ABSTRACT OF THE DISCUSSION OF PAPERS READ AT THE PREVIOUS MEETING

AVIATION INSURANCE

BARBARA H. WOODWARD

VOLUME XXV, PAGE 81

WRITTEN DISCUSSION

MR. JOHN A. MILLS:

In the introduction to her paper, Miss Woodward says, "... this paper will not be concerned with possible rate making formulas, but will confine itself to a brief review of the aviation rate making picture as it exists today, with particular emphasis on the main casualty coverages." Miss Woodward's paper is a very clear and concise presentation of this phase of aviation insurance.

Statistics have not played a very important role in aviation insurance rate making in the past, but with continued growth and stabilization in the industry, they can be expected to take on the same degree of importance they have attained in the rate making processes under other major casualty lines.

Inadequacy of exposure has been as serious a handicap in promulgating aviation insurance rates on a statistical basis as have the rapidly changing conditions within the industry. During 1938 the nation had 29,000,000 licensed automobiles but only 10,000 licensed airplanes. Due to the publicity the industry has received, a good many people are under the impression that its growth has been more rapid than actually has been the case. The following exhibit shows the increase in the number of airplanes and in the miles flown since 1930 as reported by the Civil Aeronautics Authority.

	Number of Licensed Planes Used by		Passenger Miles Scheduled Operations (000 omitted)	Plane Miles Non-Scheduled Operations (000 omitted)
	Scheduled Operators	Non-Scheduled Operators		
1930	600	6,754	84,016	108,270
1931	590	6,963	106,442	94,343
1932	564	6,766	127,039	78,179
1933	504	6,392	173,492	71,223
1934	518	5,821	187,859	75,602
1935	459	6,912	313,906	84,756
1936	380	7,044	435,740	93,320
1937	386	8,766	476,603	103,000
1938	345	9,600	555,000	120,000

Although statistics so far developed have been limited, they have nevertheless served a useful purpose in arriving at a base rate and also in judging the approximate proportion of the losses attributable to each of the major hazards connected with flying.

Figures compiled by the United States Bureau of Air Commerce for the period 1933 through 1937 show that airplane accidents are due to the following causes in the following proportion:

Cause	Scheduled Operations	Non-Scheduled Operations
Personnel	28%	53%
Engine and Plane	38	27
Weather	17	7
Airport and Terrain	10	9
Others	5	3
Undetermined and doubtful	2	1
All causes	100%	100%

The Bureau of Air Commerce assigned accidents that occurred during the period 1928 through 1937 to the following circumstances:

Circumstances	Scheduled Flying	Non-Scheduled Flying
Collisions	12%	5%
Takeoff (Including taxying)	17	20
Landing	33	32
Forced Landing	25	20
Spin or stall	3	17
Other types	10	6
All circumstances	100%	100%

Questions asked a prospective insuror by aviation underwriters are designed to provide the underwriter with all data having an important bearing on the causes and circumstances surrounding airplane accidents. The underwriter knows the approximate part of the pure premium attributable to each of the factors on which information is required and the final rate quoted recognizes within practical limits the extent to which the individual risk can be expected to vary from the average.

A large proportion of the loss cost is under the direct control of the insurance buyer and it can be expected that experience rating on both a prospective and retrospective plan will play an increasingly important role in the aviation insurance business.

The dangers connected with flying have been the principal reason the industry has not expanded more rapidly. That is why everyone interested in its future has tried to do his part towards promoting the six major requisites for safe flying. These, according to the Aeronautical Chamber of Commerce are:

1. A machine sound aerodynamically and structurally.
2. An engine of sufficient power, operating satisfactorily.
3. A competent and conservative pilot and navigator.
4. A sufficient number of airports and emergency landing fields.
5. A nationwide system of weather forecasts.
6. A nationwide chart of air routes.

Substantial headway has been made towards making flying more safe as is evidenced by the following table on aviation death rates per 100,000,000 occupant miles covering the years 1930 through 1938.

Year	Scheduled Operations	Non-Scheduled Operations
1930	28.6	234.1
1931	23.5	212.0
1932	15.0	205.3
1933	4.6	217.6
1934	9.0	214.9
1935	4.8	154.6
1936	10.1	145.7
1937	8.4	137.1
1938	4.5	114.2

The insurance companies are contributing their share towards promoting greater safety in flying through safety engineering. They also encourage safe practices by recognizing them in the rates. The rate level for public liability, for property damage, and for passenger liability has decreased materially during the past decade.

When the system for making blind or all-instrument landings is perfected, many accidents including a considerable proportion of those arising from fog and poor visibility at airports will be eliminated. Many improvements have been realized in recent years including the improved two-way radio, a more sensitive altimeter, a manifold pressure gauge which warns the pilot when the pressure of the gas mixture rises too high, and de-icing equipment. These forward steps keep the insurance rate structure in constant need of adjustment and they promise to keep it that way for some time to come.

WATCH YOUR STATISTICS!

A PARTIAL STATISTICAL GUIDE FOR NON-ACTUARIES

G. F. MICHELBACHER

VOLUME XXV, PAGE 97

WRITTEN DISCUSSION

MR. W. W. GREENE:

There once was a smart actuarius,
Who invented a rate plan precarious;
The loss ratio grew worse,
So he died from remorse,
*Thus ending his conduct nefarious.**

Mr. Michelbacher's paper embodies a sincere and eloquent protest against the misinterpretation of statistics in the casualty business. His plea is bound to evoke the sympathy of all of us who, like him, have "attempted to prevent the improper use of statistics." After his initial comment upon the statistical ineptitude of producers, assured, insurance counsellors, underwriters, claim men, public officials, legislators, etc. he buckles down to the onerous duty of "unscrewing the inscrutable" for their benefit; and, once he gets into his stride, he does a fine job of directing the searchlight of "pitiless publicity," as it were, upon each, in turn, of several of the favorite stumbling blocks of amateur statisticians.

