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August Zillmer, an actuary with less reserve

by William L. Roach and Gunnar Alksnis

August Zillmer (1831-1893), a Prussian actuary best known for the development of preliminary term valuation, also made some observations on life insurance accounting that seem quite contemporary. Zillmer also wrote the first comprehensive German actuarial mathematics text in almost a century. He brought about the founding of the Institute of Actuarial Science at Berlin in 1868, and, as head of the Institute, he oversaw the publication in 1883 of the first multicompany mortality study on the continent.

Zillmer first published his reserve method in the monograph, *Contributions to the Theory of Life Insurance Reserves* in 1863. Thomas Brand Sprague, a Scottish actuary, published the first English-language paper on preliminary term valuation in 1875.

Zillmer's work is not well known to English-speaking actuaries. Current trends in the international insurance business, however, make it likely that Zillmer will come into his own. The Zillmer Method is sanctioned in the reserve regulation of Japan and the European Economic Community. The growth of the life insurance industry in these areas will prompt a reevaluation of Zillmer's work.

Zillmer reserves

Zillmer wrote *Contributions* for a nonactuarial audience, probably company executives and regulators. Zillmer did not include a single formula in his presentation of the Zillmer Method. Instead, all formulas are presented conceptually and justified by "general reasoning" rather than algebra. His points are illustrated with very extensive examples based on the Combined Experience Table and 3½% interest. To assure an accurate understanding of Zillmer's reasoning, this article's authors replicated all of Zillmer's calculations using spreadsheet software.

In contrast to American modified reserve systems, the Zillmer reserve explicitly takes into account the issue expenses of the life insurance company. Zillmer argues, "...there is no reason not to include other considerations relating to the amount of net premium if only these are rationally calculated, completely covering the obligations of the bank [insurance company]." Zillmer justified the inclusion of these other obligations in the calculation of the reserve by noting the tremendous growth in the German life insurance industry and the benefits of that growth for the citizenry and the state. That growth was achieved through the efforts of the career life agent. Career life agents were made possible by high first-year commissions. High first-year commissions, in turn, require some adjustment of the method of calculating life insurance reserves.

Zillmer proposed a modified reserving system that in essence involves capitalizing issue expenses; he argues that such a modified reserving system must meet certain conditions:

1) the capitalized issue expenses must be amortized (over the premium payment period or some shorter period);

2) there must be some prudent limit on issue expenses (1¼% of face amount); and

3) the modified reserving system must be constructed to allow for the fact that the issue expenses of early lapses are paid for by continuing policyholders (no posting of negative reserves).

Zillmer proposed that actuaries continue to use the traditional method for accumulating reserves but that the first-year net premium be reduced to account for allowable issue expenses. He also proposed that subsequent net premiums be increased to allow for the amortization of those allowable issue expenses.

I = the amount of closing costs to be amortized per $100 of insurance

Px = the net annual premium for $100 of insurance

$\propto x$ = the first net annual premium
$= Px + I / äx - I$

βx = the second and subsequent net annual premium
$= Px + I / äx$

Issue Age	Max. Rate of Closing Cost	
	% Ins Sum	% Premium*
10	0.48%	42.4%
15	0.59	46.7
20	0.71	50.1
25	0.86	53.3
30	1.04	56.0
35	1.27	58.5
40	1.58	61.1
45	1.95	62.3
50	2.33	60.2
55	2.77	57.0
60	3.28	52.8
65	3.80	47.2

Maximum Closing Costs
$= Px+1 - Ax\overline{:1|}$

Maximum Closing Costs as a Percent of Premium
$= (Px+1 - Ax\overline{:1|}) / Px+1$

*Since these maximal rates grow with the issue age in a similar relationship as the premium, it seems preferable to measure the closing costs in percent of the first annual premium. The results of that calculation are shown in this column. It is evident that here the maximal percentage selected is not exposed to as great a fluctuation.

If the closing costs are calculated in percent of the first annual premium, the agent will also receive a closing commission as a percent of the first annual premium. He would naturally prefer to direct his efforts to attracting older persons to insurance.

Zillmer notes a natural limit on issue expense I; issue expense must not be so large as to reduce the first-year, adjusted premium below the premium for one-year term insurance. Thus, Zillmer derived the familiar formula for the limit on issue expenses for full preliminary term valuation. This need not hold for every issue age, but on the average and for the preponderant number of issues it must hold true. The alternative to limiting issue expenses is the development of negative first-year terminal reserves.

