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**DISCUSSION OF PAPERS PRESENTED AT
EARLIER REGIONAL MEETINGS**

ANNUITY APPROXIMATIONS

R. GRAHAM DEAS

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NEWTON L. BOWERS, JR., AND CECIL J. NESBITT:

This paper was discussed in Michigan's actuarial mathematics seminar by a graduate student, Mr. Kirk Dorn. In preparing his presentation, Mr. Dorn asked us what, if any, was the theory underlying the approximation formulas developed by the author. Our first reaction was that the formulas were purely empirical, but we have now found some theoretical justification for them. We wonder if the author might have had some of these considerations in mind, which led him to consider formulas of the type chosen.

Let us begin with the approximation formulas for the crucial function ${}_{0.035}K_{x:\overline{n}|} = \ddot{a}_{\overline{n}|}^{(12)} - \ddot{a}_{x:\overline{n}|}^{(12)}$, namely,

$${}_{0.035}K_{x:\overline{n}|} \doteq 0.00005426n^2(1.085)^x. \quad (1)$$

To simplify the discussion, we go over to continuous functions and write

$$\ddot{a}_{\overline{n}|} - \ddot{a}_{x:\overline{n}|} = \int_0^n v^t {}_t p_x \mu_{x+t} \ddot{a}_{\overline{n-t}|} dt.$$

If we apply the theorem of the mean to the integral on the right side, we get

$$\ddot{a}_{\overline{n}|} - \ddot{a}_{x:\overline{n}|} = {}_t p_x \mu_{x+t} \int_0^n v^t \ddot{a}_{\overline{n-t}|} dt,$$

where ${}_t p_x \mu_{x+t}$ is a weighted average of the integrand factors ${}_t p_x \mu_{x+t}$. Assume now that in the age range for which the formula will be applied, μ_{x+t} has a Gompertz form, Bc^{x+t} , and note that

$$\int_0^n v^t \ddot{a}_{\overline{n-t}|} dt = (I\ddot{a})_{\overline{n}|}.$$

It follows that

$$\ddot{a}_{\overline{n}|} - \ddot{a}_{x:\overline{n}|} = B {}_t p_x c^x (I\ddot{a})_{\overline{n}|} c^x. \quad (2)$$

Now expand $(I\bar{a})_{\overline{n}|} = (\bar{a}_{\overline{n}|} - nv^n)/\delta$ in powers of δ to obtain

$$\begin{aligned}(I\bar{a})_{\overline{n}|} &= \frac{1}{2}n^2 - \frac{2}{3}\delta n^3 + \frac{1}{8}\delta^2 n^4 \dots \\ &= \frac{1}{2}n^2 [1 - \frac{2}{3}(\delta n) + \frac{1}{4}(\delta n)^2 \dots] \\ &\doteq \frac{1}{2}n^2 \exp(-\frac{2}{3}\delta n),\end{aligned}$$

where, as usual, $\exp x$ denotes e^x . To justify the approximation, we note that the third term of the series for $\frac{1}{2}n^2 \exp(-\frac{2}{3}\delta n)$ is $\delta^2 n^4/9$, just slightly smaller than $\delta^2 n^4/8$ in the series for $(I\bar{a})_{\overline{n}|}$.

Using this approximation for $(I\bar{a})_{\overline{n}|}$ in formula (2), we get

$$\bar{a}_{\overline{n}|} - \bar{a}_{x:\overline{n}|} \doteq \frac{1}{2}B {}_x p_x c^x \exp(-\frac{2}{3}\delta n) n^2 c^x, \quad (3)$$

which is of the same form as the author's formula if $c \doteq 1.085$, and the factors $\frac{1}{2}B$, ${}_x p_x c^x$, $\exp(-\frac{2}{3}\delta n)$ are swept into a constant term. A partial justification for doing so is that the factor ${}_x p_x c^x$, coming from the weighted average ${}_x p_x \mu_{x+\frac{1}{2}}$, will increase with n as long as $x+n$ lies before the point at which the curve of deaths starts to decrease. On the other hand, the factor $\exp(-\frac{2}{3}\delta n)$ will decrease with increase in n , and the two factors will tend to balance out. If $x+n$ lies beyond the point at which the curve of deaths starts to decrease, ${}_x p_x c^x$ may increase or decrease with n , and, if x itself is beyond the point, ${}_x p_x c^x$ will decrease with n . In this last case, the two factors ${}_x p_x c^x$ and $\exp(-\frac{2}{3}\delta n)$ will not balance out as before, and formula (3) will be more in error. This reinforces the author's suggestion about not extending the method to advanced ages.

Formula (3) leads immediately to the author's certain and life adjustment factor (CLAF). If δ in formula (3) is the force of interest equivalent to an effective rate of $3\frac{1}{2}$ per cent, then, for any other force of interest δ' , the factor $\exp(-\frac{2}{3}\delta n)$ changes to $\exp(-\frac{2}{3}\delta' n)$; hence the approximation should be adjusted by the factor

$$\exp[-\frac{2}{3}(\delta' - \delta)n]. \quad (4)$$

This assumes that ${}_x p_x c^x$ remains relatively unchanged by a change in the interest rate. For $(\delta' - \delta)n = -0.01$, the adjustment factor is $\exp(0.0067)$, which compares closely with the author's common ratio of 1.0065. Note also that the adjustment factors are geometric, as found by the author.

Turning now to the cash refund type of death benefit, we assume that for n years of death benefit remaining for an annuity with unit income the value of the refund benefit may be approximated by

$$(\bar{D}\bar{A})_{x:\overline{n}|} = \int_0^n v^t {}_t p_x \mu_{x+t} (n-t) dt.$$

Applying the theorem of the mean gives

$$\begin{aligned} (\bar{D}\bar{A})_{x:\overline{n}|} &= {}_r p_x \mu_{x+\tau} \int_0^n v^t (n-t) dt \\ &= {}_r p_x \mu_{x+\tau} (\bar{D}\bar{a})_{\overline{n}|}. \end{aligned} \quad (5)$$

If one proceeds with formula (5) in the same manner followed in formula (2), one gets

$$(\bar{D}\bar{A})_{x:\overline{n}|} \doteq \frac{1}{2} B_r p_x c^r \exp(-\frac{1}{3} \delta n) n^2 c^x, \quad (6)$$

which bears out the author's statement that the cash refund values bear a close resemblance to those of the certain and life benefit.

To adjust formula (3) to formula (6) with force of interest δ' , the indicated cash refund adjustment factor (CRAF) is

$$\exp[(\frac{2}{3} \delta - \frac{1}{3} \delta') n], \quad (7)$$

which is not directly comparable with the author's formula but gives fairly similar values, especially for $n = 10$. In writing formula (7), we assume that the weighted average ${}_r p_x \mu_{x+\tau}$ in formula (5) is close to the corresponding average ${}_t p_x \mu_{x+\xi}$ used in developing formula (3).

The author has shown skill and ingenuity in developing and applying approximation methods for valuing group annuity death benefits. We were pleased to see his demonstration that there is still a place for skillful formulation of problems to reduce a mass of computation.

RALPH GARFIELD:

I am sure that the author is aware of the ingenuity of past actuaries who have developed and published many approximate valuation techniques. To the actuary who is also very much interested in mathematics, these methods are extremely elegant and, in the past, were probably used quite extensively. The journals of the Institute of Actuaries are replete with these beautiful pieces of work. The names which come to mind for making real contributions in this area are Henry, King, Lidstone, Woolhouse, Parks, and so on—surely great names in the halls of actuarial science.

In 1954 two British actuaries, Messrs. Bizley and Lacey, both fine mathematicians in addition to being first-rate actuaries, published a splendid book on approximate valuation methods entitled "Approximate Valuation of Life Assurance and Annuity Contracts" (notice the reference to annuities). The Institute at one time considered this subject important enough to include this book in its course of reading for the Fellowship examination, and I, in fact, studied from the book.

In this computer age, however, it seems to me that such methods must be looked at in a historical light. They seem to have *no relevance* in an era when we can, in a matter of, at most, minutes, make a valuation of a large pension fund. The Institute has recognized this development by removing the book from the course of reading.

One cannot help feeling that Mr. Deas's paper is a contribution to a field that is no longer relevant to most well-run pension consulting offices, particularly where gain-and-loss analyses, requiring accurate and consistent valuation techniques, are performed. It is no longer good enough to approximate when actual figures can be developed quickly and efficiently.

(AUTHOR'S REVIEW OF DISCUSSION)

R. GRAHAM DEAS:

I have to confess that my formulas and methods were empirical. If I had attempted to develop them by logical processes, I should probably have found myself bogged down by mathematics and getting nowhere. The methods were found to work, and I settled for that. I had hoped that some real mathematicians would take my ideas and polish them up a bit. That is just what Dr. Bowers and Professor Nesbitt have done; I am grateful to them.

Like Mr. Garfield I have a British actuarial background and take pride in my professional heritage. I think, however, he may have been a little too exuberant in his praises of the giants of the past and his mentors of more recent years.

If computers can handle all of Mr. Garfield's calculation problems, he is more fortunate than many of us. I happen to be employed by a very large insurance company. In the bad old days before we had computers, life was nice and simple. We had only two or three valuation bases, and our products conformed to a few standard patterns. Reducing square table valuations to two linear ones would have helped, of course, but we had no great need in those days for methods of approximation of the kind described in the earlier part of the paper.

I should like to say, at this stage, that when I mention "computers" I do not refer specifically to those admirable pieces of hardware which can do such wonderful things for us. I refer, rather, to the whole computer system, particularly to the availability of computer time and an adequate supply of programmers without whom computers are useless. I might say "worse than useless," because it sometimes happens that you depend on computers to do a job for you and discover shortly before the deadline that they cannot make it. You are then in much worse shape than

you would have been had you planned to do a leisurely job by hand; you are forced to press the panic button and do the best you can in the time available.

My company has an extensive computer system which handles the great bulk of our calculation work to our complete satisfaction. Our technicians are competent and work exceedingly hard, but they never quite manage to catch up; they are constantly being confronted by challenging new assignments from all parts of the company. In my own area of group annuities, complications have been forced upon us in the last few years. Generation mortality and variable annuities, for example, make our work much more involved than before. We had hoped, I think, that computers would handle the extra work, but they have not quite been able to do so.

In consequence, the number of "special calculations" that have to be made is increasing every year. A feeling of sheer frustration at what the computers leave undone has forced me to devise the methods described in the paper; they are indeed helpful when "panic" situations arise.

In his last sentence, Mr. Garfield says, "It is no longer good enough to approximate when actual figures can be developed quickly and efficiently." If he would change two words—"actual" to "exact" and "when" to "if"—I might agree with him. In the paper I have gone to some trouble to demonstrate (*a*) that what I think Mr. Garfield refers to as "actual" is not always "exact" and (*b*) that situations can arise in which my humble approximations are closer to the truth. His use of the word "when" implies the element of certainty. I am sure many would be inclined to dispute this.

Mr. Garfield refers to the mathematical elegance of the works of such men as King and Lidstone. Elegant they undoubtedly were. More important, I would say, they were of real practical use in the conditions of their time. We come to meetings of the Society in the hope that we will learn something that will enable us to do our jobs better. Some of our modern actuaries are brilliant mathematicians. I am sure they are every bit as elegant as their predecessors. But I doubt if many of us have been able to glean much in the way of practical help from the more mathematical of their writings.

I am confident there are actuaries whose duties involve calculation who are not as fortunately placed as Mr. Garfield. If my paper will help them to overcome some of their practical problems, my efforts in preparing it will have been rewarded.

STATUTORY EARNINGS, ADJUSTED EARNINGS, AND NET WORTH

MELVIN L. GOLD

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GEORGE BRUMMER:

Once again Mr. Gold has written on a topic which is of great concern to life insurance companies. The problem of accurately determining earnings and their source is a very real one, constantly presented either to or by management, stockholders, and potential investors. Fortunately for us, Mr. Gold is able to be objective in pinpointing and describing a problem and then, without hesitation, to suggest several possible solutions. This serves to make it easier for others to offer comments.

The importance of knowing a company's earnings, current or future, is undeniable. But differences do arise among industries and among companies over the manner in which such earnings are determined. Mr. Gold recognizes these differences when he discusses the variations between statutory life insurance accounting and the accounting practices of other industries and the need for adjusted earnings and net worth. Armed with this recognition, Mr. Gold then proceeds to try to find a common denominator through which all these differences and distinctions can be either overcome or reduced to nonexistence. Mr. Gold proposes that this can be accomplished by transforming or adjusting the statutory earnings of a life insurance company.

But the differences between the products and services offered by a life insurance company and those offered by an industrial organization are more basic than can be established by the variations in accounting statements and practices enumerated by Mr. Gold. One must consider the nature of the two products or services, when and how they are delivered, the length of time before they are paid for and before intended benefits are derived, and how profits emerge. Let me illustrate.

1. Unless it is a multimillion-dollar item, such as a commercial jet airplane, an office skyscraper, or the like, which requires a few years for completion, an industrial product is available for immediate delivery. It often travels through several hands—wholesaler, jobber, and retailer—before it reaches the consumer. The profit for each of these parties emerges as soon as payment by the succeeding party is made, and this occurs within

a matter of months, except perhaps for the retailer who may have to wait a bit longer if an installment purchase is involved. The consumer can enjoy the benefits of his purchase as soon as the product or service has been delivered, and, if he delays enjoying it, such a delay is by his own choice.