So far so good, but my own feeling is that the author's six rather brief rules for avoidance of the aforesaid stumbling blocks leave something to be desired. The rules themselves, with one possible exception, are, I am sure, entirely sound as far as they go: but the practical casualty man or casualty insurance buyer who has been convinced by five pages of exposition that he must at all hazards bear in mind the distinction between policy year and calendar year figures is bound, I think, to crave, on the constructive side, considerably more than the following somewhat oracular utterance which appears on page 103:

* This wholly irrelevant stanza is inserted solely to uphold the worthy custom established years ago by the author whose paper is under discussion.

"Rule I.

Always make certain whether the statistical data under consideration were compiled by the policy year or the calendar year method of accounting. Never, under any circumstances, attempt a comparison of two sets of data unless both are prepared by the same method of accounting."

Our layman by the time he reads the foregoing has become convinced that casualty statistics may easily be misinterpreted, and that he himself has been drawing hasty and false conclusions from them. Even so, insurance figures are part of his stock in trade, and he has to deal with them whether he likes to or not. He would welcome authoritative instruction as to just how he may safely and soundly utilize casualty statistics. This paper, I fear, provides affirmative instruction of this kind only to a very limited extent, for the other five rules of statistical interpretation are similarly brief. This is not exactly a fault on the part of the author (his subcaption states that the paper is only a "partial" statistical guide) but it may afflict the expectant layman with an inferiority complex which can be cured only by further treatment.

Reverting to Rule I for a moment (and this is the only part of the paper with which I would differ specifically), nobody can properly quarrel with the first sentence. The second is, I submit, too inflexible. Consider, for a moment, the reinsurance underwriter. He is deeply concerned at times with mass results, such as the loss ratio of a given company on an entire line. In forecasting, as he must, to the best of his ability, what this loss ratio will be in the immediate future he must perforce use whatever evidence he can lay his hands on. Sometimes he is presented with the experience on the latest one or two policy years as evidence of the desirability of the business. If the loss ratio on this recent policy year experience is invitingly low, he may be tempted to take a step which will cost his company a great deal of money unless before taking these figures at their face value he looks at calendar year results. If the calendar year loss ratio is higher than the loss ratio for the last policy year and rates and other underwriting conditions have apparently been fairly stationary for several years, then the situation strongly suggests that in the policy year experience the loss reserves are not adequate. If, on the other hand, calendar year figures are presented, it is by all means desirable to require a breakdown by policy years to see

how the loss reserves originally set up on the more remote policy years have stood the test of time. In fact, the reinsurance underwriter's only chance of guessing right may depend upon making comparisons of policy year and calendar year figures from as many angles as possible; so that if he were to take Rule I as gospel and not make these comparisons he would eventually find himself, in a manner of speaking, abaft the octasphere: and much the same considerations apply in the determination of rate levels in the direct writing field which, indeed, are arrived at as the result of a comparison of calendar year loss ratios with policy year loss ratios, to which fact the author refers by implication on page 98.

I am inclined to believe that the improper use of statistics in our business is largely a fault of omission on the part of the actuaries. Comprehensive and trustworthy statistics are of no value whatever unless they are used properly, and is it not unreasonable to expect that they will be so used by the majority of those for whose benefit they are prepared unless the figures are presented in a form such that an intelligent person who has a fair working knowledge of our business can understand them? I am sure the author would join me in answering "Yes!"

This paper contains much useful closely-reasoned material and is admirable as literature, but in my opinion it does not, in its present form, go far enough toward the accomplishment of its avowed purpose, namely, to instruct laymen in the more correct use of statistics. It does break considerable important ground in that direction, but I am inclined to think that if the really substantial good which the author had in mind is to be achieved, much more ground has to be covered, in even greater detail, and probably in somewhat less technical language.

I would like to suggest that the Society undertake the task of preparing a statistical handbook for the use of all persons connected with the business in order that they may be fully acquainted with not only the principles and distinctions which Mr. Michelbacher has ably expounded, but also with many other practical points as to the significance and proper use of the figures which appear in the financial statements of the companies, in the schedules accompanying the statement, and in all exhibits normally compiled by carriers and bureaus in connection with

classification, individual risk, and agency experience, and the determination of experience and retrospective rates. This handbook might easily run to two hundred pages. It should contain not merely explanations, but, and this is even more important, *examples* illustrating just about every way in which figures can be used in the casualty business. Mr. Michelbacher's excellent text could be worked into the proposed manual; but the manual could do a much more complete job than he had space for in his paper in the matter of taking the layman by the hand, as it were, and leading him in the paths of statistical rectitude.

APPENDIX

(Which should be cut out if it causes any trouble)

The following folktale is to be read slowly by or to all good little actuaries upon retiring:

The Actuary and the Grain of Truth

Once upon a time there was an Actuary who was big and strong, but so kindly by nature that he could not refuse anybody anything. He was very unhappy because his cruel stepbrothers, the underwriter and the producer, kept him bending his back all day long at heavy tasks in the field of casualty insurance, but when they met him on John Street their noses were always so high in the air that they could not even see him.

One day the Actuary found in the field of casualty insurance a grain of truth.

"Who will plant this grain of truth?" he asked.

"I won't," said the underwriter.

"I won't," said the producer.

"I will then," said the Actuary.

So he put the grain of truth in one of the many pits of illusion which dotted the field of casualty insurance, covered it with dirt which the producer had brought in from the street, fertilized it with garbage which the underwriter had thrown out the window, and watered it with his own sweat and tears. After a while the grain of truth began to grow and grow, and soon there rose a tall, strong plant, and on its top was a big golden clump of ripe statistics.

