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IMMUNIZATION WITH (ALMOST) NO MATHEMATICS

by Irwin T. Vanderhoof

Having talked (and written) about immunization for years, I've found a glazed look followed shortly by loud snores to be the normal audience reaction. Yet, after three or four of these lectures, faithful listeners tell me that the subject is simple and they can't understand why they ever had a problem. So, with some concern about disturbing readers' sleep habits, I offer a simple illustration requiring only high school algebra rather than the ordinary and stochastic calculus that has been applied to this subject. Once a simple example is understood, the elaborations that now stud actuarial and financial literature become comprehensible.

Illustration

Assume that today's interest rate for all maturities is 10%, that you now have $1,000 and that you need $1,100 one year from now. Assume further that the only investments available are a money market fund, where interest rates change daily, and a two-year obligation, without coupon, that matures for $1,210. How can you invest your money so as to be assured of $1,100 in one year regardless of changes in the interest rate?

Needing to avoid the losses that may ensue if either you invest short and interest rates fall, or if you invest long and interest rates rise, what do you guess to be the right investment strategy? You are absolutely correct! You have instinctively made the right decision—to invest half your money short and half long. Let's see why.

If the interest rate remains at 10%, the following expression displays the identity between our investments and

"THE EDUCATION AND TRAINING OF ACTUARIES"

The above is the title of an extraordinary paper presented to the Institute in London in January 1982 by W. W. Truckle, F.I.A., Director of that body's Actuarial Tuition Service. Written to provide a framework for oral and written discussion, it features questions rather than opinions.

This summary is limited to subject headings and the questions that end each section, but we cannot resist giving also the apt quotations Mr. Truckle has picked to headline each of his topics. For his. paper as a whole he quotes Francis Bacon: "I would live to study, and not study to live."

(1. is an introductory section.)

2. Policy

2.1 What an actuary needs to know

"A smattering of everything, and a knowledge of nothing"—Dickens

Ques.: What are the limits of knowledge to be demonstrated by a qualified actuary, distinguishing between essential subjects (to be examined) and incidental subjects (to be treated as post-examination education)?

2.2 Adaptation to change

"Knowledge advances by steps, and not by leaps"—Macaulay

Ques.: How do we ensure that developments in the actuarial and allied fields are adequately monitored and tested?

Ques.: Do we need to clear a route by which the results of research into new ideas are filtered into the educational and examination system so as to create and maintain a momentum of change?

2.3 The scope of actuarial education

"I don't know why they make all this

COMMITTEE ON ELECTIONS INVITES VOLUNTEERS FOR LEADERSHIP

The Committee on Elections cordially invites any Fellow who would like your availability as a nominee for election to the Board of Governors to be drawn to our voters' attention on this year's first ballot, to write to its chairman (Julius Vogel, Senior Vice President & Chief Actuary, Prudential Insurance Company, Newark, NJ 07101) giving a brief summary of your background and accomplishments. You should do this before May 7, 1982.

In 1981, for the first time, a "reference list" of over 70 names, compiled on specific criteria having to do with past services to the Society, was offered as possible nominees for the Board. This year's committee will repeat this procedure, and will include in that same list such names from among those who respond to this invitation as the Committee picks on the strength of the material those volunteers submit. The list won't identify which actuaries volunteered their names.

Service on the Board of Governors is for a three-year term and requires attending three or four Board meetings a year. Meetings, frequently held on weekends adjacent to Society meetings, may last a day or a day-and-a-half. Board members (or their employers) pay the costs of attending these meetings. Board members occasionally serve on special committees that require additional travel and correspondence. Board service necessitates careful advance review of lengthy and detailed agendas.

□

Immunization

our needs:
$$500 + (1210/2)(1/1.1)^2 = (1100)(1/1.1)$$

If the interest rate changes, either upward or downward, to y, then let's let $x = 1.1/(1+y)$. The value of the first term above is still 500, but the value of the second term, which had been 500, now becomes $500x^2$, and the third term, which had a numerical value of 1000, now becomes 1000x.