2. In the case of life insurance, the relationship is directly between company and policyowner, without any middle man. Although a promise to pay is delivered immediately, actual payment is not made when a policyowner desires but may depend upon the sudden occurrence of an unforeseen and dread event, as in the case of a death claim, or may require that a period of years elapse without death, as in the case of an endowment claim. Thus, most life insurance company contracts represent commitments over ten or twenty years and stretching possibly as long as seventy-five or one hundred years. During that period, the policyowner continues paying his premiums; no material benefits can be derived by the purchaser (except to the extent of cash surrender or loan values, and these also take a number of years to be of meaningful size); and profits emerge little by little and year by year until the contract is terminated in one way or another.

Admittedly, these are by no means all of the differences, but they seem to be sufficient in import for one to question whether it is possible and meaningful to adjust a life insurance company's earnings so that an investor can use "the same criterion as that used in buying the stock of any industrial corporation." Since a life insurance company sets its premiums on expected future benefit payments, expected future expense rates, and expected future profits, it stands to reason that it should be easier to determine the future earning power of a life insurance company than that of an industrial organization which operates on a far more current and immediate basis. It, therefore, seems reasonable that serious consideration be given to adjusting an industrial organization's statement of earnings so as to reflect better its future expectancies. This proposal may seem facetious at first glance, but that is not the intention. Nor is it farfetched, when one takes into account that more and more industrial organizations are projecting future sales, production, expense, and profit levels by means of electronic computers, using ideas and methods that are hardly new to the actuary.

In summary, I believe that it is more difficult to determine a life insurance company's earnings than it is to determine those of an industrial corporation, but for the short run only. Over a long period, and it is the future earnings that are of greater concern, the determination of an industrial corporation's earnings is far more difficult.

That is not to say that statutory life insurance company earnings can be used without adjustment. As Mr. Gold points out, the present Convention Blank is directed toward solvency rather than realism. The Blank does enjoy the advantage of being completed by all life insurance companies, in identical form, in great detail, and at the same time (such consistency and detail, incidentally, are not found among industrial corporations, except for a few that are very stringently regulated); consequently, this advantage should not be tossed aside lightly. Since insurance regulatory authorities will continue to look for expressions of solvency, while other organizations and individuals seek realism, it would make sense to revise the Convention Blank to include enough additional data to enable anyone to derive that information which he feels he needs. For example, there might be a more complete description of the reserve calculation method used, thereby giving a better picture of first-year surplus strain and of the incidence of renewal profits; another possibility is the inclusion of a breakdown for the in force into broad plan-age-duration groups. Perhaps this will furnish Mr. Gold still another timely and important topic on which to write.

GARY E. CORBETT:

Mr. Gold has written a paper that touches upon many aspects of the problem of adjusting statutory earnings. Hopefully, such a comprehensive presentation will initiate discussion among actuaries on this problem which we, as a profession, should be very much involved in if we are not to leave the solution to the accountants and financial analysts. As a part of this discussion I would like to raise questions on three aspects of the paper.

The most vital point that I question is Mr. Gold's definition of "adjusted earnings" and his resulting conclusion that a method which utilizes the present values of future profits is inappropriate for the purpose of adjusting earnings. Mr. Gold states, "Adjusted earnings' might be defined as the normal operational earnings resulting from the sale and servicing of insurance and the investment of the company's assets. They would include the increase in the capitalized value of the 'investment in new business.'" While accepting the first sentence as a reasonable definition of "adjusted earnings," I do not see how this definition leads one inevitably to the conclusion that such adjusted earnings must include the increase in the capitalized value of the "investment in new business." Surely the second step in the development of the definition should be: "They [adjusted earnings] would include the increase in the value of new business." The final step is to decide on the method of valuing this new business. Mr. Gold evidently believes that a capitalization and amortiza-

tion of a company's investment in new business is the only appropriate method. I, among others, believe that a gross premium valuation, which measures the present value of future profits of a company's book of business, is not only an appropriate method but, for many purposes, superior.

One advantage of a present value approach is that it results in sales activities' being directly reflected in earnings in the year a sale is made. If "adjusted earnings" are to be defined as "the normal operational earnings resulting from the *sale* and servicing of insurance . . ." (italics added), then a present value approach accomplishes the definition much better than does a capitalized investment approach, which goes only so far as to remove any negative effect on earnings resulting from sales activities. Since the pros and cons of the different methods were discussed extensively in the concurrent session on adjusted earnings in Los Angeles (and, I am sure, at the other spring regional meetings), I shall not go further into this subject at this time. I do, however, want to emphasize the fact that it is a matter of opinion as to which methods of adjusting earnings are most appropriate and that a definition of adjusted earnings should not be written so as to exclude a certain method unless a good case is first made for such an exclusion.

In discussing the appropriate base for an investor to use for applying a price earnings ratio, Mr. Gold says that "it is clearly improper to include extraordinary earnings or the increase in the present value of future profits in a base used to project future earnings." What earnings it is proper or improper to include in the base clearly depend on which earnings are to be considered present and which future by the investor in his determination of an appropriate price earnings ratio. It seems to me that the best base for the financial analyst to work from is a base that makes the earnings of a life insurance company most comparable to those of a company in another industry. For the noninsurance company he essentially must predict future sales, which depend on a number of factors, such as economic projections and the resulting effect on the industry, the company's position within the industry, and the management of the company. In order to predict future sales for the life company, he must project essentially the same factors. This projection he can probably make with as much proficiency for the life company as he can for another company. However, if we say to the investor that he must also project the future earnings on the life company's block of in-force business, we introduce him to the problems of projecting such factors as mortality and persistency and of then obtaining sufficient information about the company's mix of business and gross premium level to apply these projections to estimate probable future earnings on the in-force business. The investor is not capable of such cal-

culations and thus cannot, even intuitively, allow for the appropriate effect of the value of the in-force business on the factor that he applies to an earnings base, either statutory or adjusted for the capitalization and amortization of the company's investment in new business, in order to produce his estimate of the value of the company's stock. But, if earnings are adjusted by taking into account the present value of future profits on in-force business, this problem is eliminated and the investor is thus provided with an earnings base more comparable to those provided by other industries.

The third aspect of the paper on which I would like to comment is the definition of the capitalized value of the "investment in new business." Mr. Gold describes two approaches which may be followed: (a) capitalization of excess first-year expenses and (b) capitalization of the new-business strain. My comments are restricted to his first approach. I believe that expenses in excess of the ultimate level of expenses should be capitalized regardless of the year in which they are incurred. In Mr. Gold's example I would capitalize $\$26.95 - \$1.83 = \$25.12$ in the first year and $\$2.66 - \$1.83 = \$0.83$ in the second through the tenth years. The rationale for such an approach is that renewal commissions in excess of what could be called a "service-fee" level are an integral part of the commission package that motivates an agent to sell a given product for a particular company. The practical effect of ignoring renewal year excess expenses is relatively minor for Mr. Gold's example, but, if a company uses "heaped" renewals or level commissions in the early years, the effect can be quite marked. Such "renewal acquisition expenses" must be taken into account if such a company's earnings are to be adjusted to a basis comparable to another company which uses the traditional commission scale. (As an aside, it can be shown that capitalizing and amortizing all expenses in excess of ultimate and using experience reserves result in adjusted earnings which are constant per \$1,000 in force in each policy year.)

I do hope that Mr. Gold's paper and the panel discussions at the three spring meetings will result in actuaries' becoming much more involved in the problems of adjusting earnings. Even if we do not agree among ourselves on the best method of adjusting earnings, we can certainly contribute to our own understanding and that of our accounting and financial analyst associates, who will soon be proposing guidelines in this area with which we shall all have to live.

MEL STEIN:

Mr. Gold is to be congratulated on presenting a broad survey paper which shows the different methods (correct, incorrect, refined, crude, etc.) used to determine adjusted earnings and net worth.

Of the three methods of calculating the present value of future profits presented, only the gross premium valuation method can be considered as actuarially correct and free from serious limitations and severe inherent risk.

The simple illustrative examples presented in Mr. Gold's paper show identical results produced by the gross premium valuation and the Lidstone methods. This is only true, however, because Mr. Gold's examples assume a very special (and unprobable) condition—that the value of money (the rate that future profits are discounted by) is equal to the insurance company's net investment earnings on assets.

Table 1 shows the "profit factor" shown in column (14) of Mr. Gold's Exhibit I recalculated using a 15 per cent yield rate to discount future profits. The new profit factors are, as is expected, substantially lower than the "experience reserves" calculated by Lidstone's method.

TABLE 1

Policy Year	Profit Factor	Policy Year	Profit Factor	Policy Year	Profit Factor
1.....	\$ 0.88	11.....	\$17.37	21.....	\$20.07
2.....	13.31	12.....	17.33	22.....	19.60
3.....	13.80	13.....	17.33	23.....	18.91
4.....	14.12	14.....	17.29	24.....	17.99
5.....	14.48	15.....	17.39	25.....	16.81
6.....	14.86	16.....	17.79	26.....	15.29
7.....	15.26	17.....	18.17	27.....	13.36
8.....	15.69	18.....	18.52	28.....	11.01
9.....	16.16	19.....	18.93	29.....	8.15
10.....	16.71	20.....	19.44	30.....	4.59

The "aggregate profit projection" method is far too crude and subject to major distortion to be used in determining a company's net worth for merger or outright sale purposes. Renewal profits per \$1,000 (or unit) often vary substantially and erratically by duration for individual plans and for blocks of business. Changes in the distribution of the renewal insurance by plan, issue age, and year of issue also contribute to the riskiness of the aggregate profit projection method.

Mr. Gold lucidly explains the difference between "adjusted earnings" and "increase in net worth" along with the respective purposes of these two items. He then presents two methods of capitalizing a company's investment in new business: (a) capitalization of excess first-year expenses and (b) capitalization of the new-business strain. I believe that these should be defined as follows: (a) capitalization of the *allowable portion* of excess first-year expenses and (b) capitalization of the *allowable portion* of the new-business strain.

In the case of capitalizing excess first-year expenses, the competition may have forced the premium for a particular age-plan cell below that required to achieve a company's minimum desired profit objective. If, for instance, this objective required that the value of renewal profits through policy year 20, discounted at 10 per cent, were at least equal to the first-year investment in new business, the capitalization of excess first-year expenses for this policy should be limited to these discounted renewal policy year profits. This is probably analagous to what Mr. Gold had in mind when he said, "The first-year expenses employed should probably be limited to those expenses inherent in the structure of the gross premium."

The "capitalization of the new-business strain" method, as presented in Mr. Gold's paper, seems to be far too liberal and nondiscriminating as to quality of business written. Thus, if two companies invested \$300,000 of surplus in the same amount of new business and one issued business of little, if any, profitability while the other issued unusually profitable business, it would be foolhardy to allow both companies \$300,000 for the capitalization of new-business strain. This approach, particularly in the case of a rapidly growing company, would cover up unjustifiably high acquisition costs and inadequate premiums and renewal profits. The capitalization of the new-business strain must be controlled by the value of the expected renewal profits of the new business that surplus is invested in.

Like Mr. Gold, I view the methods used to estimate adjusted earnings and net worth from outside a company as arbitrary, fallacious, and extremely dangerous.

Mr. Gold states that "*adjusted earnings and increase in net worth* are not interchangeable and certainly are not equivalent." The distinction between them might be further stated as follows: Adjusted earnings include the allowable or justifiable portion of a company's investment of surplus in new business but do not (even if the whole investment is allowable) include the value of unrealized expected future earnings from this business which are in excess of this investment.

Increase in net worth, on the other hand, includes the excess of the value of unrealized expected future profits from the new business issued over the surplus invested in obtaining this business. The increase in the value of the unrealized expected future profits from the insurance previously in force is, of course, also included in a company's increase in net worth.

B. RUSSELL THOMAS:

Mr. Gold's paper constitutes a timely and most valuable contribution on a subject which has been of increasing importance during the past

few years. As he points out, the number of life insurance companies in the United States has increased substantially since World War II, and most of the new companies are stock companies, for which there is a great need for realistic earnings statements.

Inadequacies in the present annual statement form are due primarily to the changes which have occurred in accounting emphasis over the years. At one time, net worth was regarded as being much more important than earnings. Net worth was emphasized in all types of businesses, including industrial and commercial concerns as well as individual enterprises. During the past twenty, thirty, or forty years, the emphasis, from an accounting standpoint, has changed from net worth to earnings. Many of the items which now appear in the balance sheets of industrial corporations are placed there only to produce proper earnings figures for each accounting period. Since the state insurance commissioners are still primarily interested in solvency, it is understandable that their statement form still emphasizes assets and liabilities rather than earnings. Unfortunately, the use of net premium reserves distorts both the earnings statement and the liability page of the financial statement. In other words, net premium reserves, together with the other balance sheet items prescribed by the regulatory authorities, have the effect of distorting the net worth of the company and, at the same time, of producing gain from operations or statutory earnings figures which bear little resemblance to reality.

Mr. Gold discusses three methods of calculation of the present value of future profits—the gross premium valuation, Lidstone's experience reserves, and the aggregate profit projection. He has also presented methods of capitalization and amortization of new-business strain in order to produce more realistic earnings statements. It appears that he has dealt only with nonparticipating insurance, although it must be recognized that many stock companies also write participating policies which should not be ignored in determining either earnings or net worth.