"Who will pick off these statistics?" asked the Actuary.

"I won't," said the underwriter.

"I won't," said the producer.

"I will then," said the Actuary.

So he picked off the statistics with his keen punch machine.

"Who will thresh out these statistics?" asked the Actuary.

"I won't," said the underwriter.

"I won't," said the producer.

"I will then," said the Actuary.

So he threshed out the statistics on his fast tabulator.

"Who will interpret these statistics and get all the credit for being a Deep Student of the Business?" asked the Actuary.

"I will," said the underwriter.

"I will," said the producer.

"Like Hell you will," said the Great Big Executive, in his great big, gruff voice. And the Great Big Executive interpreted the statistics and got all the credit for being a Deep Student of the Business, so there was not a crumb of credit left for the underwriter or the producer. As for the Actuary, he was never heard of after that and if you ask any of the wise men along John Street about him they will merely shake their heads and say they can't remember him at all.

But in a nearby village where the Actuary was wont to go at night to nurse his tired back and aching pride against another day, there are those who say the reason for this is that the Great Big Executive was really just the Actuary, who had had his hair cut, bought some new clothes, and had his glandular imbalance corrected.

MR. A. H. MOWBRAY:

Mr. Michelbacher's effort to pass on to non-actuaries some enlightenment to help them avoid pitfalls in the use of statistics reminds me of an occasion many years ago when I assayed the same role as an expert witness in a liability suit. The attorney for the plaintiff, suing for damages because of the death of a 14 year old girl had introduced a mortality table and shown an expectation of life in excess of 46 years, presumably to impress the jury with the immensity of the loss. When the defense called me, he strenuously objected to the introduction of an expert in such matters. The law recognized the table and it spoke for itself. It so happened that the judge was less hidebound than some. He retorted that the attorney had himself introduced the table, that mortality tables were technical things and there were doubtless

right and wrong ways to use them. He thought the court and jury were entitled to such guidance as might be given by a qualified expert. Blocked at this turn, the attorney on cross-examination tried to belittle the significance of computations of probabilities in a correct use of the table.

I am afraid some of those whose misconstruction of statistical evidence Mr. Michelbacher tries to correct are like the attorney in this case, not interested in bringing out the truth but in establishing a case. In respect to these I am afraid our genial colleague's effort is largely Love's Labor Lost, except insofar as the companies and others are led to reconsider methods of compiling and publishing data and set them up in a form less susceptible to misuse and misunderstanding.

Michelbacher's first point for consideration is the difference between policy year and calendar year accounting and the confusion arising from the use at times in the same problem of data, part of which have been compiled by the one method and part by the other. There is nothing sacrosanct about a policy year as a base of experience. It got started that way when the Massachusetts Insurance Department called for Schedule Z as an adjunct to the Annual statement as of December 31, 1912 relating to policies expiring in that year. Formerly mortality experience was always taken out in respect to a closed period and experience tables were more or less out of date by the time they were issued. The exigencies of the annuity business led the British Institute of Actuaries and the Faculty of Actuaries in Scotland about fifteen years ago to set up a scheme for a continuous investigation into the mortality of annuitants along the lines of census methods. In the evolution of compensation rate-making, the place of Schedule Z has become less important. Perhaps we have the ingenuity in our own ranks to find a new basis and method of preparing our data that may diminish the confusion arising from the double method. Until we do, we must emphasize to all we find dealing with our statistics the first Rule laid down in this paper. Indeed, even if we succeed in simplifying and making more uniform the statistics we turn out we must always insist on observance of the spirit of this rule that comparisons of data compiled by different methods are always dangerous and usually misleading.

Probably the greatest cause of misunderstanding of loss ratios

is the practice of most states of requiring in that part of the annual statement dealing with business within the state a statement of premiums written (or received) and losses paid, unless it is the quasi-cash form of the annual statement. The figures for an incorrect estimate of loss ratio are ready to hand; those for a correct estimate must be sought and sometimes are not available at all. As a company reaches a stabilized maturity a losses paid to premiums written loss ratio tends to approximate a true incurred-earned loss ratio and some who should know better are tempted to make the assumption that the approximation in a given case is close enough. It may be, but the error of approximation is unknown and it sets a precedent for those who do not know better. Perhaps the time is ripe to seek reform in statements which will make the calculation of correct loss ratios easy and of incorrect ones hard.

Rule III which Michelbacher gives relative to the interpretation of experience is sound in principle but may well be difficult to apply in individual cases. How do we know what losses "may reasonably be expected to occur?" The first example cited in this section raises the question whether anyone has made in any industrial classification a study of the correlation between large and small losses. May there not be some point in the ratio of actual small losses to expected that may give high credibility to the entire absence of large losses as a significant departure from class indication?

Rule IV is sound but why make such comparisons at all. The problem of determining the accuracy of loss reserves is probably the most difficult in casualty insurance. Yet it is of first importance because error here also vitiates a correctly calculated loss ratio. I agree that a method exists by which the loss reserves of a carrier may be *tested* but the test at best requires interpretation. Rule V gives the method determining whether previous estimates were reasonable but we must still consider whether the same bases are still used and, if not, whether changes which have been made tend to make reserves more or less accurate.

In my experience I have never encountered difficulty with a carrier's unearned premium reserve as a matter of computation. The question of the accuracy or even adequacy of the collected premiums from which the reserve is derived is, of course, the

really important question when the unearned premium reserve is studied as a measure of the sufficiency of the carrier's provision for its future requirements under unexpired policies. This is a "horse of another color," but most of those who go hunting for inaccuracies in computation of unearned premiums rarely glimpse this larger question.

