

WATCH YOUR STATISTICS !
 A PARTIAL STATISTICAL GUIDE FOR NON-ACTUARIES

BY

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The Old Mandarin
 Always perplexes his friend the Adjuster
 At the Prune Exchange Bank
 By adding his balances together
 In the Chinese fashion.
 For example: he once had \$5,000 in the bank
 And drew various checks against it.
 He drew \$2,000; thus leaving a balance of \$3,000
 He drew \$1,500; thus leaving a balance of \$1,500
 He drew \$ 900; thus leaving a balance of \$ 600
 He drew \$ 600; thus leaving a balance of \$ 000

\$5,000	\$5,100
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Yet, as you see, when he adds his various balances
 He finds that they total \$5,100
 And the Old Mandarin therefore maintains
 There should still be \$100 to his credit.
 They had to engage the Governor of the Federal Reserve
 To explain the fallacy to him.

*"Unearned Increment" from
 "Mandarin in Manhattan"*
 by CHRISTOPHER MORLEY.

I.

An incident of the casualty insurance business has been the production of a large volume of statistical data which governs almost every action we take. In fact, some critics assert that we casualty men are in grave danger of substituting statistics for common sense and personal judgment in the conduct of our affairs.

The construction of basic manual rates; the application to individual risks of experience, equity and retrospective rating; the testing of rates and rate levels for adequacy and reasonableness; the determination of the necessity for, the points of attack and the efficiency of preventive measures; the appraisal of the success or failure of the underwriting policies of an insurance carrier in a territory, in an agency, in an individual underwriting department or during a certain period of time; the compilation of assets and liabilities for financial statements; these and many other operations require the use of statistical information laboriously tabulated in minute detail. Statistics unquestionably have become an indispensable factor in our daily business life.

Experts prepare this vast aggregation of statistical data: but

once the information has been compiled and published, its subsequent interpretation is not confined to individuals with adequate statistical training. Agents and brokers, policyholders, chart makers, insurance counsellors, special agents, underwriters, claim adjusters, payroll auditors, inspectors, public officials, attorneys representing chambers of commerce, manufacturers' associations and labor unions, trade press editors, legislators and many other persons frequently use statistics and their conclusions are sometimes so incomprehensible as to pass all human understanding.

Like others among our membership, I have spent a considerable part of my time attempting to prevent the improper use of statistics. This is a never-ending task because each successive crop of new participants in the business must be educated in this important subject. It has occurred to me that a compilation of some of the fundamental rules of statistical analysis and interpretation might be useful in this educational process and it is with that thought that I have prepared this paper.

II.

No discussion of this subject would be complete without reference to a fundamental difficulty created by the use of both the policy year and the calendar year methods of accounting in our statistical procedure. The existence of various statistical exhibits, some compiled on one and some compiled on the other of these two bases, is confusing enough; but when we employ both types of information in the solution of a single problem, the opportunities for misunderstanding are multiplied. For example, in workmen's compensation insurance rate-making, pure premiums are based upon Schedule Z classification experience (a policy year record), expense loadings are predicated upon expense analyses taken from the Casualty Experience Exhibit (a calendar year record of national experience by lines of coverage) and rate levels are based upon calendar year loss-ratio data. Again, in the Annual Statement, assets, liabilities and the underwriting and investment exhibit are all compiled on a calendar year basis; but one of the most important appended schedules, Schedule P (calculation and testing of loss reserves for workmen's compensation and liability insurance), contains figures on a policy year basis. No wonder our

friends who lack statistical training become perplexed when they seek to comprehend these situations.

As every expert knows, there are excellent reasons for the compilation of both policy year and calendar year statistics.

The policy year account is a complete record of exposure, premium and loss transactions on policies which became effective during a given period of time, irrespective of when these transactions may actually have taken place. For example, if workmen's compensation insurance is the subject, the experience of policy year 1937 will include, eventually, the complete payrolls, premiums and incurred losses on policies issued to become effective during the twelve months of 1937. Since workmen's compensation insurance policies are usually issued for periods of twelve months each, the last policy included in the 1937 account (effective on December 31, 1937) will not expire until December 31, 1938. Then some time must elapse during which audits may be made and delayed notices of accident may be received. During 1939 the facts with regard to payrolls and premiums will become definitely known. By this time, all the accidents properly chargeable against this particular group of policies may have been reported, also, but since the resulting claims probably will not be entirely liquidated at once and the deferred loss liability must be estimated, several years must elapse before the ultimate incurred losses are definitely ascertained.

The policy year record usually is compiled at periodical intervals and since only the transactions of a certain group of policies are involved, a complete experience is gradually produced which is readily assembled in any desired arrangement such, for example, as a grouping of policies for a manual classification or for an individual agency.