As suggested in the final sentence of Mr. Gold's paper, it is essential that appropriate methods be developed by actuaries for computing reserves which will produce realistic earnings statements for stock life insurance companies. In the long run, such methods would require the concurrence of accountants and the SEC if they are to be generally acceptable. The fundamental assumption made by the actuary in determining gross premium rates to be charged is that the profit margin will be the equivalent of $\$X$ per year per \$1,000 of insurance. With this fundamental assumption, it seems necessary, in order to produce realistic year-to-year earnings, to compute reserves based on realistic assumptions, such as

those which were used in determining the gross premium rate. While such reserves would be similar to "natural reserves," as described in Bruce E. Shepherd's paper by that title (*TASA*, Vol. XLI), they should not only properly reflect the true incidence of expense but also include provision for lapses and cash surrenders and intended or expected profit. Having established reserves computed in this manner in two successive annual statements, the net gain shown for the year should be an amount equal to $\$X$ per \$1,000 of insurance in force during the year, plus or minus gains or losses resulting from interest, mortality, expenses, and terminations during the year. It should be noted that reserves computed on this basis would not be the same as gross premium reserves and that, therefore, reserves computed in this manner would not be appropriate for determining the net worth of a company.

The problem of producing realistic earnings is somewhat more complicated when one is dealing with a stock company writing both participating and nonparticipating policies. If, under the company's charter or the laws of the state in which it is organized, it is not permissible for the company to make a profit from the sale of participating policies, all earnings generated by participating insurance should be set aside in a contingency reserve and should not be treated as earnings of the company for the year. On the other hand, if it is permissible for the company's stockholders to profit from the sale of participating policies and if the premium rates charged and the dividend scales adopted for such policies produce a profit which will accrue to the stockholders, reserves for participating policies should be computed in a manner similar to that used for nonparticipating business, with an additional provision for dividends, so that the emerging profit to stockholders would not exceed the permissible amount. Only the expected profit to the stockholders would be reflected in the earnings statement. Reserve calculations would reflect the dividends payable on participating policies which tend to increase by duration. Furthermore, if the profits produced by the actual operations during the year exceed the maximum permissible charge against the participating class of policies, the excess should be treated as an increase in the contingency reserve held for participating policies rather than as an additional profit for the year. On the other hand, if mortality, interest, and expense experiences are such that the profit for the year is less than the permissible charge to the participating department, any contingency reserve previously accumulated could probably be drawn upon to cover the permissible charge.

If one is dealing only with nonparticipating policies, it may be appropriate to continue to use, for a substantial period of years, reserves

based on the assumptions used in calculating the gross premiums. However, if there have been substantial changes in mortality, expense, or interest rates since the premium basis was adopted, changes in the reserve basis would be appropriate. Changes in the level of reserves due to changes in reserve basis would be reported as nonrecurring gains or losses and not as earnings or losses in the year of change in basis. With respect to participating policies, it would be necessary to change the reserve basis whenever the dividend scale is changed.

As previously indicated, the reserves for nonparticipating business which produce realistic earnings probably will not produce an accurate representation of net worth. A gross premium valuation based on the same assumptions as those used in calculating the realistic going-concern reserves would produce reserves equal to the going-concern reserves less the present value of expected future profits.

Theoretically, the reserves required for participating business would be substantially less than those for nonparticipating business, because participating premiums include substantial margins for dividends. A gross premium valuation would produce lower reserves because of the higher premiums, but a gross premium valuation of participating business is not particularly meaningful. As a practical matter, dividends cannot be eliminated. Therefore, a more realistic measure of required reserves for a block of participating policies might be obtained by making a gross premium valuation using as the gross premium either (a) a competitive nonparticipating premium or (b) the gross premium less an estimate of the minimum level dividend which could be paid without significantly affecting withdrawal rates. From the standpoint of determining the net worth attributable to participating policies issued by a stock company, however, the maximum contribution of such policies toward the net worth would be the present value of the maximum charges which the company is permitted to make against the participating department.

While the total net worth of a life insurance company may include the value of the agency organization, good will, value of group insurance, and other items, any changes in the value of the agency organization and in the good will of the company probably should not be reflected in the company's normal earnings statement. These items become important only if serious consideration is being given to sale or merger of the company.

Appropriate methods of determining earnings are necessary if the insuring public and the investing public are to be properly protected. The actuary's technical knowledge should be fully utilized in the development of such methods. I therefore concur in the author's hope that his

paper will elicit "contributions on a facet of [the life insurance] business neglected by actuaries for far too many years."

STUART E. TINKER:

Mr. Gold has produced an interesting and worthwhile paper on a very important subject. I am in full agreement with his point that adjusted figures are useful for internal management purposes, as well as for others. My comments are concerned with the theory involved in determining the adjusted or realistic reserve and the effect thereof on surplus and earnings. This will be approached from the viewpoint of participating insurance and will ignore all adjustments other than reserves.

A prospective type of reserve formula may be written as:

- Present value of future benefits (death, withdrawal, maturity, conversion)
- + Present value of future expenses
- + Present value of future dividends according to present dividend scale
- + Present value of future contributions to surplus provided for by some predetermined plan of surplus emergence
- Present value of future gross premiums

An examination of this formula under various conditions provides considerable insight into the relationship between adjusted reserves, surplus, and earnings.

1. If the basic factors (mortality, lapse, conversion, expense, interest) used in calculating the reserve are exactly the same as those used in establishing the premiums and/or dividends, and the predetermined plan of surplus emergence remains the same, the formula becomes a form of "natural reserve." Contributions to surplus can then be thought of in two parts:

- a) The part provided by the predetermined plan. Since the present value of future surplus contributions is held in the reserve, this part is released to earnings and surplus each year as planned.
- b) The part (profit or loss) due to the difference between actual experience and the basic factors assumed in the reserve calculation. This part goes into earnings and surplus each year as it occurs. To the extent that future changes in the basic factors are reflected in future dividends, these profits or losses will be reduced.

Since the basic factors used in the reserve calculation have been assumed to be the same as those used in setting the dividends, the same reserves can be obtained by either a retrospective or prospective type of formula. Under the retrospective formula there would be a deductive item for the accumulated value of surplus contributions allocated to past

years by the plan chosen. This is the counterpart of the similar term in the prospective formula and serves the purpose of letting contributions to surplus emerge each year as planned rather than accumulating in the reserve and being released only when the policy terminates.

2. If the basic factors used in calculating the reserve are different from those used in the determination of the premiums and dividends, the formula is essentially a gross premium valuation. Contributions to surplus then may be thought of in three parts:

- a) The part provided by the predetermined plan. This part is released to earnings and surplus each year as planned.
- b) Contributions to surplus, in addition to those provided by the predetermined plan, arise because of the differences between the basic factors used in the reserve calculation and those used in determining the premiums and dividends (or those used in the previous reserve calculation). These contributions may be either positive or negative. In either event, the entire present value is reflected in the reserve, and hence in surplus, at the time of valuation.
- c) The profit or loss due to the difference between actual experience and the factors used in the reserve calculation. This part goes into earnings and surplus each year as it occurs.

3. Whatever type of reserve formula is used, if realistic expense factors are used in the reserve calculations, the results will reflect the high initial expenses and the reserves may even be negative. Thus the strain on surplus in the early years of new business is avoided, and surplus will emerge as provided by the formula given above.

4. The purpose for which the adjusted figures are to be used will determine which of the above approaches will be used. If the liquidating value of the company is wanted, the gross premium valuation approach, without the term for a predetermined contribution to surplus, could be used. If the purpose is to obtain realistic figures for internal management purposes for a continuing business, the natural reserve approach probably would be preferred.

Whatever definition of reserve is chosen, this definition determines the adjusted surplus and how expected future profits emerge. Thus, under any one definition of reserve, "net worth" and "adjusted book value" are the same.

FREDERICK S. TOWNSEND:

Mr. Gold's paper is presented at a time when there is an ever increasing discussion, or debate, about adjusted earnings. Such discussion has been prompted by various actions of the investment community, which has felt the need to examine the life insurance industry on the basis of adjusted earnings rather than of statutory earnings.

Historically, adjusted earnings have been in use for a relatively short period of time. Not until 1960, plus or minus one or two years, did adjusted earnings become prevalent in investment analysis of life insurance stocks. Investment analysts did not understand life insurance accounting prior to the time that they adopted adjusted earnings, and they still did not understand life insurance accounting after they had adopted the concept of adjusted earnings. As a result, adjusted earnings have been severely abused.

But the analysts are not wholly to blame. During the 1960's life insurance company managements were as unco-operative in discussing adjusted earnings with investment analysts as they were steadfast in their refusal to consider entering the mutual fund or equity products fields of activity. This lack of co-operation on the part of managements is not unnatural; it stems from two reasons. First, most managements did not know what investment analysts were talking about when they used the term "adjusted earnings." Second, those managements which were willing to discuss adjusted earnings were unfamiliar with the tools and proper methods of investment analysis.

So what happened? For the most part, liberal equity adjustments were introduced, based upon rules of thumb which purported to recognize the increase in the present value of future profits as a base for adjusted earnings, a totally incorrect concept. Adjusted earnings for major stock life insurance companies, as reported by various investment houses, often showed variances of 50-100 per cent from the most conservative to the most liberal methods of computing adjusted earnings. Differences were even more ridiculous when adjusted earnings were applied to new or small life insurance companies.

What is the current situation? The more sophisticated investment analysts are finally discarding the present value of future profits approach, but many are having difficulty finding a new approach because of the lack of company co-operation in arriving at a new method for calculating adjusted earnings. However, the companies are not solely at fault for the lack of progress in this area. My major criticism of the investment analysts is that they are trying to arrive at a formula for adjusted earnings which requires an unreasonable amount of information from the life insurance companies. The data requested from the company are often unavailable, and significant expenditures of time and money are required to obtain them.

What, then, can the life insurance industry and the investment community do to arrive at an adjusted earnings formula which will be uniformly accepted and recognized? What are the prerequisites for such a formula?

In my opinion, a formula for adjusted earnings must be conservative, it must be accurate, it must be simple, and it must be practical and reasonable.

I say that such a formula must be conservative because many formulas in present use are much too liberal and thereby cast a bad reputation not only upon adjusted earnings but also upon the stocks of all life insurance companies, including the largest.

I say that such a formula must be accurate, for, if it were not, the problem of calculating adjusted earnings would not be solved. It does not have to be accurate to an infinite degree. A formula which recognizes the first-year operating loss incurred by the writing of new business is sufficiently accurate for determining adjusted earnings.

I say that such a method must be simple because a complicated formula is unwieldy. It cannot require a complex calculation by computers but must be capable of being calculated quickly with paper and pencil or by a desk calculator. Also, a complicated and lengthy formula does not guarantee absolute accuracy merely because of the amount of detail required.

I say that such a formula must be practical and reasonable, and this means for all parties concerned. Demands upon company managements for additional information must be minimal. Otherwise they simply will not provide the data. The formula must be one which the investment analysts can easily and quickly calculate. Finally, consider the plight of the poor investor. The formula must be one of which he can understand a verbal description and one for which he can also perform the calculations himself.

It seems that all I have done to this point is to criticize. Can I help? I am still waving the banner for my own proposed uniform method of calculating adjusted earnings. I have discussed this proposal at three previous meetings of the Society of Actuaries—at Washington, D.C., in April, 1966; at Miami in November, 1966; and at Chicago in November, 1967. Also, upon its request, this method was presented to the New York State Insurance Department, in June, 1966. The illustration which I presented to the department is reproduced by Mr. Gold under section 5, adjustment 2, definition *b*, method 2 of his paper. The numbers are the same, but Mr. Gold prefers to use premiums in force instead of insurance in force as the parameter for calculating adjusted earnings. It is rather immaterial whether premiums or the insurance accounts are used at this point, because the method itself is not yet in common use. Also, whereas my illustration was based upon column 3 of page 5 of the Convention Blank, Mr. Gold adds columns 4-6 to the calculation process. I feel that this is unnecessary, because it greatly compounds the work required and

the results will be relatively unchanged. Consideration of columns 4-6 in the Convention Blank will probably mean a difference of less than \$0.01 per share for most life insurance companies (Southwestern Life being the only notable exception).

I made the following statement at Miami in November, 1966:

Perhaps the necessary correction lies in making a single change in the NAIC annual statement. I would like to see column 3 of page 5 (the by-line income statement for ordinary life insurance) split into two columns (possibly cols. 3a and 3b) representing the respective income statements for first-year business and for renewal business. Thus, the first-year operating loss for ordinary life insurance, divided by the volume of new ordinary life insurance written, will give a surplus depletion factor per \$1,000 of new business. Then, multiplying the surplus depletion factor per \$1,000 of new business written times the increase in ordinary insurance in force will give an approximate total surplus depletion created by the increase in the company's ordinary insurance in force account.

By using this method, adjusted earnings would equal the net gain from operations increased by the amount of surplus depletion incurred in increasing the company's in-force account. Thus, adjusted earnings would approximate the statutory earnings which would have occurred if there had been no increase in the in-force account during the year. Or, expressed in a different manner, adjusted earnings would approximate the statutory earnings which would have occurred if the company had written just enough new ordinary insurance to replace the total ordinary insurance terminating during the year by death, surrender, lapse, maturity, or expiry.

How well does this method meet the criteria for a uniform adjusted earnings formula?

It is *conservative*. It recognizes only the surplus depletion incurred by the increase in the ordinary insurance in-force account. Equity adjustments using this method will be about half the level of many equity adjustment methods in common usage today.