AUTHOR'S REVIEW OF DISCUSSIONS

MR. G. F. MICHELBACHER:

Some of my friends have said of me that I would rather argue than eat. Certain it is that in my day I have participated in many a wordy battle. But I must be slowing down with approaching old age because I have derived real pleasure from the knowledge that my good friends Greene and Mowbray agree in the main with the fundamental purpose of my paper, which was to make the world safer for casualty insurance statistics. I never intended that this should be the last word on the subject. Rather it was my hope that it might be the first or introductory word and that others would be prompted to carry the good work forward.

If the preparation of a statistical handbook (as suggested by Greene) seems feasible, I am enthusiastically in favor of the project. But before that work is undertaken, perhaps it would be well to consider some of the points raised by Mowbray. Are our methods of compiling and publishing data susceptible to misuse and misunderstanding? Is the policy year accounting procedure indispensable? Must we continue indefinitely to include in our annual statements written premium and paid loss figures for individual states? Is there a test which can be applied to loss reserves for the latest calendar year to establish their adequacy? What about Schedule P: is there room for improvement here? Is the adequacy of the unearned premium reserve dependent upon the adequacy of the collected premiums from which the reserve is derived? These and a host of other problems might well be investigated and a new, improved statistical system devised before we set out to educate the participants in our business in the proper use of statistical information.

Here is a real job for casualty actuaries and I hope the members of the Society will grasp the opportunity to promote a practical project of interest and value to our business.

As to Greene's introductory poem and bedtime story for infant actuaries, I heartily approve of both. I have been accused of introducing levity into some of my contributions to the *Proceedings*. "It isn't dignified," say some of my critics. That may be true; but can anyone tell me why an actuarial treatise should be as dry as dust and absolutely devoid of humor? My belief is that the casualty actuary will grow and prosper and win respect in exactly the degree to which he can demonstrate to the world that he is a normal human being with a real sense of humor (even if the joke may be on him, as seems to be true in this instance). I, for one, will always welcome a little humor to brighten the pages of our *Proceedings*. We cannot have too much of it!

TABLES ADAPTED FOR MACHINE COMPUTATION

FRANCIS S. PERRYMAN

VOLUME XXV, PAGE 121

WRITTEN DISCUSSION

MR. RALPH M. MARSHALL:

The simplicity and ease of operation of the tables of logarithms presented by Mr. Perryman at the November meeting are best appreciated after one has attempted to calculate annuity values with the tables and calculating machines to be found in the average office.

In our own office we have frequent occasion to calculate present values of annuities in connection with estimating the effect of changes in the benefit provisions of a compensation act, or, as was recently the case in Arkansas, in setting up the initial compensation rates under a newly enacted compensation law. It is customary to assume an interest rate of 3½% for these calculations and simple annuities certain are used for dismemberment schedule cases. These values have been set up in a table of values of "one per week" for various periods from one week to 832 weeks. The valuation of permanent total disability benefits and fatal benefits to children involves the use of life contingencies and we have

special tables which have been calculated giving the values of temporary annuities for various periods for the ages encountered in the American Accident Table. These tables are based upon mortality rates from the U. S. Life Tables of 1910 for both sexes with 3½% interest converted continuously. Finally for evaluating the benefits payable to widows, we have similar tables based upon mortality and remarriage rates from the Danish Female Survivorship and Dutch Remarriage Tables respectively with interest at 3½% converted continuously. These of course are special tables made up for our purposes and would probably not be suitable for calculating monetary reserves on individual cases, unless the rate of interest desired happened to be 3½%. In our calculations the results usually take the form of ratios of one valuation to another and therefore a slight difference in the interest rate assumed for both numerator and denominator would not be as important as where monetary reserves are desired.

If called upon to calculate annuities at some interest rate other than 3½% or with other than weekly conversion periods, we would be in no better position than the average office. I find we have a table giving logarithms of numbers from 1 to 9999 to five decimal places, and another table giving logarithms of the same numbers to six decimal places. If we are going to interpolate for the logarithm of a number of five significant figures it seems desirable to have the logarithms given to at least six decimal places because a difference of one in the fifth significant place of the number is equivalent to a difference of .000043 (43 in the 5th and 6th decimal) in the logarithm at the top of the table, i.e., from 10,000 to 10,001; but at the bottom of the table, from 99,998 to 99,999 the difference in the logarithm is .000004 (4 in the sixth decimal) and therefore interpolation from the five place logarithms would not give accurate results. Likewise in determining the antilogarithms from the six place table, anything beyond the fifth significant place would be in doubt.

I also found a condensed logarithm table that was rather interesting. This table was set up to give the logarithms to 15 decimal places of numbers from 1 to 9, of numbers from 1.1 to 1.9, of numbers from 1.01 to 1.09, from 1.001 to 1.009, etc. down to 1.000000001 to 1.000000009. This table was attributed to Hoüel, Recueil de Formules et de Tables numériques, and was intended

to be used by a factorization method similar to that employed by Mr. Perryman. However it is necessary to have as many factors as there are significant figures in the number whose logarithm is desired and therefore the process of determining a logarithm by use of this condensed table becomes very cumbersome and laborious. Mr. Perryman seems to have struck a very happy medium between the size of the logarithm table and the amount of machine calculation required and his tables of logarithms are so much superior to the condensed table by Hoüel that I have not bothered to reproduce it. In the text accompanying this condensed table the figure of .434294 quoted by Mr. Perryman in his Table VI is given more completely as .4342944819 and is the value of $\log_{10} e$. The error introduced by using $M.x$ in place of $\log_{10}(1+x)$ is less than $\frac{M \cdot x^2}{2}$.

