



SOCIETY OF ACTUARIES

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**NEW INVESTIGATION OF BUILD AND BLOOD PRESSURE**

by Edward A. Lew and Courtland A. Smith

(Messrs. Lew and Smith are Chairman and Secretary, respectively, of the Ad Hoc Committee on the New Build and Blood Pressure Study).

In 1974 the Society of Actuaries and the Association of Life Insurance Medical Directors appointed an Ad Hoc Committee on a New Build and Blood Pressure Study to produce a sequel to the Build and Blood Pressure Study 1959. Reports on the preliminary findings were made to the sponsoring organizations at their annual meetings in October, 1978. Final review of the figures is expected by fall. It is planned to publish the results of the Study in two volumes: one on build late this year and the other on blood pressure early in 1980. Members of the Society will be advised when they may place orders for these volumes through the Society's office.

The main investigation focused on medical issues of 1950-71 traced from anniversaries in 1954 to anniversaries in 1972. It covered about 4,500,000 policies of which 650,000 were on lives with borderline or definite overweight or elevated blood pressure. The study was carried out separately for men and women, both by number of policies and by amounts of insurance. Four basic mortality tables by sex, based on number and amount, were derived from the corresponding standard experience of the companies in the study and not from the contemporaneous experience of the companies contributing to the Recent Issues Investigation. A prodigious amount of effort was needed to check, tabulate and analyze the vast amount of information assembled. Much of this work was accomplished at the Center for Medico-Actuarial Statistics of the MIB.

In assessing the results of the study, the following points should be kept in mind:

(a) The period covered by the main study saw the beginning in the early 1960's of a continuing decline in death rates from heart disease, a decline which over 15 years has been estimated at 25 percent for insured men and 15 percent for insured women.

(b) Over the period covered by the study underwriting has become more

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**THE UNIVERSE OF ANNUITIES CERTAIN**

by Robert L. Brown

As a review of general annuities, I like to have my students fill in the first three rows of the following table. Each entry represents the present value of payments which total \$1 per annum over 25 years at 4% per annum. We consider different payment frequencies and different interest conversion frequencies as follows:

| $i/P$      | Annual  | Semi  | 1/4 ly                                  | Continuous                               |
|------------|---|---|---|--|
| Annual     | $a_{\overline{25} 4\%}$                               | $a_{\overline{25} 4\%}^{(2)}$                                   | $a_{\overline{25} 4\%}^{(4)}$           | $\bar{a}_{\overline{25} 4\%}$            |
| Semi       | $\frac{a_{\overline{50} 2\%}}{s_{\overline{2} 2\%}}$  | $50¢ \cdot a_{\overline{50} 2\%}$                               | $50¢ \cdot a_{\overline{50} 2\%}^{(2)}$ | $50¢ \cdot \bar{a}_{\overline{50} 2\%}$  |
| 1/4 ly     | $\frac{a_{\overline{100} 1\%}}{s_{\overline{4} 1\%}}$ | $50¢ \cdot \frac{a_{\overline{100} 1\%}}{s_{\overline{2} 1\%}}$ | $25¢ \cdot a_{\overline{100} 1\%}$      | $25¢ \cdot \bar{a}_{\overline{100} 1\%}$ |
| Continuous | A   | B   | C                                       | D  |

The solutions to the fourth row can be expressed in some extremely interesting ways. For example, in Box C we can come up with three logical and correct answers corresponding to the entries in the column above; namely,

Box C

- 1)  $\frac{1-v^{25}}{i^{(4)}}$  defined as  $\delta = .04$
- 2)  $50¢ \cdot \frac{(1-v^{50})}{i^{(2)}}$  defined as  $\delta = .02$
- 3)  $25¢ \cdot \frac{(1-v^{100})}{i}$  defined as  $\delta = .01$

The same can be said for Boxes A, B, and D.

In fact, it can be said that there are an infinite number of logical and correct answers for Boxes A to D. (While it is possible to find an infinite number of correct expressions for the other twelve boxes, those listed are the only logical ones).

The proof of equivalence for the expressions in Boxes A to D is simple since

all we have really said is:  $e^{\frac{m(\delta)}{m}} = e^{\frac{n(\delta)}{n}} = e^{\delta}$  for all m, n, and  $\delta$ . □

## Build and Blood Pressure

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effective, especially on policies for larger amounts where ECG's, x-rays, and blood chemistry tests have been increasingly utilized.