The method will be *accurate* in that it recognizes the major deficiency in the life insurance Convention Blank from the point of view of accountants and analysts. This is the fact that statutory earnings are distorted by the effect of charging all acquisition expenses against income in the year in which a new policy is written.

The method, as acknowledged by Mr. Gold and as clearly shown by comparison with other methods in Mr. Gold's paper, is *simple* indeed.

The remaining question is how *practical* and *reasonable* the method is in its presentation to investors, in its computation by investment analysts, and in the extra work load imposed upon company managements. It is very practical for presentation to investors and for computation by investment analysts. The area of objection is bound to lie within company man-

agements. However, the method is based upon deriving information from the Convention Blank rather than upon seeking additional data from management.

The main question is, "Is the proposed change in the Convention Blank onerous?" I say no. Most of the data on page 5, column 3, are already split into new and renewal business.

Premium income is split into new and renewal business. A sufficiently accurate allocation of investment income may be made between the new and renewal accounts. First-year death claims and first-year cash surrender benefits should be readily identifiable with little additional internal work. If reserves are computed recognizing year of issue, first-year reserves are readily obtainable from within the company. First-year commissions are already shown in the Convention Blank.

The only difficult, time-consuming, judgment allocation required is that of general insurance expenses and taxes. Taxes are relatively small and may be in proportion to the new and renewal premium accounts.

I do concede that expenses are difficult to allocate between new business and renewal business. However, a hasty and approximate allocation of general insurance expenses between the new and renewal accounts will be satisfactory.

I say that a hasty and approximate allocation is sufficient because an error of 20 per cent in first-year expenses will have little effect upon adjusted earnings. (I assume that general insurance expenses could be roughly allocated without too much difficulty and one could still be reasonably sure of hitting the proper figure, plus or minus 20 per cent.) For instance, refer to the year 1962 in the table at the end of the section of Mr. Gold's paper titled "Calculation of Adjusted Earnings." A 20 per cent overstatement of first-year expenses would result in an additional \$360,000 first-year operating loss. Multiplied by 25 per cent, this results in an additional \$90,000 equity in new business. The addition of \$90,000 to adjusted earnings is only 2 per cent of the figure of \$4,750,000 shown in the table.

In summary, I am saying that this method offers both investment analysts and life insurance company managements the opportunity to solve the adjusted earnings problem. Demands upon the company managements are minimal. The only increased work load, from a practical point of view, is the allocation of general insurance expenses into new and renewal accounts. The calculation can be hasty and approximate, because large percentage errors are reduced by the equity ratio applied to such errors and also by the ratio of the equity adjustment to the operating earnings.

To return to Mr. Gold's paper, my only comment is that I believe adjustments involving restatements of the "increase in reserves" are improper. They reflect changes in the prospective net worth of the company, as contrasted to current earnings derived from the current calendar year. Such adjustments also ignore the relationship of cash values to statutory reserves. One example of such an adjustment is adjustment (2) under approach five in the section on "Adjusted Earnings and Net Worth from Outside a Company."

I am also surprised to find that Mr. Gold states in the section "Calculation of Adjusted Earnings" that an adjustment should be made for "the annual increase in the excess of statutory reserves over 'experience' reserves."

In discussing price-earnings ratios and current earnings, Mr. Gold states that "it is clearly improper to include . . . the increase in the present value of future profits in a base used to project future earnings." Later, in discussing Lidstone's formula, he quotes that "the present value of the total future profits of a policy is the valuation reserve less the reserve based on experience rates of interest and mortality and with a valuation premium equal to the gross premium less expenses." Thus, I believe Mr. Gold says that the future profits of a policy should not enter into adjusted earnings and that the future profits of a policy are equivalent to the valuation reserve less the experience reserve.

Mr. Gold later proposes, however, an adjustment to statutory earnings equal to "the annual increase in the excess of statutory reserves over 'experience' reserves." This appears to be a contradiction.

I am pleased that Mr. Gold took the time to write this paper. In so doing, he has created a forum for the discussion of adjusted earnings. My only hope is that other persons will be motivated to help adopt a reasonable and uniform method of calculating adjusted earnings.

(AUTHOR'S REVIEW OF DISCUSSION)

MELVIN L. GOLD:

I would like to thank Messrs. Brummer, Corbett, Stein, Thomas, Tinker and Townsend for their thoughtful and pertinent comments.

I think that we all agree that discussions of adjusted earnings and net worth have all too rarely appeared in the actuarial literature. This time we hit the jackpot with six discussants and a separate panel discussion on this topic at three regional meetings. In this vein, I would also recommend a reading of the remarks of Alan Richards and Stuart Robertson at the Pacific States Actuarial Club meeting on October 27,

1967; the paper presented by Crawford Laing at the Canadian Institute of Actuaries—Younger Actuaries Meeting on April 2, 1968; and my remarks to the Richmond Society of Financial Analysts, March 11, 1968.

With regard to the specific question raised by Fred Townsend, I feel that it is improper to include the increase in the present value of future profits in a base used to project future earnings. In other words, the increase in the present value of profits should not be used as an adjustment to statutory earnings in order to obtain adjusted earnings, which adjusted earnings are subsequently used as a base to apply a price-earnings ratio. However, the difference between statutory reserves and experience reserves can be used. By experience reserves, I mean reserves based on the assumptions implicit in the gross premiums—say, the 1958 CSO Basic Table at $4\frac{1}{2}$ per cent interest or perhaps the assumptions implicit in the commutation columns of Exhibit IIA. No expense assumptions are employed, so that the reserve at time zero is always zero. Terminal reserves can then be calculated by the usual formulas. These experience reserves would ordinarily be lower than the statutory reserves. The “increase in reserves” element for experience reserves would likewise generally be lower than the corresponding statutory increase in reserve item, particularly at the earlier policy durations. These experience reserves, I maintain, do not discount future profits; they are merely based on a less conservative basis.

The experience reserves mentioned in connection with the Lidstone approach would differ in two fundamental ways from the experience reserves used to adjust premiums: (1) the gross premium less expenses would be used in lieu of formula net premiums and (2) parameters differing from those implicit in the gross premium calculations might be used since mortality, interest, expense, and persistency experience may have changed since the gross premiums were formulated.

These differences are fundamental and would undoubtedly result in experience reserves differing considerably from the experience reserves used to adjust statutory earnings. Thus a company may (a) value its business on 3 per cent interest, (b) calculate $4\frac{1}{4}$ per cent experience reserves in order to proceed from statutory earnings to adjusted earnings, (c) calculate 5 per cent Lidstone reserves in order to value its in-force business preliminary to its sale.

I would like to thank Ted Cohn, Jacob Landis, Leonard Rosenberg, and Paul Weichert for reviewing the preliminary drafts of the paper. Their suggestions and comments proved very helpful. I am also indebted to the anonymous reviewers of the paper for the many valuable suggestions incorporated therein.

PRICES AND PROFITS

JOHN M. BRAGG

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GEOFFREY CROFTS:

Mr. Bragg has examined more deeply the nature of the process of determining prices for life insurance contracts. In general, actuarial students are taught that careful consideration of mortality, interest, and expense elements tends to suggest the premium bases. In practice, carefully developed rates are altered by top management by bringing to bear other subjective considerations. Mr. Bragg has attempted to quantify other considerations and bring them into a larger model. To the extent that the model is a valid representation of the significant factors on which rates should depend and the numerical values of the parameters are correct, more precise rates will result.

The parameters for his model are difficult to determine at the present time. But, if the model is accepted by at least a segment of the profession, more resources can be allocated to produce more accurate measurement. The history of actuarial science has been characterized by the increasing precision of measurement; for example, two hundred years ago mortality rates were very crudely determined, while today they are determined for many different groups with greater precision.

Let me offer a few comments on the nature of the model.

The expressions used for ${}_1p_x$, ${}_2p_x$, ${}_3p_x$ are more elaborate than they need be. The functions have desirable mathematical properties, particularly for extreme values of the price. These particular properties need not carry any great weight in determining the shape of these functions in the neighborhood of the pivotal price or the optimum price. They are apt to encourage the "fallacy of actuarial perfection." That is, the relatively elaborate functions have a chance of leading persons to assign greater validity to the conclusion than the basic assumptions warrant.

The slope of the probability functions in the neighborhood of the pivotal price is of prime importance and suggests such expressions as

$${}_1p_x = a - {}_1s(x - \phi),$$

$${}_2p_x = d + {}_2s(x - \phi),$$

$${}_3p_x = j - {}_3s(x - \phi).$$

These expressions should have as great a degree of validity as those given in the paper, and it might be easier to estimate the parameters.

It is even possible to assume P_x to be a straight-line function and to determine the optimum price as the solution of a simple linear equation. It is a question of whether a function should be measured in the aggregate or built up from elements. In actuarial science, we often find it more feasible to measure the elements, as is the case in determining joint life and contingent functions where elementary probabilities for individuals are mathematically combined to determine the probability for a more complex status. In other cases, it seems easier to measure the aggregate function. For example, we measure total mortality rather than observe mortality from different causes and put them together to determine total mortality. However, I think his analysis of P_x into these components is one of the valuable concepts of the paper. It might be possible to measure some of the elementary probabilities, and each has interesting qualities and various degrees of controllability.

Mr. Bragg has attempted to look at the process of price determination as realistically as possible. I hope that it will be viewed that way by others and improved by the introduction of other relevant factors or more precise measurement of the parameters.

MEL STEIN:

Mr. Bragg is to be congratulated upon having written an excellent paper. The new pricing concepts this paper introduces to actuarial literature will, in my opinion, have a profound influence on par and nonpar rate-making and will result in additional papers on this subject, thereby further developing the theory presented therein.

Equation (2) could be expanded to take into account the average unit cost to an insurer of an unsuccessful sales attempt. This cost can vary from zero (insured does not even fill out an application) to a substantial amount (a not-taken after underwriting, a retail credit report, APS, medical exam, EKG, etc.). If this were done, equation (2) would then become

$$(X - C - K \cdot X) \cdot P_x - (1 - P_x) \cdot y,$$

where y is the average per unit cost per unsuccessful sales attempt.

The "functional cost" concept advocated by Mr. Bragg can be of particular value in setting gross premiums if reasonable estimates can be determined for a , f , j , l , m , and n . There can be no question that the use of functional costs (assuming that these six variables have been reasonably estimated) results in far more realistic and meaningful results than the use of "conventional" expenses.

Mr. Bragg's paper is focused on sales through a company's present sales force. Insofar as individual life insurance sales are concerned, the assumptions made about the effect of commissions and premiums on sales are most applicable to weekly premium and MDO insurance. In practice, the first-year commission rate can have at least as great an effect on a company's level of sales as the premium rate, particularly as they affect (1) business from brokers, (2) success in recruiting experienced agency field personnel from other companies, and (3) retaining the present agency field personnel.

This, in turn, leads to the prospect of the simultaneous maximizing of two variables and a margin plane instead of a margin curve. Needless to say, approximating the parameters would be many times more difficult than estimating a , l , j , m , n , and f .

On the other hand, solving for an optimum commission rate after solving for an optimum gross premium would be far more practical, if not as theoretically correct.

Mr. Bragg places great emphasis on the importance of the number of critical encounters and discusses basing an agent's compensation, at least partially, upon the number of critical encounters or interviews he brings about. This approach to agents' compensations is, in my opinion, most suitable (or least unsuitable) for weekly premium insurance, and, to a lesser degree, MDO insurance. As the bulk of Life of Georgia's individual life business is weekly premium and MDO insurance, Mr. Bragg's company may very well be the first (if there ever is a first) to successfully implement an agent's compensation system which takes into account the number of critical encounters or interviews brought about. In my opinion, such a system would have to include at least the following features: (1) a minimum number of interviews required for an agent to receive compensation for these interviews and (2) varying the reward per interview by the proportion of interviews that result in a sale, with a minimum proportion required for the lowest reward per interview.

In any event, I am afraid that I am very dubious about the successful application of such a method of agent compensation for those who sell "regular" ordinary individual life insurance.

There is no doubt in my mind regarding the size of this paper's theoretical and practical contribution to actuarial science and rate-making. I, personally, am more interested in the concepts rather than in the general equations (with two exceptions) presented—and plan to spend a considerable amount of time further developing these concepts for specific practical applications.

In conclusion, I would again like to congratulate Mr. Bragg for his excellent and somewhat revolutionary paper.

JAMES E. HOSKINS:

Mr. Bragg's optimum price maximizes the dollar profit to the company from a given amount of sales effort, subject, of course, to the proviso that the assumptions are realized. At a lower price the company would sell more business, but at a lower profit margin per \$1,000 the total profit would be less. At a higher price the profit margin per \$1,000 would be greater, but less business could be sold, and again the total profit would be less.

Mr. James C. H. Anderson's paper on "Gross Premium Calculations and Profit Measurement" (*TSA*, Vol. XI) suggested that the desirable profit provision in a premium rate might be related to the amount of surplus invested in each \$1,000 of new business. In discussing that paper, I suggested that the desirable profit provision might be related to the risk which the company assumes by the issuance of a policy. Under either suggestion it was recognized that the "desirable" profit loading might be modified by competition. Mr. Bragg's paper furnishes a method of measuring numerically the probable effect of such a modification. After such measurement, management might conceivably conclude that a price other than Mr. Bragg's optimum price might be preferable in the light of the company's business objectives.