There are one or two typographical errors which become apparent in reading Mr. Perryman's paper. The log of 1.23456789 on page 124 should be given as .0915149771700. Also in example (8) illustrating the construction of a table giving the present value of a weekly annuity, the exponent of the second term in the expression near the bottom of page 142 should be corrected so the expression will read,

$$\frac{\mathrm{r}}{j_{(\mathrm{r})}} - \frac{\mathrm{r}\, v^{\frac{q}{\mathrm{r}}}}{j_{(\mathrm{r})}} \times V^{\frac{30p}{\mathrm{r}}}$$

and in the next line also to $\frac{\mathrm{r} \cdot v^{\frac{q}{\mathrm{r}}}}{j_{(\mathrm{r})}} = Aq$

The values of logarithms of $(1+i)$ and values of $J_{(r)}$ in Tables I and II should also be very valuable, especially the values of $J_{(r)}$ for $r = 52$, $r = 52.1775$, in compensation work where compensation is usually paid on a weekly basis. Mr. Perryman has, perhaps, confronted us with an embarrassment of choice between values of $J_{(r)}$ for $r = 52$ and $r = 52.1775$. We are confronted with a similar choice between 52 and 52.1775 in determining the period for an annuity where interest is assumed to be convertible continuously. Neither one is exactly correct for the limited periods encountered in compensation work, but there is very little practical difference as Mr. Perryman illustrates in his examples 5 and

5a. 52.1775 is the more nearly correct and there is, of course, an advantage in using the terminating decimal.

In addition to the utility of the tables themselves, the annuity formulas, interpolation formulas, and illustrative examples which Mr. Perryman has been kind enough to include with his tables are invaluable as a "memory freshener" to anyone who seldom has occasion to make calculations of this nature. I am sure that the Society is indebted to Mr. Perryman for his paper and that it will prove a valuable contribution to the annals of the Society.

MR. ROBERT J. MYERS:

Mr. Perryman's paper presents a very interesting mathematical demonstration of the use of calculating machines and abridged tables in determining solutions to ten or more significant figures. While this method is quite elegant from the theoretical viewpoint, I have some question as to its practical value. Too often the layman imputes that a failure of many actuaries lies in being charmed by the beauty of their own figures. This hypnosis tends to lead the actuary into using as many significant figures as he can possibly lay his hands on, despite the fact that the original data was possibly statistically reliable to only four or five figures at the most. A particularly vivid illustration of this practice is present in the recently published 1937 Standard Annuity Table. Here, following the well-established actuarial traditions in the construction of life tables, the commutation functions are carried out to eight significant figures (9 decimal places) for age 109, whereas for all ages under 88 only 4 decimal places are used. I do not know of any instance where statutory or other legal requirements would require more accuracy than could be obtained from the usual published tables which give accuracy to five or more significant figures.

In determining the values of weekly annuities on page 126, it is assumed that a year contains 52.1775 weeks on the average. As explained in a footnote, this is based on the present calendar system. However, according to the Naval Observatory, the number of weeks which are actually contained in a solar year are 52.17746, since with the present calendar there are .003 days too many in a calendar year. This would result in the present calendar being one day off in 3000 years. However, although this

difference is really insignificant for all practical purposes, nevertheless if 10 figure accuracy is required, even this should be taken into account.

Next considering the examples of the use of the tables on page 139. Example 1 may be far more accurately solved by the following method:

Let $e = \pi - p = .000000266$, then the required error is $(p+e)^{19} - p^{19}$.

Next expanding by the binomial theorem, we get

$$19\,p^{18}\,e + 171\,p^{17}\,e^2 + \cdots\cdots$$

$$= e\,p^{18}\left(19 + 171\frac{e}{p} + \cdots\cdots\right).$$

Substituting the values of e and p we get

$$.000000266 \times 3.14159^{18}\ (19 + .000014)$$

since all terms of the series beyond the second are negligible. Evaluating this with ordinary seven place logarithms, we get a value for the required error of 4.491. This is much closer to the true value of 4.504 than was the value of 4.457 obtained by Mr. Perryman.

I also solved several of the other examples by the use of seven place logarithms and in every instance obtained results correct to the nearest cent.

In the examples, using the slightly incorrect value of 52.1775 weeks to the year, the equivalent number of years for various periods of weeks are determined to 9 decimal places. Thus, the unit of time used is .000000001 years. The significance of the insignificance of this figure may be better realized when we translate it into seconds. Roughly, it amounts to .03 seconds which is the length of time that it takes light to travel one mile, or that it takes a fast runner to travel one foot. In valuing an annuity certain to such accuracy, a delay in the issuance of the benefit check by as much as one second (as might be due to a clerk sneezing at an inopportune moment) would result in an appreciable difference in the annuity value out in the ninth place. If the clerk were female and took time to powder her nose instead of promptly depositing the check in the mailbox thus resulting in missing the last mail train, the effect would be almost catastrophic.

AUTHOR'S REVIEW OF DISCUSSIONS

MR. FRANCIS S. PERRYMAN:

I am quite gratified with the discussions of my paper by Messrs. Marshall and Myers. Mr. Marshall gave my paper the kind of reception I had hoped for. He appreciated the purposes for which the paper was intended, and, accordingly, his discussion does not call for any comment other than "Thank you." Mr. Myers' discussion, on the other hand, was what I had rather feared. I had anticipated that my paper might be criticized on the grounds of the apparent attempt to obtain a verisimilitude of exactitude because of the extension of the tables to so many significant figures. However, I would ask Mr. Myers to read, again, my statement of the purpose of the tables. It wasn't to save Mr. Myers or some other mathematically competent person the trouble of evaluating a few occasional series (although I believe that Mr. Myers will find it quicker to use the tables now that they have been prepared rather than to make the said evaluations). The purposes of the paper are to enable persons actuarially trained (but not, therefore, necessarily practicing mathematicians) to deal rapidly with questions involving logarithms and interest certain. I thoroughly agree with Mr. Myers regarding the superfluity of decimal places in many standard life tables and commutation columns but I submit that there are times when a certain amount of accuracy is necessary along the lines for which my tables were designed. If, for example, a State Compensation Law calls for a certain benefit to be valued as an annuity certain of so much a week for so many weeks, at a certain annual rate of compound interest, it is easy enough to estimate the value within a dollar or so but if we have to discharge by a lump sum payment the obligation to pay the benefit, then we must have the value "exactly," i.e., to dollars and cents. I was afraid some mathematically inclined person would cast his eyes on my example "I," for it is, of course, easier to solve it the way Mr. Myers gives but, again, my beforementioned not too mathematically trained person would probably do it the way I gave. I am on firmer ground in discussing Mr. Myers' strictures on my use of 52.1775 weeks to a year. I will grant that there are not exactly that number of weeks in a solar year but the point is that we don't make our civil calculations