The policy year method possesses both strength and weakness. Its strength is obvious since it is the only way an ultimate experience record can be obtained for a particular group of policies. Its weakness arises out of the fact that time must elapse before the outlines of the experience emerge in definite and final form. As indicated, knowledge of all the transactions of a given policy year does not become available until the second succeeding calendar year. In the interim, assumptions must be made with regard to earned exposure, earned premiums and deferred loss liability and

this increases the difficulties of interpreting the data. I need not dilate upon the rate-making problem created by this "gap" in the experience record because that has been the subject of much discussion before this Society.

It must be obvious that the policy year method, valuable as it is for certain purposes, has its limitations as a statistical process. It can only be used satisfactorily where the separate items of data relate to individual policies (because it is the effective date of the individual policy that governs the classification of the data by years of account).

Certain transactions in the insurance business cannot be allocated that way. Expense items, generally, fall in this category. Imagine the difficulty of allocating every item of expense to each of several million policies! Similarly, the data with regard to a carrier's financial structure or its operating results are not referred back to individual policies: assets and liabilities and underwriting and investment results must necessarily be compiled as they arise or as they change from day to day. A different accounting method is needed to fit these chronological requirements and this record is known as a calendar year account.

It must be obvious that the two accounting methods produce entirely different statistical results. While the policy year method establishes the experience of a certain group of policies, the calendar year method develops a running account of daily operations as they occur during a given period. A record of workmen's compensation experience for calendar year 1937, for example, would comprise the aggregate net balances at December 31, 1937 of all the payroll, premium and incurred loss transactions occurring during the twelve calendar months of 1937, irrespective of the effective dates of the policies on which these transactions arose. And since such a calendar year record is not segregated by manual classifications, it might include, also, an analysis of expenses allocated to the workmen's compensation business. Given earned premiums, incurred losses and incurred expenses, the underwriting profit or loss for the year can be ascertained.

The advantage of such calendar year experience is that it represents conditions presently prevailing in the field of workmen's compensation insurance. Hence its use for the determination of expense loadings and for the establishment of rate levels.

III.

A discussion of some of the difficulties arising in connection with the interpretation of agency experiences compiled on a policy year basis will still further clarify the differences between the two foregoing accounting methods.

Carriers periodically compile the experience of their agencies by lines of business. The information thus obtained is used as a guide in the underwriting treatment of each agent's business. It is very important, therefore, that the agent and employees of the carrier should be able to agree upon a reasonable interpretation of the data.

For reasons already stated, the policy year method is best adapted to the preparation of agency experiences; but some carriers use the calendar year method for this purpose and an agent may have become familiar with calendar year experiences before he has an opportunity to analyze a policy year experience. In spite of explanations accompanying the policy year exhibit, the agent usually will have difficulty in interpreting the experience.

Naturally, the agent will desire to check the carrier's record against his own data. The carrier exhibit shows written premiums; are these premiums comparable with premiums on his books? He has before him, let us say, an experience compiled as of December 31, 1937, by policy years, terminating with 1937. He consults his accounts current to see what premiums he wrote for the carrier in 1937 and he discovers to his surprise that the two sets of figures do not jibe. Which set is correct?

The likelihood is that both sets of figures are correct. The answer is this: the agent's premiums are compiled on a calendar year basis. He records on his books every premium transaction as it occurs from January 1, 1937 until he closes his books on December 31, 1937. To obtain premiums comparable with those contained in the carrier's policy year exhibit, he would have to re-classify all of these transactions according to the effective dates of the policies on which they arose. If he did this, he might discover that substantial audit premiums on 1936 policies, entered on his records during calendar year 1937, account for the fact that his books show written premiums of \$50,000 for 1937, while the agency experience exhibit shows written premiums of only \$35,000

for policy year 1937. In the agency experience the audit premiums on 1936 policies are included in the 1936 policy year account.

With this point cleared up, the agent proceeds to examine the losses in the carrier's policy year exhibit. He has a record of loss payments and he knows that an important automobile public liability claim was disposed of during 1937 by a payment of \$2000. He is mystified because the experience exhibit shows incurred automobile public liability losses for 1937 of only \$500. Has he discovered another error?