By way of concrete illustration I have made some rough calculations on the simplified assumption that a company's entire business consists of \$25,000 regular ordinary whole life policies issued to males aged 35, using the assumptions as to competition and so forth in Mr. Bragg's Exhibit I and the expense assumptions in his Tables 1 and 2. I then arbitrarily assumed that the "desirable" price under, say, Mr. Anderson's criterion is \$18.24 per \$1,000, the top figure in Mr. Bragg's "price plateau" as defined in connection with his Exhibit I. I compared the results, under Mr. Bragg's assumptions, with those expected from using his optimum price of \$17.55. According to these calculations, Mr. Bragg's formula (8) indicates that 34 per cent more business could be sold at the lower price with the same effort. By reason of the increased volume, the so-called overhead expenses, expressed as a level cost per \$1,000, would be decreased about \$0.25.¹ However, the premium income less benefit cost and less expenses other than overhead and sales commissions would be decreased about \$0.60 per \$1,000. The investment of surplus, or the risk assumed, per \$1,000, would, of course, be the same for the additional business that could be written by dropping the price to \$17.55 as for the smaller amount that could be written at \$18.24. In other words, the increment of business which the lower price could produce would not yield

¹On an otherwise similar \$5,000 policy the decrease would be about \$0.40.

the rate of return which the company considers desirable. Management would then have to decide whether the increased volume and total dollar profit which the lower price would be expected to produce would justify accepting a lower return in proportion to investment in new business, or to risk assumed, than had previously been considered desirable, or perhaps whether to adopt an intermediate price.

If, instead of adopting Mr. Bragg's suggestion of making the sales commission depend on the amount of margin, the company continues the traditional practice of relating it to the size of the gross premium, his method can still be used to determine the optimum and the probable effect of competition. The value of k in formula (8) would be changed, and a different optimum premium (in Mr. Bragg's sense) would result.

RICHARD S. ROBERTSON:

This is a very exciting paper. Mr. Bragg presents a number of new ideas. Many will be accepted and probably improved on by the profession. Some will be rejected or presented again in substantially altered form.

The central idea of the paper is perhaps the most important. Mr. Bragg has developed a mathematical model expressing the probability of completing a sale as a function of the price of the insurance and six parameters. The product of this probability and the marginal profit is the expected marginal profit. He suggests that a company should price its product so as to maximize this expected value, subject to the practical considerations outlined in Appendix IV. This is far superior to the traditional techniques, which consider theoretical profit and competition independently.

The theoretical model is very general: ${}_1p_x$, ${}_2p_x$, and ${}_3p_x$ depend on such variables as the amount spent on advertising, the cost of the agents' training program, and the like, in much the same manner as those probabilities depend on the price of the product. The function relating these probabilities and the variables will differ. However, the techniques used to find the optimum level of expenditure would be quite similar.

Even if a company is not immediately concerned with adjusting its gross premium structure, it might be well advised to develop the parameters which would apply to its operations. Such a mathematical model would be a very useful analytical tool for making decisions related to the management of the company sales organization. To the extent the mathematical analysis supports the decisions made by the organization, the confidence in the assumptions underlying the model is increased. If the mathematical analysis contradicts the judgment of the company

management, both the reasoning behind the decision and the assumptions underlying the mathematical model should be re-examined and adjusted to bring about a consistent conclusion.

Admittedly, the selection of the parameters underlying the probability functions is very difficult and somewhat arbitrary. Moreover, these parameters will change from time to time as the nature of the company's agency force and the characteristics of the market change. As a starting point, studies of the company's operations, of other companies' experience, and particularly of data such as those summarized by Mr. Bragg in Table 4 will give reasonable estimates of the magnitude of a , d , and j . To determine l , m , and n , in the absence of any evidence to the contrary, a company might assume that its current rate structure is optimized. This is not an unreasonable assumption, for those rates will already represent a compromise between the pressures of theoretical profitability and competitiveness. If reasonable values of l , m , and n can be generated without contradicting that assumption, the resulting theoretical model will begin life with a stronger belief in its validity and usefulness.

Another idea, which is not developed to as great an extent but which has not been given much study in actuarial literature, is the consideration of only those expenses that are marginal in the determination of the cost of insurance. The general overhead expenses are absorbed out of the over-all company profits. While not appropriate for all actuarial analyses, this treatment of expense would be particularly helpful for a company contemplating participation in a low-margin market which could not be expected to carry more than a part of its share of the company's overhead. It would also be an appropriate way to consider whether to issue and reinsure very large policies or to refuse to issue policies for amounts greater than a fixed amount.

The application of Mr. Bragg's ideas to a mutual company appears to need some further study. The objectives of a mutual company are not as easily defined as those of a stock company. At least they are not as directly related to the net cost of the product. Perhaps the combination with the ideas Mr. Trowbridge presented in his paper of last October would give a workable theory.

Mr. Bragg's approach is of particular significance to a stock company writing the same plan on both a participating and a nonparticipating basis.

Table 6 implies that the relationship between profits and the numbers of sales attempts is linear for a given premium structure. In fact, the amount of sales attempts made will depend on the size of the agency force and the number of attempts each man makes. The former is a func-

tion of a number of factors, including the amount of funds available for agency expansion. Both are functions of the portion of the gross marginal profit remitted to the agency force as commission.

To determine the ideal sales-attempt quota, the relationship between the quota and profits must be reviewed. The return on funds invested in agency development and the amount of funds available must be considered.

Mr. Bragg's studies indicate the desirability of a number of fundamental changes in pricing and commission practices for the life insurance industry. Current practices of varying premium rates by the size of policy would change significantly. The commission patterns would be fundamentally altered, with variations in rates not only by plan but by age and size. If such changes do result, they will be slow to come because of the difficulties in replacing old ideas and customs. I do believe that Mr. Bragg's work will help initiate changes that will benefit both the stockholders and agency forces of life insurance companies.

GARY E. CORBETT:

When Mr. Bragg published "Prices and Commissions Based on the Theory of Games" in the *Journal of Risk and Insurance* in 1966, I thought it was an excellent and thought-provoking paper. I am very pleased to see that he has expanded this earlier work and is using the *Transactions* as his vehicle. Although some of us may not readily grasp all the mathematical formulas used, the basic concepts come through very clearly and can be intelligently discussed apart from the mathematical development.

I would like to restrict my comments to three specific areas: the problem of no company-agent coalition; the effect of price upon persistency; and the problem of carrying Mr. Bragg's pricing and profit philosophy past the rate-setting into the financial statement area.

If a life insurance company is selling its product through independent agencies, there is one further probability that must be introduced into P_s , the probability of sale. This additional factor, which might outweigh all others, is the probability that on any given sale the independent agent will be predisposed to attempt to sell our company's product. This probability depends not only on the company's premium level but also on its commission scale. A further difficulty is that, regardless of predisposition, an agent may switch to another company's product during the sales attempt if he runs into a particular competitive situation or a particular type of sales resistance. For instance, if he finds himself in competition with another agent who has a very competitively priced product

to offer or if the prospect is well informed and price-conscious, the agent may switch from a high-premium, high-commission, high-service company, whose product he prefers to sell, to a low-premium, low-commission, low-service company. I do not feel competent to define mathematically the probability of the independent agent-company coalition, but I would like to pose it as an additional problem for Mr. Bragg and others to consider.

Mr. Bragg appears to have ignored the effect of price upon persistency and thus upon the annuity factor, \bar{a} , which he uses to determine the present value of the margin. Perhaps this effect on \bar{a} was considered and disregarded because the practical effect would be negligible, but there is no mention of any such investigation in the paper. Again, I admit that all I am doing is posing a question without suggesting an answer.

In the third area of comment, I believe I can be somewhat more constructive than in the first two. I would like to illustrate one method of how a "margin" rather than "profit" approach can be applied to statements of financial results for the purpose of management analysis.

In our company we attempt to compare the efforts of production units (geographical divisions) based on their new-business results. The starting points for these comparisons are what we call "acceptable new-business results." These are equal to the present value of all future profits, assuming that each production unit experiences the assumptions built into our premiums. The acceptable new-business results are actually calculated by multiplying the amount of insurance written (in thousands) by the average company present value of all future profits per thousand. We then, in essence, add back to these acceptable new-business results the expenses built into the premiums for field expenses to arrive at a margin that must cover the divisions' actual expenses plus profit. We consider everything other than the divisions' expenses as direct costs of production. In this category we would include mortality costs, reserve increases, all home-office expenses, and agents' compensation. By deducting from the total margin for each division the actual expenses, we arrive at "actual new-business results," or profit. We then divide this actual new-business result by the acceptable new-business result to produce a "performance ratio." What I have described is obviously not a full-blown "margin" approach to profits, but, at least for the field, the effect is to compare actual expenses with the total margin available in the premiums.

I hope that Mr. Bragg's paper will have the effect of raising more questions and, more important, that Mr. Bragg or others of his ability will undertake to answer such questions.

CHARLES L. TROWBRIDGE:

Mr. Bragg in this paper has made a truly significant contribution to actuarial literature. To get the full flavor of what Mr. Bragg has to say, however, one must also study his earlier work appearing in the *Journal of Risk and Insurance*. The two papers taken together suggest an ingenious approach to the problems of pricing and commission-setting, based on the theory of co-operative games. They include a frontal attack on the important, interesting, and largely unexplored question of the probability of sale at a given price. Finally, they raise exceedingly important questions about life insurance marketing methods.

The interested reader should consult Mr. Bragg's earlier article for a fuller treatment of what he describes there as the Second Contest, revolving around the best division between company and agent of the margins in the optimum price, arrived at through game theory. One of Mr. Bragg's important concepts here is that of the sales-attempt quota. From a point of view of practicality rather than theory, this may be a little hard for some actuaries to accept. Perhaps his company is more successful than others in getting the sales force firmly committed to a specific sales-attempt goal. The sales-attempt quota appears to be an over-all quota based on all products offered rather than the sum of several individual product quotas. This leads us to wonder whether the principle of maximization of margins would have the effect that low-margin coverages would hardly be offered, as is already charged by some critics of life insurance commission practices.

The student of Mr. Bragg's paper finds himself intrigued by the ingenious six-parameter probability function P_x , representing the probability of sale at price x . In the earlier article only three parameters were employed, each designating a point on one of the three subsidiary probability functions. The three new slope parameters appear as exponents (replacing the square in the earlier model) and add additional flexibility for fitting one's opinions as to price elasticity. With this improvement (at the expense of some additional complication) the model is believable with respect to the single-sale situation common in individual policy marketing through a company's own agents.

The model is much complicated, however, if the sales process really requires two critical encounters, the second arising because some middleman must be convinced before the ultimate buyer is approached. This middleman may be a broker, who has available many products from many competing companies, and who will present only a few of these to his buyer-client. From the insurer's viewpoint the probability of sale at

price x then depends upon an additional subsidiary probability—the probability that the broker will recommend the company's offering. Mr. Bragg may prefer to rule out brokers as a means of distribution, but for many companies, particularly those very active in group, the brokerage channel is a fact of life.

Another form of the two-encounter sale is the marketing of an insurance product to an individual through the sponsorship of some third party. Salary savings, association situations, and perhaps H.R. 10 sales are likely to have such characteristics. Again the model needs an additional subsidiary probability related to one's chances of getting the sponsorship. Having once obtained it, the chance of selling the individual is presumably increased.

Perhaps marketing through some sponsoring organization will ultimately be one answer to Mr. Bragg's observation that we now expect the agent to be prospector, qualifier, and appointment-seeker, as well as salesman. He suggests that the company become more active in these preliminary phases, helping the agent find and qualify prospects and bring them to the critical encounter. One way the company could perform this more active role, based on the total marketing concept, would be for it to assume responsibility for arranging the sponsorship. Such a concept would modify the traditional relationship between company and agent and would call for a different division of margins. It might or might not prove to be a more efficient means of life insurance marketing.

B. FRANKLIN BLAIR:

Mr. Bragg has given us an excellent and stimulating presentation of the application of game theory to problems which are of paramount importance to most actuaries, namely, the determination of optimum prices and the maximization of profit. He has brought out into the open and treated mathematically these problems, which in the past we have tended to tackle either by trial or error or by simply copying competitors.

As I understand Mr. Bragg's development, it is assumed that the commissions should be "as fair as possible to the field force" and that "commissions are expressed in terms of percentages of the margins in actual sales made." These assumptions may be possible for companies not operating in New York State. However, for companies operating in that state, there is a definite upper limit on the allowable commission, and that limit is expressed as a percentage of the price and not as a percentage of the margin. It would be interesting to see how this additional restraint would affect the mathematical development and the "price plateau."

In the section of his paper on "Measurement of the Probability of Sale," Mr. Bragg reports on a survey conducted by the field force of Life Insurance Company of Georgia. Table 3 shows, *inter alia*, that competition was encountered on 11 per cent of the 349 sales *attempts* on regular ordinary insurance. This figure happens to agree exactly with the results of a survey of sales *closed* by Provident Mutual full-time agents during January, 1968; they reported competition on 11 per cent of the 1,242 applications completed during that month.

Table 5 seems to indicate that the choice of the parameter set affects considerably the optimum commission rate. It is unrealistic to have optimum commission rates vary according to the face amount of the policy as much as they do for regular whole life in those "Selected Examples."