according to solar years—we use civil years and thus are spared the necessity of consulting the Nautical Almanac to obtain the data for commuting an annuity. Of course, it may be that certain Social Security actuarial calculations are made in Washington from data supplied by the Naval Observatory. Mr. Myers should know more about this than I. He will find, however, that my paper actually gives the proper instructions for adopting the tables to any given number of weeks in a year. I am sorry to confess, however, I have not yet found a proper formula for allowing for the time lost when Mr. Myers' female clerk finds it necessary to powder her nose.

I was interested to notice that in Bulletin No. 45, dated March 31, 1939, of the Permanent Committee for International Congresses of Actuaries, received yesterday, there is a notice of some tables similar to mine. These have been published by a Swiss, M. Frédéric Deprez, and are called "Tables pour le calcul à la machine des logarithmes à 13 decimales." These give logarithms and anti-logarithms to 12 or 13 places. The tables are presented on much the same lines as mine but are, of necessity, more extensive.

PROBLEMS IN RELATION TO CONTRACTUAL LIABILITY INSURANCE

JOHN W. AINLEY

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WRITTEN DISCUSSION

MR. J. L. BARTER:

To my knowledge, Mr. Ainley's paper is the first to be submitted to this Society on the subject of Contractual Liability Insurance. This is not surprising as it is one of the smallest lines of Public Liability Insurance. The annual premium volume for both Contractual Public Bodily Injury and Property Damage is probably below one million dollars. Even so, Mr. Ainley's paper was quite timely as this is a line of liability which recently has been causing underwriters considerable concern.

Contractual or "hold harmless" agreements are frequently vicious in scope. Mr. Ainley points out that it is quite possible

in such circumstances that after an indemnitor has been made to realize the gravity of the obligation, which he has assumed, he can prevail upon the principal to agree to revised terms which are within reason and justification. The insurance fraternity should endeavor to encourage the standardization of "hold harmless" clauses as far as possible, for until such time as real headway can be made in this direction, the premiums required for Contractual Liability necessarily will be greater and out of proportion to the premiums charged for corresponding Direct Liability. It is pointed out that the premium at least should be sufficient to offset the cost of investigation (which cost is usually somewhat greater than for a Direct Liability risk) and the issuance of the required protection. The Direct Liability coverage may be issued according to the terms, limitations and exclusions of established policies, whereas coverage for the "hold harmless" clauses is not written in accordance with prescribed procedure, terms, and limitations, but is a specific coverage written for the specific contract and, therefore, calls for extra underwriting expense and a little larger premium. The underwriter further realizes that the position of the insurance company may be impaired because of the possible delay in the reporting of claims.

In his closing paragraph, Mr. Ainley mentions that Contractual Liability involves many and varied possibilities and that it was not his purpose to discuss all the ramifications of the subject in his paper. I hope that Mr. Ainley, or others, will pursue the subject further. May I suggest several courses to follow.

One subject that could be discussed would be the underwriting of such contracts and the limitations which the underwriter should make. There has been the trend of thought that such agreements are perfectly insurable provided we limit the coverage to bodily injuries and property damage; that we cover only accidents occurring during the policy period; that we exclude damage to property in the care, custody and control of the assured; and that the coverage is limited to claims arising by reason of the work being done by contractors. In general, underwriters have felt that they would be willing to cover the liability even when it arises through the negligence of the owner, provided the owner's operations are such that they would be willing to insure them as direct coverage.

Another line of discussion would be as to whether exclusions

should be made in these contracts. There seems to be some confusion as to whether all regular exclusions in the Liability Manual apply to Contractual Liability Insurance. There are times that if all the exclusions appearing in the Direct Policy Form are carried over into the Contractual Liability Coverage, the assured will not be furnished any real coverage for his contract. I am inclined to believe that all exclusions should be eliminated with the exception of property of the assured, or property in the care, custody, and control of the assured.

A third possible approach to the discussion might very well be as to the possibility of establishing some standard forms of contracts. This has been done in the case of railroads with some degree of success and it might be well to explore the possibilities of similar action in connection with construction contracts, lease agreements, and purchase or sales orders. One great difficulty with the present system is that many of the contracts, in so far as the "hold harmless" clauses are concerned, are so vague and indefinite that there is difficulty in determining who is liable and when liable.

I hope that Mr. Ainley's paper is the forerunner of other papers on Contractual Liability for this is a subject worthy of further consideration and I believe there are members of this Society who can make worthwhile contributions.

MR. MILTON ACKER:

In Mr. Ainley's paper on Contractual Liability insurance there is presented a thorough, comprehensive dissertation on the more important types of "hold harmless" or indemnification clauses found in practice and the general rating procedure used for determination of premiums for insurance coverage for such clauses. It is a commendable contribution to the lamentably inadequate material available for a form of liability insurance which, while producing a comparatively small premium volume, has an abundance of problems in the rate, legal and underwriting fields.