He notes that commissions of up to a little more than 1⅜% of the insured amount can be handled by his method. He suggests that it would be prudent to allow no more than 1¼% issue expenses to be amortized.

August Zillmer cont'd

At the time he was writing, issue expenses of 2% were not uncommon.

The Zillmer Method results in negative first-year terminal reserves at the younger issue ages. Zillmer urges that these negative first-year reserves not be included in the summation of policy reserves. Otherwise, high lapse rates can result in sudden increases in the company's aggregate reserves. If negative calculated reserves are posted as zero, then high lapse rates have no effect on the company's reserves. Not posting negative reserves results in higher expenses, but Zillmer demonstrates that this does not have a material effect on the income statement.

Zillmer's emphasis on the income statement is surprising. In the United States the balance sheet, rather than the income statement, was the primary accounting statement until well into the twentieth century. Zillmer's arguments show that the effects of reserving on the income statement were at least as important to him as its effects on the balance sheet.

All through Contributions, Zillmer illustrated his points by referring to an extensive model office calculation. The model office illustrated the effect of Zillmer reserving on the income and reserves of a growing company. The model office extended for some 60 years. Since the standard policy in the simulation was an endowment at 90 and the youngest assumed issue age 30, this was long enough to assure that "steady state" had been reached. Replicating Zillmer's calculations with an AT clone and a third-generation spreadsheet language was a substantial effort. Carrying out such an extensive set of calculations in the mid-nineteenth century must have been a monumental task.

The second part of Contributions provided a muckraking analysis of alternatives to the Zillmer Method used by some British companies. Zillmer provided a list of English actuarial practices calculated to shock proper German actuaries: 1) booking the profit from an insurance contract when it is sold, 2) using higher interest rates for discounting mortality than for discounting future premiums, and 3) calculating the net present value of gross premiums but the net present value of mortality unloaded for expenses or contingencies.

Again Zillmer focused on the income statement; he showed that the English accounting practices could not accurately depict the earnings of a growing company. A consequence of gross premium valuation as practiced by the English companies was that, after an initial period of attractive earnings, the company had to grow at an increasing rate to compensate for the write-off of assets due to lapses. Zillmer assured his readers that the German mind could not even conceive of anything so foolish.

Zillmer's examples of the English insurance industry in the early nineteenth century remind one of the history of American railroads; in many cases both the stockholders and the policyholders were defrauded. Rapidly growing companies were looted by their founders, and the corporate carcass was sold to naive investors.

Zillmer's ultimate epithet for the English insurance companies was to compare them to the fraternal (assessment) burial societies. At least when the burial societies went broke, the damage to the policyholder was minimized. The member of the fraternal burial society had not paid in enough to have an interest (cash value) in the policy. The policyholder of the English company had paid enough, but there was nothing left in the company after the entrepreneurs had finished their work.

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Record registration

Registration for the February 1989 Course 100 exam has broken records. According to SOA Registrar Bernard A. Bartels, 3,767 students signed up for the February 1989 exams, an increase of 46% over the February 1988 registration figure of 2,580. Course 100 was offered in February for the first time in 1987, when 1,596 persons were enrolled.

The February exams have not significantly decreased the number of registrants for the traditional spring and fall exams, said Bartels, who added that this year Course 110 was offered this February for the first time.

Valuation Law cont'd

subsequent years, the additional component would be amortized into the basic default component. If the additional component were to exceed a company's surplus, the company would be required to restrict its operations. The report indicates several open issues with respect to the MSVR proposal.

The committee and the NAIC Actuarial Task Force are seeking comments on the committee's report and proposals. The Task Force plans to issue an official exposure draft at the June 1989 NAIC meeting so that an amended Standard Valuation Law and accompanying model regulation can be adopted at the December 1989 NAIC meeting.

Anthony T. Spano is Actuary, American Council of Life Insurance, and is Secretary of the SOA.

Omission

The January 1989 issue of The Actuary omitted Bruce D. Schobel as coauthor of "Numberless Nevertheless." Schobel is a consultant in the Mercer-Meidinger-Hansen Louisville office and is a frequent contributor to The Actuary.

New members

As a result of the November 1988 exams, the Society has newly awarded the Associateship designation to 318 persons and has promoted 128 Associates to Fellowship.

In memoriam

Garnett E. Cannon FSA 1935
Joel E. Feingold ASA 1979
John Haynes Miller FSA 1931
(Past President of the
Society of Actuaries, 1962-63)

**1989 Symposium for the
Valuation Actuary
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