In Appendix IV, Mr. Bragg gives an example of one relationship of the premiums (using a policy-factor system) for various size amounts and various modes. Although I realize that this was set forth merely as an example and not necessarily as an ideal relationship, I would like to express disagreement with the relationships given for bank mode premiums. In view of the additional expense and the loss of interest on bank mode premiums in comparison with annual premiums, I believe that bank mode premiums should be more than 100 per cent of the annual divided by 12 and that the policy factor for twelve months on a bank mode case should certainly be more than \$12.60 if the factor is \$12.50 on an annual case.

Mr. Bragg's "Conclusion" presents a concise and helpful summarization of the practical use which might be made of his paper. His first conclusion ties in with present-day theories of management, which emphasize the need for specific objectives for the particular organization. I approve of his emphasis on the company and the field force as a coalition, particularly the emphasis on loyalty to each other and abandonment of brokerage as well as direct dealing; the company and the field force are too often regarded as playing against each other. At the same time, we must be mindful not to obtain an unreasonable short-term advantage over the third participant in the game, the prospect; for an unreasonable short-term advantage will inevitably have long-term unfavorable repercussions against both company and field force.

J. ROSS GRAY:

It is always good to have someone come along and shake up one's established ideas, and Mr. Bragg has done just that. I am not proposing

to go right along with him. Neither am I proposing to defend old ideas merely because they are old.

Mr. Bragg has pointed out the reasons behind what most of us have felt for some time, that the level of premium rates, even nonparticipating premium rates, is not critical. There is a plateau where a company is relatively free to choose between a lower premium rate if it will produce a greater volume and a higher premium rate which may well result in lower volume.

This does not help one iota, however, in mollifying the agent who has just lost a case in competition. I rather imagine that agency pressures will be toward lower premiums.

Of course, it may very well be that the agent's complaint when he loses a case in competition is a result of his inability to see that in the long run he will profit from higher premiums and the higher commission rates permitted by such higher premiums.

The use of the concept of dividing the prospective profits between agent and company, 45 and 55 per cent being suggested, is one of those things which perhaps can be considered in the basic philosophy of the company, but which in most cases has long gone past. Most of us are very much built into a position of established commission rates; we may even be held there by law. In any event, our agents are a continually changing group of persons; it is just not possible to arrive at any coalition except such as may be transmitted by agency department officers. Accordingly, it is my opinion that commissions must be treated as part of the expenses which will be incurred in issuing the policy, that is, as part of item *k*. If this is done, it would seem to restrict considerably the size of the plateau for the optimum price.

Mr. Bragg's "break even price" is far removed from the use of marginal expense rates, as suggested in topic 4 of the panel discussion on premiums and dividends. His "break even price" would contain no provision for overhead and no prospective profit for the company, but neither would it contain any commission for the agent; therefore, sales would be nil. However, a premium covering marginal expense rates would include provision for paying sales commissions, so that we would have the situation of considerable sales without profit or provision for overhead. The methods of the paper could then be used to determine what further increase in price would yield the company the greatest profit, direct provision having already been made for the agents' sales commissions.

It is a little difficult to accept the disavowal of the coalition of the

company and agent as not being harmful to the prospect. We were introduced to the idea of a game. In a game, if there is a winner there is also a loser, and if two persons by forming a coalition can increase their winnings, surely the third person has suffered greater losses. It is only a partial answer to say that if the price is too high he does not need to play, that is, that he can apply to another company.

The statement is made that at root the industry exists to assist all people in times of need. To my mind this requires the selling of as much insurance to as many persons as possible. The stockholders of the companies must be permitted to make a profit in the process, or they will not seek the business. The agent must be permitted to make a profit, or he will not try to sell the business, and the basis of his remuneration should be such that he will try to sell as much business as possible. It seems to me that, from an industry point of view, we should be trying for a premium rate which will maximize the amount of insurance sold rather than the company's and the agent's profits.

The paper touches briefly on the role of the mutual company, and I quite agree that it should be the duty of management to see that new-business operations are carried out in the best possible interests of present policyholders. We at once meet problems which do not exist in a non-participating stock company.

The first problem is that we are not selling insurance at a fixed net cost. The dividends are variable, and the moment a policy is sold the new policyholder becomes one of the owners of the company and is eligible to share in whatever profit or loss will result from the issue of his policy. It would seem that his share would only be that infinitesimal portion applicable to his policy and that we can carry out calculations based on the existing dividend scale without concern for any alteration in his dividends.

We must resist the temptation to take account of the interests of the prospective policyholder as being those of an existing policyholder and therefore those dealt with in the paper as being those of the "company." When the sale has been made to him, he is henceforth a policyholder and eligible to share in the profit of future sales; but until then he is only a prospect for whom the present policyholders have no regard.

A second problem is that the existing policyholders have no way of realizing with certainty on the profit resulting from new sales. A stock company which issues a block of new business will suffer a decrease in immediate surplus, but if the products have been properly priced the profit will arise in future and the shareholders will receive their dividends. In the meantime, if a shareholder decides to sell his stock, he will receive

a price which should reflect both the decrease in surplus which has occurred in writing new business and the prospective profit from the new business which has been sold.

The existing policyholders of a mutual company are in a quite different position. No policyholder can assume that he will be here to receive his share of the profits in the future. Neither can he sell his interest in such future profit. It is only his guaranteed cash value which is certain to be available to him. If his cash value is held down so as to yield the profit which was anticipated when his policy was issued, and if the dividends have only reflected the earnings to date—these are both pretty large “ifs”—it would seem that the terminating policyholder should be entitled to his share of the prospective profits on policies issued since he became a member. Otherwise, in determining the scale of cash values, some balance must be struck between the profit which was anticipated on his policy and his share of the profits on subsequent policies.

J. STANLEY HILL:

Mr. Bragg is to be congratulated for leading us into an important new area of logical thought and for adding a valuable new tool to our actuarial kit. His accomplishment is all the more remarkable in that a highly theoretical discipline has been applied to problems that our business theretofore considered soluble only by the most pragmatic approaches.

The author concludes that the optimum price plateau is fairly broad. This accords with my own observations based on correlative studies of projected policyholder costs and growth of the individual insurance in-force account.

At first glance this statement does not seem reasonable. Our instincts cry out that there should be a marked inverse relationship between price and growth. Further reflection leads us to believe that, as the price is raised, more money becomes available to promote the sale through additional advertising, higher commissions, more sales support, and so forth. The additional sales resulting from these activities appear to be offset by those sales lost because of a less competitive cost position.

The author has raised a question concerning the applicability of his ideas to a mutual company. I believe they are eminently applicable. Although the stated objectives of a mutual company are different from those of a stock company, its methods of achieving those objectives do not differ significantly from those of the stock company. Unfortunately, all too often the objectives of the mutual company remain unstated. It is improperly concluded, therefore, that the mutual company's objective is to provide insurance at the lowest possible cost for the existing

policyholders. This is only one objective of the mutual company. Let us consider this analogous to the stock company's objective of providing maximum market performance of its stock. Any stock company officer would quickly observe that he has a longer-term objective—that is, to build intrinsic value in the stock. Good management requires a proper balance between the shorter- and longer-range objectives.

A similar balance is required in a mutual company. The short-range objective has already been stated. The longer-range objective is to serve the life insurance needs of as broad a segment of the public as it can. The mutual company must balance off these two objectives—the one short term and the other longer term.

I conclude, therefore, that Mr. Bragg's able presentation should be of equal value to actuaries of both mutual companies and stock companies.

ERNEST J. MOORHEAD:

The aim of this discussion is twofold: first, to direct actuarial attention to what seems a fundamental difference in the field of agency management between Mr. Bragg's major recommendation and those of some other thoughtful actuaries who have spoken on the subject; second, to question whether the "company-agent coalition" is really the most desirable among the choices that are available.

On the first of these points it is instructive, I think, to meditate upon the contrast between Mr. Bragg's prescription for agency operations and those set forth in the Operations Research Panel in 1965 by Nathan F. Jones and W. M. Anderson (*TSA*, XVII, D336, D346). All three of these actuaries stress the need for change. But Mr. Bragg pins his faith upon increased efficiency through institution of the sales-attempt quota; the others seem to advocate much more sweeping revisions of our industry's marketing procedures in the years ahead. The question for us to ponder is, having regard to what is desirable and also to what is practical, whither ought our industry try to move?

Even with recognition that words used in the Theory of Games have special meanings, one must swallow hard before fully accepting Mr. Bragg's thesis that a coalition of company and agent will most effectively lead our business toward the ideal of service and toward the proper price for that service. My hope is that the author will in due course write a sequel to the present paper, entitled, perhaps, "Prices and Performance," in which the implications of agent-prospect coalition are examined with the thoroughness and skill displayed in this present paper.

The question of what constitutes loyalty of an agent to his company

is large and difficult. Mr. Bragg's idea, if I understand it correctly, is that, if the company actually charges something close to the optimum price for its product, then loyalty (defined for this purpose as writing 100 per cent of one's new business in one's own company) can be exercised without harm to the purchaser. But is this true in, for example, a company that writes only ordinary business? Such a company could determine and charge an optimum price for, say, its pension trust business, but that would not protect from harm a prospect whose needs might better be served by a group annuity.

It has seemed to me that an enlightened life insurance company should not require or even particularly urge its career agents to submit all their business to it. The company should establish a reasonably high quantity of production to qualify the agent for maximum compensation and benefits and should periodically study the characteristics of business that its agents are deciding to place in other companies. The company can then decide whether or not it wishes to change its products or its underwriting so as to attract some of that business itself. Sometimes the answer will be one way, sometimes the other.

Mr. Bragg's is a trail-blazing paper, both for what it offers directly and for the thinking that it generates.

FREDERICK S. TOWNSEND:

Mr. Bragg has presented us with a paper which is novel, which is of broad general interest, which is remarkably clear in its presentation, and which poses many interesting questions to the reader.

Although the paper is truly concerned with "Prices and Profits," some of the author's remarks leave me with the impression that the paper is indirectly an endorsement of mass marketing and a condemnation of the American agency system.

Mr. Bragg finds "little or no correlation between the growth of companies and their price positions" and states that "the sales-attempt quota is much more likely to influence company growth." Companies with high sales-attempt quotas are usually those companies employing either (1) mass-marketing techniques or (2) special prospecting techniques.

Mr. Bragg enumerates functions *a* through *d* which the American agency system agent performs. He also poses the question of whether companies could assist in functions *a* through *c*, thus freeing the agent to concentrate his time and efforts on function *d* only. This is precisely what the mass merchandisers are doing and is the reason for the rapid growth exhibited by such companies.

If an agent performs functions *a* through *d*, he is paid a regular commission rate. But, when the company brings about the critical encounter, by performing functions *a* through *c*, this commission rate is lowered (or agents are paid a salary). A form of collusion results between all three parties: the company, the agent, and the policyholder.

Because the company develops the prospects, high sales-attempt quotas are set. Because of the increased number of prospective sales, the commission rate can be lowered. Because of the lower commission rate, the price of the product can be lowered. Because of the lower price, the probability of the sale is increased. Because of increased sales, aggregate dollar commissions are increased for the agent and aggregate profits are increased for the company, but cost to the policyholder is reduced.

The preceding observations are my own, and I do not mean to imply that Mr. Bragg is pushing mass marketing upon us. Let us just say that the verbal discussions in Mr. Bragg's paper are timely and quite apropos in today's insurance market.

EDWARD A. LEW:

This paper and Mr. Bragg's earlier one on "Prices and Commissions Based on the Theory of Games" show how conceptual analysis can be used to illuminate relationships between sales and other objectives in the life insurance business. Sales operations have usually been planned on the basis of recent experience and anticipated general trends, with the aid of considerable business judgment. More sophisticated approaches have not been feasible because not enough pertinent statistics were at hand and because the sociological and psychological aspects of sales problems could not be evaluated in quantitative terms. However, much that was formerly regarded as intangible is now becoming measurable, so that logical analysis and measurement can begin to replace the more intuitive approaches followed in the past. Mr. Bragg's paper bravely explores some of the issues involved, calls attention to a few key concepts in life insurance selling, and indicates how these can be used to develop a theory of prices and profits.

My remarks pertain to the central concepts of the critical encounter and the sales-attempt quota and to the game-theory parable.

Critical Encounter

The critical encounter is a natural unit of sales effort. However, the effectiveness of this unit of effort varies under different circumstances, so that it is clearly important to find out more about the factors which influence the probability of a sale in critical encounters, assuming always

that the price of insurance lies in the rather wide range that can be regarded as optimum for practical purposes.

Many of the factors that can increase the probability of a sale relate to the characteristics of the prospect, as for instance, his age, income, phase of family life, occupation, education, and the like. Others relate to the qualities of the agent, such as his ability to establish need for insurance and to use different sales approaches. In my judgment, however, the interaction between prospect and agent is often more important than the specific qualities of either alone. Good interactions lead to sales and satisfactory relationships. This is brought out in the study by Franklin B. Evans, to which Mr. Bragg refers; in this study it was found that prospects who purchased insurance seemed to know a great deal more about the agent and the company and felt more positively about the agent than the prospects who did not buy. The sold prospects saw their agents as insurance experts who were personally interested in them and enjoyed social relationship with their agents, whereas the unsold prospects viewed the agents as motivated solely by anticipations of a commission and as not interested in them as people. When the agent and prospect had similar backgrounds in terms of age, income, religious and political affiliation, and the like, the probability of a sale in the critical encounter was distinctly higher.