"Hold harmless" agreements in contracts, from the insurance company view, are seldom defensible in that there are forms of insurance available whereby all parties to a contract may be protected substantially for bodily injury and damage to property

caused by accident and due to their own, or each other's negligent acts. As between the contracting parties, however, assumption of responsibility for the negligent acts of another may be justified. For example, where the results to be derived from the operations accrue to the sole benefit of the indemnitor, or where the operations which are the subject of the agreement are under the sole and complete control of the indemnitor, imposition of the liability of the indemnitee on the indemnitor may well be in order. In these cases we may assume a rational approach in the preparation of a contract where the liability of one is saddled upon another.

The complaint registered against "hold harmless" agreements is not directed against the foregoing types of agreements nor the types whereby the equivalent of Protective Liability insurance is provided by insuring such agreements, but rather against that type of agreement which foists upon the indemnitor the liability of the indemnitee for the latter's negligence and where the indemnitee may be engaged in operations of his own simultaneously with the indemnitor, and against the "hold harmless" agreement through which it is attempted to pass along a definite responsibility which by all judicious deduction belongs to the indemnitee only. It is against these types of agreements that criticism is leveled. Perhaps, in the not-too-distant future, contracting parties may be induced either to take voluntary action to eliminate vicious provisions in "hold harmless" agreements, or such action may be made necessary by legislative enactment.

It is interesting to note in this connection that effective June 5, 1937 the legislature of the State of New York passed the following law (now Section 234 of the Real Property Law):

> "Agreements exempting lessors from liability for negligence void and unenforcible. Every covenant, agreement or understanding in or in connection with or collateral to any lease of real property exempting the lessor from liability for damages for injuries to person or property caused by or resulting from the negligence of the lessor, his agents, servants or employees in the operation or maintenance of the demised premises or the real property containing the demised premises shall be deemed to be void as against public policy and wholly unenforcible."

The legislation was passed apparently to correct the situation which arose in the case of "Kirschenbaum *vs.* General Outdoor

Advertising Company," 258 N. Y. 489. Briefly, the facts of the case are: Defendant "General Outdoor Advertising Company" leased a roof from defendant "Landlord," agreeing in a "hold harmless" agreement to indemnify the "Landlord" from any liability arising from the use of the roof. Water collected because of a sign erected on the roof by the advertising company and as a result, goods of the plaintiff, an occupant of the building, were damaged. Plaintiff sued defendant "Landlord" who joined the "Advertising Company" as a co-defendant because of the "hold harmless" agreement mentioned. The decision in the case was made to hinge upon that part of the lease between "Landlord," defendant lessor, and plaintiff lessee, reading:

> ". . . the landlord shall not be liable . . . for injury or damage which may be sustained to person or property by the tenant or any other person caused by or resulting from steam, water, rain, etc., which may leak . . . into any part of said building . . . whether the said damage or injury shall be caused by or be due to the negligence of the landlord, the landlord's agent, servant, employee, or not. . . ."

Decision was rendered in favor of the defendant "Landlord" on the theory that the above quoted clause exempted the landlord from any liability for damage to plaintiff's goods. Because of the decision, it became unnecessary for the court to pass upon the "hold harmless" agreement existing between the co-defendants.

It is unfortunate that the legislature referred only to exemption agreements and not to "hold harmless" agreements. Considerable doubt has arisen concerning the applicability of the enactment to "hold harmless" agreements; nor are we helped any by resort to the Kirschenbaum case (since no "hold harmless" agreement was under consideration), except to conclude that "hold harmless" agreements are not affected by the law where not used to circumvent the law. However, the enactment is a step in the proper direction and it may be clarified momentarily. Other states should take notice of this constructive legislation.

The existence of "hold harmless" agreements perhaps nullifies the possibility of writing direct liability insurance protection in the names of indemnitees in satisfaction of the assumed liability provision. Direct liability forms of insurance cover the liability imposed upon an assured by law and not any liability assumed by agreement and enforcible at law. The result is that while the

indemnitor may purchase liability insurance in the name of the indemnitee, nevertheless, the terms of an agreement imposing liability upon the indemnitor for the acts of the indemnitee may be invoked at any time and be enforced. Therefore, an indemnitor under a "hold harmless" agreement can secure complete protection only through the purchase of Contractual Liability insurance.

Faced, as insurance carriers are, with the necessity of providing insurance for "hold harmless" agreements, the scope of such insurance and the limitations should be defined and uniformly applied. Simply expressed, but recognizably more difficult of application, it would seem that coverage for "hold harmless" agreements should be restricted in the same manner as coverage separately provided to the indemnitee for each element of assumed liability would be restricted. If insurance carriers under their regular policies are unwilling to provide liability insurance for bodily injury or damage to property unless caused by accident and for other hazards, coverage therefor should not be provided indirectly by insuring "hold harmless" agreements which include assumed liability with respect to these hazards. It is suggested that coverage for lease agreements might be restricted by application thereto of the policy provisions and exclusions otherwise applicable to the indemnitee under a separate policy written in his name and insuring against the liability imposed upon the indemnitor. Coverage for construction agreements might be restricted by application thereto of the following exclusions generally applicable to a Protective Liability policy written in the name of the indemnitee:

1. Liability for operations of the indemnitee.
2. Liability of the indemnitee after actual operations are completed.
3. Liability for injuries to employees of the indemnitee.
4. Liability for damage to property owned, leased, rented, used by or in the care, custody or control of the indemnitee.

In the event coverage were desired for any excluded element of exposure, it could be provided for some increased premium above that authorized for the agreement subject to the exclusions. Adoption of this principle and its universal application would assist materially in standardizing rates and rating procedure, always a most desirable objective. It would probably do much

also in eliminating drastic types of agreements, because insurance coverage for these agreements would then be difficult to obtain.