Dividing all these terms by 500, the new equation will have on the left side $1 + x^2$, and on the right side, 2x. Now, let's be high-class about this and prove a lemma:

Lemma:	$1 + x^2 \geq 2x$
Since:	$(1 - x)^2 \geq 0$
	$1 - 2x + x^2 \geq 0$
Therefore:	$1 + x^2 \geq 2x$

We can, therefore, be very comfortable with our instinctive decision to put half of our money into each of the two investments. Whichever way interest rates change, the combined holding will be adequate to provide the needed $1,100.

Since this result just doesn't seem reasonable (even to me), let's look at what we have done and see how it relates to the complex formula usually used to determine duration.

What we did was to choose our investments so that our invested funds, on the average, matured at our target date. The complex formulas for duration are the inverse of this calculation, wherein we look at a bond or mortgage and determine for what period, on the average, we have made our investment. The crucial point is that the calculation isn't based on a weighting, using amounts to be paid multiplied by the time till payment—this gives the average maturity date, which is a different thing. Rather, in these duration calculations, we multiply the *present value* by the time till payment so as to get an average term for our investments.

The Basic Idea

The simple, basic idea behind immunization is that all investments that have the same duration, or average life, have the same changes in value when interest

SOCIETY FINANCES IN PERSPECTIVE

by Robert J. Johansen, Treasurer

Inflation, membership growth and broadened activities have all boosted the Society's budget through the years. Added to our staff have been an Executive Director(1968), Director of Education (1977), Communications Manager, now Director of Communications (1978), Director of Finance (1979), and Director of Research (1981). Seminars, part of our continuing education program, have grown rapidly; 41 are in prospect for 1981-82.

Table I shows how our 1981-82 budget stacks up with results for 1980-81, and to the extent possible with two widely separated earlier years. The present cost-center accounting doesn't go back farther than 1980-81, preventing fully detailed comparisons with the early years; a three-year comparison on the old basis is available in *The Actuary*, December 1981.

Table II shows these figures adjusted for CPI changes since 1958-59, a period during which the Consumer Price Index has more than tripled.

Adjusted income from dues reflects, of course, membership growth as well as the dues scale itself; likewise, examination fee income grows with numbers of students as well as the fee level. Inflation-adjusted expenses per member increased between 1958-59 and a decade later, but have remained fairly stable since, as have, even more so, adjusted dues per member.

The Society's ability to engage in new activities on members' behalf evidently comes largely from growth in the number of our members.

Table I
SOCIETY INCOME AND EXPENSE
(Amounts in Thousands)

Income	1958-59	1968-69	1980-81	Budget 1981-82
Membership Dues	$ 44 M	128	801	932
Seminars			186	350
Meetings	1	40	264	301
Exam Fees	26	108	830	903
Publications	32	53	136	95
Investment Income	5	11	134	125
Other Income	15*	34*	408	436
Total Income	123*	374*	2,759	3,142

Expenses (By Cost Center)				
Seminars			208	348
Meetings			261	303
Examinations			1,056	1,011
Public Information		(Figures by	46	62
Research Services		Cost Center	3	112
Other Memb. Services		Not	873	1,002
Gen. & Administrative		Available)	283	301
Total Expense	114*	391*	2,730	3,139
Income Less Expense	+ 9	− 17	+ 29	+ 3

Statistics				
Number of Members	1,822	3,275	7,697	8,447
Dues per Fellow ($)	30	50	130	145
Expense per Member ($)	60*	120*	355	370
Equity per Member ($) (Funds on hand)	143	77	66	60

*These figures, and the same ones in Table II, would be higher if the assessments and expenses for mortality and morbidity reports had been accounted for in the manner used today.

LETTERS

Faux Pas

Sir:

You misquoted me in "Beneficiaries of Inflation" (Jan. issue).

As the ratio of income to capital stock has been on the uptrend, the implication is that the capital stock isn't worth as much. Both labor and capital lose, but labor loses less. Capital is by no means a winner when unanticipated inflation exceeds anticipated inflation.

Larry Bartlett

Ed. Note: Blame for this is accepted by our well meaning but bumbling assistant, Ms. Mia Culpa.