It is also manifest that once an agent has established a satisfactory relationship with a prospect, the probability of a sale is very much greater than it is where such a relationship does not exist. Accordingly, for planning purposes we should carefully distinguish between sales calls on old clients and encounters with new prospects. A recent survey shows that a significant number of the public have their own agent and that the nature of the relationship is predominantly social or based on premium collection. Many people find it useful to discuss life insurance with agents even when they are not actively considering purchase of insurance; but this is most easily done when the agent and the customer have a common frame of reference, especially similar attitudes to saving and financial security.

When the prospect does not feel a real need for insurance or can readily obtain life insurance coverage from another agent, it becomes doubly desirable for the soliciting agent to understand the prospect's problems and values. Such awareness can be crucial in the first encounter with a prospect, when initial interest is aroused and a basis for future encounters prepared.

Thus, better matching of agents with customers appears as one of the superior strategies for increasing the probabilities of a sale in a critical

encounter, especially with new prospects. This strategy may be quite practical in neighborhoods where people with similar backgrounds tend to congregate, but little has been done to trace neighborhood characteristics along these lines.

This kind of matching is often not feasible, however, and in such circumstances an optimal allocation of sales effort must be sought by reference to the ascertainable characteristics of potential customers only, particularly their ability to pay, their need for life insurance services, and other individual factors that may enhance the probability of a sale.

A recent Metropolitan survey, which included questions about the number of agents who had tried to sell insurance to male householders

TABLE 1
ESTIMATED RATIOS OF SALES CALLS* TO SALES
(Nation-wide Sample of 5,500 Married Men under 65)

A. BY AGE, BY INCOME, AND BY SIZE OF PLACE

Age	Ratio	Income	Ratio	Size of Place	Ratio
Under 25.....	3.4	Under \$4,000....	7.1	100,000 or more..	6.8
25-29.....	4.2	\$ 4,000-\$ 9,999..	6.0	25,000-99,999..	5.9
30-39.....	5.2	\$10,000-\$14,999.	5.6	2,500-24,999..	6.2
40-64.....	8.9	\$15,000 and over	6.2	Under 2,500 or in country.....	5.9

B. BY EDUCATION AND BY OCCUPATION

Education	Ratio	Occupation	Ratio
Some college or more...	5.7	Professional, executive....	5.8
High-school graduate...	5.8	White collar.....	5.9
Some high school or less.	8.0	Blue collar.....	6.3
		Farm.....	7.4
		Other.....	9.4

C. BY FAMILY CHARACTERISTICS

Number of Children	Ratio	Employment Status of Wife	Ratio
None.....	8.9	Wife employed.....	6.2
One.....	5.4	Wife not employed.....	6.1
Two.....	5.4		
Three or more.....	5.4		

* The magnitude of the figures shown for sales calls should be regarded as a crude approximation, but their gradient with respect to each factor considered is believed to be significant.

during a five-year period, provided me with some data for estimating roughly the ratios of sales calls to actual sales by age, income, size of place of residence, education, occupation, and family characteristics of the prospect. These ratios, shown in Table 1, relate to a nation-wide sample of 5,500 married men under 65; they included about 2,400 men who had purchased insurance at various times during the past five years and about 3,100 who had not done so. Other findings in this survey brought out that most of the action in life insurance selling today is not in first policies but in additional contracts.

Table 1 shows broadly where the optimal prospects are to be found with respect to age, income, place of residence, education, occupation, and characteristics of family life. Every agent has some leeway to concentrate on the optimal prospects in his area, and they should be identified for him. More specifically, the agent should be told to concentrate on sales encounters with people on crucial occasions, such as marriage or birth of a child and secondarily at time of a pay increase or starting on a better job. The probability of a sale can also be enhanced by attention to the changing needs of the prospect, including greater effort to upgrade the amount of life insurance carried by him. Surveys have been virtually unanimous in reporting that life insurance is widely regarded as a necessity, even though the public's ideas about what constitutes an adequate amount of insurance are either unrealistic or vague. Above all, companies would do well to stress the importance of customer follow-ups, simply because the great majority of men who have bought a policy recently report being satisfied with their purchases and with their companies. The aim of all such directions is to increase the productivity of the agent.

Sales-Attempt Quota

The sales-attempt quota is essentially a much-needed measure of the total amount of effort necessary to justify individual agencies, to produce fair and satisfactory incomes to agents, and to provide for company growth and overhead. If thoughtfully determined, varying sales-attempt quotas for different agencies can furnish a sharp tool for forecasting sales.

Recent surveys suggest that agents are actually much less aggressive than has been imagined. Thus, in the July, 1967, issue of *Best's Insurance News*, Elmo Roper, of Roper Research Associates, said:

They [the agents] seem to be waiting for much of their business to come to them rather than actively pursuing it, and they are not directing their sales efforts where they could pay off best. We have found, for example, that almost as many buyers of first policies take the first step toward purchase themselves as are approached by salesmen. And a third of these first buyers report that only

one agent contacted them—the one they bought from. It is an odd situation that in such a highly competitive field, when sales of first policies occur, in so many cases there is no competition at all!

We have also discovered another important fact about insurance sales. Once this first policy has been sold, the vast majority of first-policy buyers are highly satisfied with the agent and with the company they bought from, as well as with the policy itself. They are also excellent prospects for future sales. Many of them buy more insurance soon after purchasing their first policy. Yet strangely enough, they tend to be neglected as sales targets once the initial sale is consummated. Most recent first-policy buyers report no further contact with the agent after buying. As a result, about half of further insurance purchases by people who have already bought a first policy are lost to the company and agent who made the first sale, and are reported to us to have gone to another company entirely!

These remarks underline the advisability of a minimum sales-attempt quota for each agency, especially if supplemented by greater assistance to field men in locating prospects. Locating prospects by having agents search for them is not a very efficient procedure. Companies can do much to increase the efficiency of finding prospects by providing agents with lists of policyholders at the prime insurance ages and with maps showing the socioeconomic characteristics of the population in the neighborhoods they are expected to cover.

If only because of the wide disparities between the market potentials of different localities, it would appear necessary to vary the sales-attempt quotas for individual agencies, depending on the distinctive features of each locality. Variations in sales quotas might in addition take into account the special characteristics of both old policyholders and other potential customers, some measure of the agent's compatibility with the customers, the suitability of the products and services offered, the extent of competition in the area, and even other variables. To set such sales-attempt quotas intelligently for different agencies, elaborate field management information systems will have to be devised to collect, evaluate, and analyze marketing information for small areas. Studies of consumer behavior in different areas and of the intensity of competition at the local level would help us to learn more about consumer responses under different circumstances and at various levels of sales effort.

With partial information along these lines in hand, an agency could be defined in terms of a minimum number of sales-attempt interviews, perhaps with different stipulations for existing policyholders and for others. The sales-attempt quota would, of course, be fixed primarily to produce a satisfactory minimum income for the agent in the particular

locality. To have practical validity, it would have to be calculated on conservative assumptions as to the sales expected from the numbers of sales-attempt interviews stipulated. Even if circumstances later made it advisable to increase the sales-attempt quota for an agency, the increase could be held down by redirecting some of the agent's efforts into more productive channels. In this way, an agent could be reasonably assured of a satisfactory level of income related directly to the efforts he is called upon to make.

Mr. Bragg's proposal for organizing a company's sales efforts on the basis of a stipulated volume of sales-attempt interviews in each agency offers not only a more rational system of agency compensation but also real opportunities for management. Such a system would have to be accompanied by extensive assistance to agents to bring their sales encounters to a successful conclusion. This could be encouraged by providing some direct financial incentives to agency managers for promoting productive sales encounters by their agents.

Game Parable

Mr. Bragg has been wise to speak of the critical encounter between a prospect and the agent (representing a coalition between the agent and the company) as a game parable rather than as an explicit application of game theory. Game theory has been used to show what logically ought to happen in situations involving conflict or competition when two or more players have consistent preferences and follow them in a consistent manner, assuming always that they (a) pursue their interests in a rational manner, (b) know each other's strategies, and (c) have no communication with each other. Such an approach has shed some light on strategies in certain very special types of interactions but has little relevance to encounters between prospect and agent, if only because it presumes inhuman rationality, maximization of utilities about which little is known, and no communication between the parties involved. In a prospect-agent encounter, there is likely to be a great deal of talk, negotiation, and cooperation simply because some of the long-range interests of the two parties can best be served in this way.

In his earlier paper, Mr. Bragg pointed out that we have little understanding of the factors that influence a prospect's utility in purchasing or not purchasing life insurance. Rough probability estimates, rather than game theory, have therefore been used to describe interactions between prospect and agent. Some aspects of the public's behavior in dealing with agents are nevertheless in accord with game-theory considerations. For instance, recent surveys have shown that most people want

agents to present alternative offers rather than single recommendations, apparently because people feel that an agent's motives are not entirely objective, while their own knowledge of life insurance is usually inadequate. In such circumstances, game theory would counsel enlarging the set of alternatives, even to include timing as part of a wider choice, and this is precisely the way in which the public has reacted. The same surveys indicate that the more knowledgeable a prospect is the less reliance he tends to place in the agent, but the better he gets to know the agent the less concern he shows about the agent's motives.

It may well be that bargaining models and nonco-operative games could have a certain value as a new way of looking at the prospect-agent encounter, provided the sizable elements of irrational and illogical behavior in the purchase of life insurance can be disregarded. On the other hand, the theory of co-operative games may have application to negotiations between companies and agents, if only because the agreements in such games are fully binding and enforceable. In highly structured situations game models can be used to clarify the strategic values and implications of such maneuvers as coalitions, threats, and surprises.

(AUTHOR'S REVIEW OF DISCUSSION)

JOHN M. BRAGG:

Taken as a group, the discussions are fascinating. All twelve contribute to, and advance, the new ideas presented in this paper.

The paper contains pricing (and commission) proposals and merchandising theories; all are interwoven. For fear of the reply's being as long as the paper, I will refrain from comment on every point. I will comment only on the most important issues, dealing first with the pricing aspects and then with the merchandising aspects.

Several discussers have suggested a more elaborate two-stage function in which the company would offer commission designed to predispose an agent or broker to present the product instead of that of another company and to dissuade him from switching to another loyalty if the going gets difficult in midsale. Such a function would seek an optimum combination of (a) commission just high enough for the broker, (b) price just low enough for the prospect, and (c) margin expectation for overhead and profit "just as good as possible." This recognizes a common situation, especially in ordinary companies catering to upper-class markets, where the commission on the specific sale seems to be the only inducement bringing about the critical encounter. I welcome this extension and hope that such a function will be developed.

Mr. Stein has suggested an improvement by taking direct account of the expense of unsuccessful encounters and Dean Crofts by the use of straight-line functions. Dean Crofts also points out that realism is involved in the pricing methods advocated by the paper. Mr. Robertson makes valuable suggestions concerning the parameters. Mr. Corbett points out, very correctly, that persistency will vary if the price varies. The paper allows for persistency variations only by plan, age, amount, and so on. The additional refinement can be secured by having the constant quantities c , \bar{a} , and possibly k become variables of the price x . Computers would be capable of determining their values as "subroutines" to the main price and commission computations. The basic theory would be unaffected.

The paper advocates the sales-attempt quota. This is based on the elementary notion that "we sell business only if we try to sell business." The sales-attempt quota already exists, because, consciously or otherwise, every company is attempting to sell a certain amount of business. However, the sales-attempt quota does need to be recognized and systematized. Mr. Lew's excellent discussion points out how it can be established by intelligent planning on a field-office basis. The tug of commissions should no longer be relied on as the sole stimulus to sales attempts.

The paper also advocates a coalition between the agent and the company. Modern observers frequently call for an end to the traditional bickering and the beginning of greater mutual understanding. In the leading trade press, this week's headline reads ". . . Cites Need for More Rapport between Home Office, Field."

Is the coalition harmful to the prospect? It must not be. In its own best interests, the coalition must see that the prospect is protected much more than ever before. In the language of the game parable, the critical encounter between coalition and prospect is a two-person co-operative game. This is the type of game in which "both players can win," if they fully understand each other's systems of values and are willing to confine themselves to certain optimum outcomes. Such outcomes should be discovered and advocated.

Mr. Lew very well discusses the critical encounter and points out ways in which more satisfactory results can be achieved.

The author wishes to thank all those who have discussed this paper and his many other friends who were so helpful in its preparation.

EXPECTED CLAIM COSTS FOR SUPPLEMENTARY MAJOR MEDICAL EXPENSE BENEFITS

JOHN MAHDER AND DANIEL W. PETTENGILL

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GARY N. SEE:

In the area of group health insurance, this paper is perhaps the most valuable one written to this date. Its value will be even more enhanced as future experience is compared to the 1965 Supplementary Major Medical Tabular.

The authors noted that Table 6 seemed to indicate a higher adjustment to increase the maximum benefit. This could possibly be caused by selection of lower maximum plans in lower cost areas; as the paper states, it is difficult to isolate one factor to the exclusion of others.

Table 12 denotes a higher cost than expected for the \$50 deductible experience. Quite frankly, it does not seem appropriate to offer this plan on a standard basis, as it is more of a "hybrid" comprehensive approach than base plan plus supplementary major medical coverage.

Table 19, which indicates the higher claim experience for under twenty-five lives, substantiates an additional loading or some form of individual underwriting for this size category. For those companies offering coverage to groups as small as three lives, an even greater loading might be required; I presume that most of the experience for under twenty-five lives in the paper would include groups with a minimum of ten lives.