As mentioned by Mr. Ainley, there is some question among underwriters concerning the standardized rate used for the type of railroad agreement known as the National Industrial Traffic League agreement because the rate does not vary by reason of differences in physical characteristics and hazards of sidetracks. A substantial investigation in these several respects would not appear warranted because of the nominal premium involved,—$12.50 for Bodily Injury and the same amount for Property Damage insurance for standard limits. However, a substantial investigation need not be made since information concerning the length of sidetracks, their position and number may be developed usually from the agreement itself. Information concerning the frequency of use to which a sidetrack is put may be obtained from sources of information available when other forms of insurance are written. Furthermore, if the rate for this form of agreement should prove inadequate to cover the expense of any investigation, adjustment may be made. But, if technical underwriting consideration of this nature for a simple form of agreement should block efforts to secure moderate and standardized forms of agreement, as it well might, then perhaps we are now using the proper rating procedure.

The Manual of Liability Insurance implies that the only exclusion applicable to coverage for sidetrack agreements is damage from any cause to property owned, leased, or occupied by the assured. The exclusion, it is suggested, should apply to the indemnitee and broadened so as to include damage to property used by, or in the care, custody or control of the indemnitee or his employees. Contractual Liability insurance does not provide protection to the assured for the assured's negligent acts. Such protection is usually provided either by a Manufacturers' and Contractors' or Owners', Landlords' and Tenants' Liability policy. The protection provided is for the liability of another assumed by the assured. Any coverage in the name of the indemnitee insuring him independently and separately for an obligation imposed upon another, would extend to damage to that other's property. Hence, and on the same theory that prompts the recommendation that coverage for a "hold harmless" agreement for

construction operations should exclude certain designated items involving the indemnitee, coverage for a sidetrack agreement should be co-extensive with the coverage otherwise provided the indemnitee as an assured.

Mr. Ainley, in his paper, refers several times to the uninsurability of an indemnification provision relating to damage to property owned, or in the care, custody and control of the assured (the indemnitor). An examination of the situation, however, must show that liability for damage to such property is properly the subject matter of Contractual Liability insurance for the reasons advanced.

Much can be said, and it will only be touched upon briefly here, about the rating procedure now used in the rating of "hold harmless" agreements for construction operations. Mr. Ainley has given us the details in his paper. In justifying an initial loading on the Protective Liability rates where the equivalent of Protective Liability is provided by insuring the agreement, he states that in the latter case specific coverage is written for an agreement, whereas a Protective Liability policy is subject to established policy conditions. In further explanation of this, it may be said first, that the underwriter's interpretation of the extent of the "hold harmless" agreement may be erroneous; and secondly, the indemnitee is not subject to the terms of the policy and therefore may give late notice of a claim or even settle claims himself and ask for reimbursement from the indemnitor. The first point may require some explanation. There are some of us who would say that an indemnification clause requiring the assured to assume liability of the indemnitee for any liability arising out of the operations of the assured does not require a rate in excess of the Protective Liability rate, yet on further study, an important objection to such a clause lies in the fact that injuries to employees of the indemnitee are covered and otherwise excluded under a Protective Liability policy. Of course, there are other objections to this clause. One need only revert to the exclusions proposed for construction agreements to recognize these other objections.

Question may arise concerning the practice of authorizing a percentage of the indemnitor's compensation premium to cover the waiver of subrogation feature of an agreement, as the best means of developing a charge for this exposure. Wherever pos-

sible, and this may be extremely infrequent, the premium should be developed as a function of the indemnitee's direct liability premium as the best measure of the liability being assumed. It is not always possible to use this method because the indemnitee may be engaged in more extensive operations than those for which indemnification is provided and which may be taking place on or about the location of and at the same time as the operations of the indemnitor.

Building or land leases, as mentioned by Mr. Ainley, wherein the lessee assumes the liability of the lessor in varying degrees, are rated by authorization of a percentage of the lessee's premium where insurance for the lessee is provided by an Owners', Landlords' and Tenants' Liability policy and coverage for the assumed liability is endorsed thereon. This is done on the theory that the coverage provided is comparable to that provided the lessor as an additional interest. This reasoning is fallacious, however, if only because the limits where Contractual Liability insurance is so provided apply severally; but more about limits later. The resulting quotation is not made subject to any minimum premium for the same reason that the additional interest charge is not made subject to any minimum premium.

The subject of policy limits where coverage for "hold harmless" agreements is provided by endorsement to existing policies may be disposed of by the simple statement that Contractual Liability insurance is a distinct form of coverage. It is as much an independent miscellaneous form as Owners', Landlords' and Tenants', Manufacturers' and Contractors', Elevator, Product or Teams Liability, all of which are separately rateable. The rates for such insurance apply for limits independent of any other limits provided on a policy which may extend insurance protection for other elements of exposure. The fact that coverage for "hold harmless" agreements is usually provided by endorsement on policies relating to other forms of coverage does not change the situation and policy limits should apply severally.

In conclusion, I should very much like to see some legal expression treating with this side of the problem. Rate approvals are based on broad interpretations and interpretations of "hold harmless" provisions will vary as between underwriters. For example, some reasonable doubt may exist concerning the interpretation

placed on the first quoted agreement in Mr. Ainley's paper. It will be noticed that liability is assumed "from the performance of the work contemplated by this contract or in connection therewith," which relates to the work being performed by the indemnitor and not work of the indemnitee. The contract therefore, may not require a complete assumption of liability as respects negligent acts of the indemnitee. However this may be, much of the difficulty in this connection would be eliminated if certain guides were erected based upon court adjudications within which interpretative and rate judgment could be exercised. It is very possible that a legal discussion might help to dispel the rate and underwriting problems and pave the way for standardization of rates in the absence of complete elimination of "hold harmless" agreements.