(c) The new study is more heavily weighted with policies for larger amounts. This is especially true at issue ages under 40 where a steady increase in non-medical limits has increased the average size of policies issued with a medical examination.

(d) In the Build and Blood Pressure Study 1959, five of the large north-eastern companies that traditionally concentrated on the mass market contributed more than half the material. In the new study however, these companies accounted for only about a quarter of the experience. Correspondingly, several companies which have catered more to the carriage trade accounted for half the experience in the new study as against only a fourth in the earlier study.

(e) Both the 1979 and the 1959 studies include a rather high proportion of exposures in the early durations. Generally, death rates among marked and severe overweights increase with duration, while death rates among underweights decrease with duration. Therefore, the mortality found for all durations combined in both studies tends to understate the true mortality among marked and severe overweights, but overstate that among underweights.

The more interesting results of the new investigation are as follows:

(1) Average weights of insured men have increased, more so for medium (5'7"-5'10") and tall (5'11"-6'2") men than for short (5'3"-5'6") men. Average weights for women under 30 have also increased, but those for women 30 and older have continued to decline. The proportion of underweights has decreased in both sexes.

(2) The weights associated with lowest mortality have increased by about 15 lbs. for men and by about 10 lbs. for women. The optimal weights for short men are close to the statistical average; those for medium men about 10 lbs. below average, and those for tall men about 15 lbs. below average. The optimal weights for short and medium sized women are about 10 lbs. below average and those for tall women 15 lbs. below average.

(3) Mortality of overweight men and women classified by ranges of absolute weight was not much different in the new study from that in the earlier study. The mortality of overweight men, classified by percent departure from average weight, was 10 percentage points lower than in the 1959 study for those 30 percent overweight, 20 percentage points lower for those 40 percent overweight and 30 percentage points lower for those 50 percent overweight.

(4) The mortality of men and women 20 percent or more underweight was very favorable in the Build and Blood Pressure Study 1959. However, the mortality ratios turned out to be somewhat above 100% in the new study.

(5) The mortality of men with elevated blood pressure at time of application was appreciably lower in the new study than in the earlier study. The differentials ran from 10 percentage points for borderline blood pressure to 35 percentage points for systolics of 160 mm or diastolics of 100 mm. The corresponding mortality of women with elevated blood pressure was not much different for borderline blood pressures, but distinctly lower for high blood pressures.

(6) The new study included an experience on some 26,000 men who at time of application for insurance reported treatment for hypertension. It should be emphasized that these men were carefully selected for life insurance, so that their experience may not apply to the usual treated hypertensives in the general population. The mortality experienced by these men whose blood pressure after treatment was below 150 mm systolic or below 100 mm diastolic was in the aggregate only 109% of standard, with normal mortality from heart disease. By contrast, the mortality of those men with systolics in excess of 150 mm or diastolics in excess of 100 mm after treatment was about twice standard; their mortality from heart disease was likewise twice the expected. The virtually normal mortality recorded in the new study for men carefully selected with blood pressures after treatment below 150 mm systolic or 100 mm diastolic is concrete evidence of the efficacy of recent treatment for hypertension. □

## Flesch to the Test

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$$\text{Score} = 206.835 - 84.6 (154/122) - 1.015 (122/17) = 93$$

The last example is from *Truck Stop Lust* by Emanson.

Crackle, crackle came interference over the citizens band radio in Hernando Portocarrera's eighteen wheeler. Suddenly a sultry voice became audible and purled, "Hello, eighteen wheeler jockeys. This here's Cynthia Salmonella at Leroy's Trucker Haven, and it's lonely tonight in Massachusetts. How about some of you eighteen wheeler jockeys pulling into Leroy's for some exotic relaxation?"

$$\text{Score} = 206.835 - 84.6 (108/55) - 1.015 (55/4) = 27$$

Imaginary research indicates that fewer than 1% of Massachusetts citizens have even a vague notion what the theorem is about, but 84% of them have a pretty good idea what sort of exotic relaxation Cynthia is offering Hernando. But if we are to mindlessly follow the formula that the Massachusetts legislature prescribes we must conclude that the Bolzano-Weierstrass theorem is easier reading than *Truck Stop Lust*. □

## Society Seminar

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The meeting was well-organized; presentations progressed smoothly; the equipment functioned properly; the room was spacious and comfortable, although the temperature fluctuated from 60° to 80°; ice water was provided; the luncheon was better than my cooking. There were even a few laughs, such as when we were greeted "lady and gentlemen."

All things considered, I found the program interesting and informative. I might even attend another one some day. □