Immunization

(Continued from page 4)

rates change. If we have three investments with different durations, we can take some combination of any two of them to get the same duration as the third. This is true even if the investments themselves are complex, as are bonds or even cash flows from portfolios of insurance policies. Even the profound developments of immunization are based upon the simple principle of our illustration.

Purists may say that our illustration doesn't hold water because interest rates aren't flat by duration, and there aren't the parallel interest rates pictured in the illustration. If such were so, there'd be a sure way to make money without taking any risk. The fact is that several studies, unpublished but carefully conducted, have shown that immunization works—not perfectly but very well indeed. In addition, there is a reason why interest rates move in parallels—inflation. Although the way in which inflation enters into interest rates seems not to be stable, the current rate of inflation does affect rates for all maturities in a similar way.

I hope this is of help to readers whose interest in the immunization idea has been dimmed by the complex mathematics involved.

Now, is that all clear? Why are your eyes closed? Wake up! Wake up!

Ed. Note: Some references given us by Mr. Vanderhoof will be printed in our May issue. □

We Aren't Doing Our Job

Sir:

Your January 1982 issue contained more than one message that life insurance stands in need of being made safer. Charles F. B. Richardson repeated his excellent advice of 40 years ago, and Frank M. Redington described his 1952 exploration of immunization. In intervening years neither of these problems has gone away, and competition has resulted in smaller and smaller levels of contingency reserves.

Competitive pressures remove any hope that the life insurance industry will voluntarily increase the prices of its products in order to solve such problems as these—which is, to some extent at least, a reflection on our profession.

Too few actuaries have resigned in public protest against top management's short range attitude. Too many actuaries have allowed ourselves to be outwitted by agency officers, who are apt to be good communicators to management while most of us are incurable introverts. Top management itself seems mostly interested in short range results anyhow.

Although philosophically uncomfortable about advocating more regulation, I believe our industry needs outside regulation to overcome its demonstrated inattention to long range safety, the very heart and soul of life insurance.

Stuart J. Kingston

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Rollercoaster

Sir:

J. Bruce MacDonald's memorable afternoon (October 1981 issue) prompts me to relate an experience of my own.

Most students have learned what it's like to get exam results by phone, and I agree that's not the ideal way. I called a Chicago number (not the Society's) last July and was told that my candidate number was not on the Part 10 pass list. Since Part 10 was my only remaining obstacle to fellowship, I felt demolished—but elated when the next day's mail brought news that I had passed.

What an emotional rollercoaster!

Steven D. Bryson

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Who Should Pay For What?

Sir:

As an E. & E. Committee member, I think it important to bring out two points about Society finances (R. J. Johansen, Dec. 1981 issue).

The first is evidenced by the numbers themselves. The cost of setting and administering our examinations is rising faster than our income from them, resulting in a subsidy of the examination process from members' fees. While it's true that we all benefit from bringing in new members, shouldn't our dues be routed more toward publicizing the profession and lobbying to improve its position in our countries' economic market? The cost of examinations should be met by the fees we charge for them.

The second point can't be seen on Mr. Johansen's chart, but reflects a similar condition. We who serve the examination process are expected to subsidize our own expenses by sharing hotel rooms —an annoying requirement often discussed at our meetings. The costs of setting and marking examinations should be borne by the students and their employers, not absorbed by those who contribute time and effort to make this whole thing work. *Leslie J. Lohmann*

Mr. Johansen replies: The Society is well aware of, and appreciates, the efforts of the E. & E. Committee members. Nevertheless, a partial subsidy of exam costs has been continued in order not to discourage the prospective actuaries we need from attempting our examinations.

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Intrinsicality

Sir:

Stuart J. Kingston (Nov. 1981 issue) said that high taxes are intrinsically unethical. The fact is that Federal taxes taken from our citizens are all paid back to us; in fact, President Reagan has arranged to pay back about $100 billion more this year than the government will receive. This can be called unethical only if the war industries and poor people who get it need it less than does the taxpayer; or do less good with it; or deserve it less.

Such terms being undefinable, there never can be consensus on ethicality. Hence, taxes are not intrinsically unethical; saying so merely warns people of the biassed position from which one comes. *Charles M. Larson*