The authors indicated that loading the employee age-female adjusted rate was not entirely logical but produced good results. Actually, to be logically consistent, one could make a good argument for charging the spouse of a high-female-content employee group a rate close to the 0-11 per cent male employee rate. The reason the industry does not generally do this, I believe, is related to the difficulty in enrollment of the dependents, possible antiselection involved, and other underwriting considerations.

I agree with the authors that differences in utilization by area cannot be ignored. This becomes particularly apparent in a modest base plan and supplementary major medical plan in comparison with a comprehensive plan which reflects differences in utilization.

Our company, in the latter part of 1967, drastically revised its supplementary major medical rates. The result was that groups having the same

base plan for the last three years often had a rate increase of more than 100 per cent in their supplementary rates. This can be simply illustrated as follows:

	CALENDAR YEAR	
	1965	1968
Basic tabular cost	1965 tabular cost	130% 1965 tabular cost
Base plan credit	75% 1965 tabular cost	75% 1965 tabular cost
Balance tabular cost	25% 1965 tabular cost	55% 1965 tabular cost

This tabulation assumes that the only change which has taken place is a 30 per cent increase in the basic tabular cost. As can be seen, an increase in liability of over 100 per cent results. Quite frankly, I believe many companies have been underpricing their supplementary major medical coverage; hopefully, this paper will help to correct this situation.

The authors, the Committee on Experience under Group Health Insurance, and the contributing companies are to be congratulated for this accomplishment. This paper will certainly become required reading for students of group health insurance.

THEODORE W. GARRISON:

The authors have done a tremendous job in designing and presenting the intercompany tabulars for supplementary major medical insurance. All of us who work with health insurance are indebted to them for their efforts. I would like, however, to make two minor critical comments concerning their work.

My first comment is rather superficial, having to do only with the interpretation of results rather than with the tabulars themselves. Care must be taken in interpreting the results by area. The 1965 area factors are multiplied by the no-base rate before it is reduced for the base plan benefits. Therefore, the area variation that exists after the reduction for base plan benefits is considerably greater than that in the 1965 area factors. The amount of the leverage depends on the richness of the base plan. In many cases it will be about 2 or $2\frac{1}{2}$ to 1. Thus, if the 1965 area factor is 1.08, the resulting tabular cost will be about 16 or 20 per cent greater than it would be with an area factor of 1.00.

In Table 5 of the paper the authors have shown the area factor for each location alongside the ratio of actual to tabular. It would be logical, I believe, for an unwary reader to assume that the tabular costs vary in the

same manner as the area factors, but this is not the case. I think that it would be appropriate to warn of this pitfall each year in the presentation of the intercompany experience.

My second critical comment pertains to the variation that exists in the dependent tabulars according to the age and female percentage of the employee group. The spouse tabular is increased by the age-female factor in the same manner as the employee tabular is. This variation is then approximately offset by other adjustments. The sex variation is almost exactly offset by the fraction of a spouse that is included in the "one or more" dependent tabulars. The age variation is partially offset by the "relative number of children" factor. I think the dependent tabulars would be improved if (a) they did not vary according to the female percentage of the employee group and (b) the variation by age was limited to a single simple factor.

When a variation is accomplished through offsetting adjustments, it is complex and difficult to interpret. The purpose of intercompany tabulars is to facilitate a meaningful interpretation of intercompany experience. Offsetting adjustments complicate rather than facilitate the interpretation of the experience.

As a practical matter, the net effect of the variation by sex in the tabulars is so slight that it can be ignored. However, there is, and should be, a significant variation by age. My concern is that it is unnecessarily difficult to determine the extent and nature of the age variation.

FRANCIS T. O'GRADY:

Messrs. Mahder and Pettengill are to be commended for the long, hard work they devoted to the preparation of this paper, which is a most valuable contribution to actuarial literature.

The authors recognize that the method used in their fourteen-step formula for calculating the 1965 Supplementary Major Medical Tabular claim cost for a given plan is not the only one which might be used and that there are actually a number of different methods currently in use for calculating manual rates for supplementary major medical plans. The purpose of this discussion is to describe briefly one such different method used at Metropolitan.

Under this approach rates are determined for a supplementary major medical plan which provides specified benefits and which supplements specified basic hospital and surgical coverages. These basic rates are then adjusted to reflect the extent to which the specifications of the supplementary major medical plan being evaluated, the base plan benefits, and the characteristics of the insured group differ from the assumptions used in deriving the basic supplementary major medical rates.

The adjustments for difference between the specifications in the supplementary major medical plan being valued and the assumptions in the basic rates include adjustments for such factors as level of deductible and coinsurance, maximum room and board benefits provided, maximum annual and lifetime benefits, and definition of dependents.

Adjustments for differences between the actual basic plan benefits in force on the group and those assumed in the rate structure for the supplementary major medical plan include adjustments for such factors as the maximum daily room and board benefit and the duration of such benefit, the level of ancillary benefits provided, the "in-hospital" physicians' visits benefit provided, and the basic plan surgical schedule.

The rates are also adjusted for age distribution, income distribution, and, to a limited degree, for the geographic distribution of the group.

Metropolitan has used this approach since it first began issuing this coverage, and, while we have adjusted our supplementary major medical rates several times since then, we have found this approach successful and have continued to use it.

One advantage that we find in the approach is that it starts with a base (a supplementary major medical plan) which assumes a distribution of covered medical expenses by type which is closer to that for the particular plan being evaluated than is true when a comprehensive plan is used as the starting point. Supplementary major medical plans do, of course, have a different distribution of expenses than comprehensive plans, since they include only the more serious cases (i.e., those in which expenses have been incurred in excess of the sum of those covered under the basic plan plus the deductible), while the comprehensive plan includes all covered expenses in excess of the deductible.

JOSEPH W. MORAN:

As a member of the subcommittee which reviewed several preliminary versions of the material incorporated in this paper, I saw firsthand some of the tremendous efforts expended by the authors in arriving at the tabular basis described in the paper. While we can acknowledge the reasonableness of some of the questions raised by Mr. Garrison with regard to further improvements that might desirably be built into the tabular, it became quite apparent to the subcommittee that it would be utterly impractical to do so if the paper were to go to press before the material was very obsolete. I can assure you that the tabular described in the paper works better than the many alternatives that were tried previously. The authors should be commended for their efforts and patience in working through these alternatives to arrive at such good results.

The experience data examined in the body of the paper for the period

from 1962 to 1965 do not show as severe a pattern of upward trends in claims experience as would be expected from other sources. A more up-to-date appraisal of current trends in claim costs for major medical would show a much more severely adverse pattern. The most obvious explanation for this is that hospital charges for room and board increased only modestly in the years 1962-65, but the rate of increase has accelerated greatly since then.

There have been some comments that claims experience on group medical care coverage apparently improved in 1967, or at least that the degree of deterioration in experience was not as severe as that anticipated. Although these comments appear to have some validity with respect to experience on plans which include both basic hospital-surgical and supplementary major medical coverage, actuaries must be careful not to let such results distort their estimates and projections of future trends on the supplementary major medical portion of the costs.

The relatively favorable 1967 results arose mainly on the base plan coverage. Also, the starting-point claim experience figures for 1966 used for comparison typically included most of a year's high-age exposures on a pre-Medicare basis. These circumstances appear to have masked a very sharp increase in major medical claim levels from 1966 to 1967. One crude index of this is the fact that, for New York Life's entire medical care portfolio, the ratio of total supplementary major medical claims to total base plan claims increased by 21 per cent from 1966 to 1967.

When we consider the tremendous amount of effort expended in compiling the data for these experience studies and in developing the tabular basis, it is reassuring to learn that a large number of the actuaries attending the meeting at which this paper is being discussed report that they envision using the paper itself as a point of reference in evaluation of their own experience and in development of future rate structures for supplementary major medical coverage. Presumably these actuaries will be mainly concerned with the proper pricing of plans which include both basic hospital-surgical coverage and supplementary major medical rather than with the pricing of the supplementary major medical fragment alone.

If we use the supplementary major medical tabular in the paper for this purpose—to develop a rate basis for combined base plus supplementary major medical package related to 1969 or 1970 expected claim costs—it is likely that some adaptations will have to be made to avoid illogical results. Some anomalies result from the “stopper” adjustments to the base plan credit that were built into the supplementary major medical tabular. While these adjustments produced a better correlation of tabular with the

actual experience data for the period studied, they make it somewhat difficult to use the tabular basis in projecting future claim costs as base plan benefit levels continue to increase.

The anomaly shows up when the supplementary major medical tabulars in the paper are added to any tabular costs for basic hospital-surgical coverage to derive total-plan tabular costs. If we then compare total-plan tabular costs among base plus supplementary major medical plans which have identical benefit provisions except for variations in level of hospital room and board benefits, we find that the differential in tabular cost for an increase in room and board benefit from \$30 to \$35 per day is greater than the differential for an increase from \$20 to \$25 per day. Such a result is intuitively unrealistic and almost a mathematical impossibility.

It is obvious that some modification in the adjustments to the base plan credits will be made if the tabular is to produce reasonable results in this type of comparison.

(AUTHORS' REVIEW OF DISCUSSION)

JOHN MAHDER AND DANIEL W. PETTENGILL:

We are very grateful to all who have taken the time to read and analyze our paper. We feel that the points raised by the discussants have added to the value of the paper and require only a brief reply.

Mr. See properly points out the apparent need for additional loadings or tighter underwriting for groups with less than twenty-five lives. The relatively small exposure for the groups should, however, be noted. The experience reported in the paper is based upon groups with a minimum of ten lives at issue; a few groups contained less than ten lives during the policy years reported.

With respect to the spouse rate for a high-female-content employee group, it would not necessarily be logical to charge a spouse rate close to the 0-11 per cent male employee rate. The age factor for the high-female-employee group would generally be lower than that applicable to the dependent spouses, since wives are generally younger than their husbands and the female content of employees with dependent coverage is often considerably different from the female content of the total employee group. The data submitted to the intercompany studies do not contain the female content of employees with dependents, and these data are generally not available for most groups.

Mr. See's comments concerning the substantial increases required for supplementary major medical only as a result of recent medical care cost increases are timely and indicate the need for a frequent review of supple-

mentary major medical rates if rates are to be in line with costs. Any significant change in the underlying basic benefits would substantially alter supplementary major medical costs; the important consideration is the total increase in cost of both the base and supplementary major medical plan.

Mr. Garrison is correct in his observation that a change in the area factors does not produce a corresponding change in the final tabular rate and that the variation in change depends upon the richness of the base plan. Typically, a 1 per cent change in the area factor will produce approximately a 2 per cent change in the tabular rate, but, for very rich underlying base plan benefits, a 1 per cent change in the area factor could result in a change of 3 per cent or more in the final tabular rate. We concur that this should be noted in the annual report of intercompany experience.

We agree with Mr. Garrison's comment that the dependent tabulars which contain offsetting adjustments for age and female content produce results which are difficult to interpret, although the net effect is readily observed. However, results based upon a tabular without female adjustment and limited to a single age factor would also be difficult to interpret, since other factors influence actual to tabular ratios and the results could not be attributed solely to variations in costs by age or female content. In addition, the wider range of actual to tabular ratios resulting from no female adjustment could influence the results shown in other tables. In theory (and in fact) the dependent tabular costs should vary according to the age and male-female content of spouses as well as by the age of the employee group which can be used as a measure of the number of children in each dependent unit. Our objective was to include in the tabular as many variables as possible to produce reasonably uniform actual to tabular ratios for those factors which influence claim costs. Also, it was hoped that the tabular would provide some insight into cost variations for those preparing rates on a separate spouse and children basis instead of the one or more dependents basis used in the tabular. Those who wish to estimate the effect of the tabular on actual to tabular ratios by age and per cent female can do so by using the employee and dependent claim and exposure tables contained in the paper.

We are grateful to Mr. O'Grady for his description of the procedures used by the Metropolitan Life Insurance Company in determining rates for supplementary major medical. The use of a base which assumes a distribution of covered medical expenses after basic benefits based upon a specified basic hospital and surgical plan is an interesting variation of the method used in the tabular. It would appear that this method would also

be subject to the problems which beset supplementary major medical rate determinations, such as the effects of inflation, changes in the amount of underlying base plan, and the like.

Mr. Moran, in pointing to the need for consideration of recent trends in claim costs when calculating supplementary major medical rates, correctly emphasizes the need to review the combined cost of base plus supplementary major medical. The anomalies referred to by Mr. Moran when changing the amount of basic room and board benefit do not occur if benefit and charge levels appropriate for 1965 are used. An increase in the amount of room and board benefit for a rich basic benefit plan will produce a smaller reduction in the supplementary major medical claim costs than will the same room and board increase for a modest basic plan. This feature is discussed in II, F, Reduction Adjustment Table, and is reflected in the reduction adjustment table contained in the Appendix to the paper. The tabular without adjustment, however, is not appropriate for 1969 or 1970, and the use of the unadjusted tabular would produce anomalies, as Mr. Moran has indicated.

The "stopper" of a maximum hospital credit is included in the tabular in order to avoid hospital reduction amounts which are excessive in relation to the total amount of the Step I tabular costs. This will occur as hospital room rates increase for years following 1965. In order to adjust the tabulars to avoid this problem, an increase in the Step I basic tabular costs reflecting current charge levels could be made. If hospital costs represent approximately the same percentage of total medical costs as was the case in 1965, the maximum hospital reduction per cents could remain unchanged. If the cost relationships are different, the maximum hospital reduction per cents should be reviewed for consistency.