the computation of the minimum series of net premiums which would meet the proposed requirements could be a difficult matter of trial and error. Under most conditions which will be met in actual practice, however, the comparison of the averages of progressive sums of the yearly term costs of insurance with the next succeeding term cost will indicate the approximate areas over which level premiums should be computed.

Negative reserves for level accidental death benefits normally occur only on continuous premium plans and then only at the younger issue ages (up to a possible age 32 under the 1959 Table) but may run in a few cases for over 40 years. Negative reserves for disability benefits occur quite generally on the shorter term plans and in a few cases on waiver or income to ages 55 or 60 with co-terminous premiums. While reserves, in general, for accidental death benefits and waiver of premium benefits are small dollar-wise per $1,000 of basic insurance, the methods recommended in this note can result in doubling at some durations the mean reserves obtained by present methods. □

## Specialization

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York in 1923). As one who was hurt years ago and whose brother, Professor Dan Pedoe, a well-known mathematician, was seriously hurt recently in trying to board a London bus while it was in motion, I would not wish to blame any actuary for the design of the London buses (see *The Actuary*, March 1968).

However I stick by my guns and praise the Faculty of Actuaries in Scotland for concentrating on a uniform standard for its Fellowship qualification and leaving specialization for that long period of life *after* a man qualifies. I regret that the Society and the Institute (of London) have departed from this. One can express surprise regarding the Society, for the profession of actuary in the U.S.A. owes much to the Scots.

### Some History

As for *How to Become President of a Life Insurance Company*, the following tid-bit of our history should be of interest. In 1930 Ben Holmes and I started the Fellowship Study Circles (which are still in operation). In 1935 we passed the supervision on to six of the younger Fellows. All six have become leaders of the actuarial profession and three of them presidents of their companies: Alistair Campbell of the Sun Life, Harold Lawson of the Glens Falls and George Ryrie of the North American Life.

Again, when I became Chairman of the Educational Committee of the Society in 1934 and introduced major changes in our syllabus, etc., two of the Committee who took the most active part in our work were Henry Beers of the Aetna and the late Horace Bassford of the Metropolitan. So, engaging in the educational work of the Society increases the chances of becoming President of your company.

Regarding *Management Science*, I can appreciate the problem of the clever young actuary who, on qualification, expects the salary of a junior executive but dodges the responsibilities of the position in relation to the other members of the staff. As companies get larger and the business more complex,

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team work and leadership become of major importance. Should not our aim be to qualify the young man while his mind is still fresh and receptive and *then* see that he becomes conditioned to the responsibilities of his position, if this is needed?

The senior staff of a Canadian life insurance company was recently "business oriented" by an after-dinner address by a professor of management science on *Decision Making,* based on some special research recently completed by the school of business of a university. To one of the listeners the "seventy-minute address" could be summed up as: get your facts before you make a decision.

What an overwhelming discovery! Yet I have attended business meetings where a committee of ten men is expected to come to a decision on a matter and no effort was made, prior to the meeting, to distribute the facts on which a decision could be based; in some cases even the subject was not announced previously.

Study and examinations can only accomplish so much. There is the story of the comment made by a wise Presbyterian minister to a young man in Scotland leaving his village to go to the university. "Noo laddie, remember, the university can gie ye philosophy, biology, mathematics and the like, but if ye havena got common sense, it canna gie ye that." □

## Math of Finance

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In solving problems of the first type, ingenious manipulations are often taught so that the answer could be determined using tabled functions. Problems of the second type are often solved in traditional courses by clever approximation and iterative methods.

Today, standard computer programs for solving polynomial equations can be used to solve yield rate equations and the value of a stream of payments at a fixed interest rate is usually determined by direct calculation rather than through table look-up. (See, for example, "Computer Algorithms for Finding the Exact Rate of Return," by S. Kaplan, *Journal of Business,* October 1967).

### Random Components

The recognition that business transactions do not take place in a world characterized by certainty has led to the development of economic and financial models that explicitly incorporate random components. In the past it was common to ignore uncertainty about the occurrence and the value of future payments. This new stochastic view of business processes has also tended to reduce the stress placed on learning the fundamentals of compound interest and shifted the emphasis to probability.

However, it would be a mistake to conclude that the study of compound interest is dead. The subject is currently flourishing in the field of capital budgeting. In the *Journal of Business,* the *Journal of Finance,* and in *Management Science,* a series of interesting papers has used compound interest in developing a theory to guide managers in selecting alternative investment projects.

One of the most influential of these papers was by Lorie and Savage ("Three Problems in Capital Rationing", *Journal of Business,* October 1955). The paper indicates that if capital projects are to be evaluated by their internal rates of return, the comparison may be confused by the existence of multiple rates of return. That is, if $a_j$ is the amount of money that flows into (−) or out of (+) a project at integer time $t_j$, $t_0 = 0$, the internal rate of return equation

$$\sum_{j=0}^{n} a_j v^{t_j} = 0$$

may have more than one solution on the unit interval.

In other words, there may be more than one value of $v$ on the unit interval that solves this equation and this implies that there is more than one positive interest rate ($i = 1/v - 1$) that is an internal rate of return.

### Illustrative Problem

In 1960 John Boermeester showed me such a project hidden in the form of an elementary problem:

*A states to B: "I want a loan of* \$208 *one year from today. The loan period will be one year. In return, I will pay* \$100 *today and* \$108.15 *two years from today at the end of the loan period."*

*What is the interest yield to* B *if he accepts?*

It is easy to show that $i = .03$ and $i = .05$ will both solve the internal rate of return equation. A letter to the Editor from Daniel Harris published in *The Actuary,* September 1968, contained a similar example. The apparent paradox may be resolved by making additional assumptions about reinvestment rates and/or loan rates. However, an interesting mathematical problem remains: What pattern of cash flows in and out of an investment project will lead to multiple positive internal rates of return?

A recent paper by Jean, entitled "On Multiple Rates of Return" which appeared in the March 1968 issue of the *Journal of Finance,* answers this question. By using Budan's theorem from the theory of equations, Jean shows that when, as in the Boermeester example, a reverse flow of funds occurs in the middle of the project's time range, multiple positive internal rates of return will result.

Actuaries may amuse themselves by constructing other examples, or they may be interested in tracing some of the references in Jean's extensive bibliography. □

### Canadian Note

The Toronto Press is not behind Dallas (see *The Actuary* Editorial June, 1968) in recognizing and explaining the actuarial profession.

The July 12 edition of the *Toronto Globe and Mail* carried an interesting article on the profession written around the new President of the Canadian Institute, Colin E. Jack.

Mr. Jack reported among other items that his civilian occupation—actuary—was classified 999 in the Army. This highly mathematical number when decoded meant "Others including piano tuners, taxidermists, and actuaries." Apparently a harmonious but stuffy profession!