The answer is "no" because the claim which was finally settled in 1937 for \$2000 arose on a policy which became effective in 1936. It will, therefore, appear in the 1936 policy year account in the agency experience exhibit although it was settled in 1937. If the carrier has maintained a reserve of exactly \$2,000 against the claim, the latest compilation of the 1936 policy year account shows the transfer of the loss from the "outstanding" to the "paid" column without a change in the incurred losses. If the reserve has been \$1,500, the 1936 account now shows an increase of \$2,000 in paid losses, a reduction of \$1,500 in outstanding losses and an increase of \$500 in incurred losses. If the reserve has been \$2,500, the paid losses for 1936 are increased by \$2,000, the outstanding losses are reduced by \$2,500 and the incurred losses, therefore, are reduced by \$500.

This point is clarified, and the agent begins to comprehend the strange statistical exhibit which has been placed at his disposal. He accepts the written premium and loss figures as correct and undertakes to calculate some loss ratios. To do this he must establish earned premiums for the several policy years. Here he runs into another snag, particularly when he examines the experience for the latest policy year.

He is accustomed to the calendar year formula for calculating earned premiums:

$$\begin{array}{r}
 \text{Earned premiums for calendar year 1937} \\
 \text{equal} \\
 \text{Unearned premium reserve December 31, 1936} \\
 \text{plus} \\
 \text{Written premiums for calendar year 1937} \\
 \text{minus} \\
 \text{Unearned premium reserve December 31, 1937}
 \end{array}$$

In this formula there is a "carry-over" of the unearned premium reserve from the preceding year. In the policy year exhibit nothing of the sort appears to have been done. Why? Simply because the policy year record for 1937 begins with transactions on policies effective on January 1, 1937 and consequently cannot possibly include any items ante-dating 1937. By the same token, no losses are carried over either so that a loss ratio based upon the estimated earned premiums of the 1937 policy year and the incurred losses of that policy year is confined to and properly reflects the character of the business which was placed on the books during 1937.

And so at long last I come to the first rule of statistical interpretation:

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.

IV.

The statistical factor most extensively used in our business is the "loss ratio." Rates of insurance contain a specific factor for the payment of losses ("pure premium"). By comparing this "pure premium" with the gross rate, the "permissible loss ratio" may be ascertained. This represents the percentage of premium income which may be spent for incurred losses without producing either an underwriting profit or an underwriting loss. The actual loss ratio produced by the experience of an insurance carrier, an agency, a risk or a group of risks, a manual classification, a territory, or a period of time, when compared with the permissible loss ratio, provides a simple test of underwriting results. If the actual loss ratio is lower than the permissible loss ratio, an underwriting profit is indicated; if it is higher, the reverse condition may be inferred. In the nature of things, it would be regarded as purely accidental if the actual and permissible loss ratios should coincide.

The use of the loss ratio for testing underwriting results would seem at first blush to involve no peculiarly difficult problems. The process looks simple; but this is another case where looks are deceptive. There are numerous opportunities for misunderstand-

ing unless the person seeking to interpret an experience fully appreciates the nature of the loss-ratio formula.

The loss ratio is a ratio of losses to premiums; but there are some twelve combinations of these factors to choose from. On the loss side of the equation any one of the following items may be selected:

1. Paid losses, excluding both allocated and unallocated claim expenses.
2. Paid losses, including allocated claim expenses.
3. Paid losses, including both allocated and unallocated claim expenses.
4. Incurred losses (paid and outstanding), excluding both allocated and unallocated claim expenses.
5. Incurred losses, including allocated claim expenses.
6. Incurred losses, including both allocated and unallocated claim expenses.

On the premium side the choice lies between two items:

1. Written premiums.
2. Earned premiums.

With this array of loss ratios available, one person may make one choice and another person may make another: under these circumstances an attempt to compare notes will surely fail because the two are not talking the same language. Obviously the first essential, before drawing conclusions from loss ratios, is a definition of the factors constituting them.

Actuaries will agree, I believe, that the closest approximation to the truth is obtained by comparing one of the *incurred* loss figures with *earned* premiums. Yet each spring we are deluged with endless compilations of loss ratios which involve comparisons of *paid* losses with *written* premiums. I cannot imagine any set of data which is *more likely to create misunderstanding!*

The paid loss-written premium ratio increases in value as the volume of the data used for the computation of the ratio increases. But even under the best conditions, this particular loss ratio is not entirely dependable. Let us take, for example, the largest and latest compilation of calendar year experience which we have—the Casualty Experience Exhibit for Calendar Year 1937—and compute loss ratios on the two bases:

NATIONAL EXPERIENCE FOR STOCK COMPANIES ENTERED IN NEW YORK STATE — ALL LINES

Net Premiums Written..... \$627,839,420
 Net Premiums Earned..... 610,729,241

	Ratio to Written Premiums	Ratio to Earned Premiums
Net Losses Paid (Excluding Allocated and Unallocated Claim Expenses).....	38.2%	39.2%
Net Losses Incurred (Excluding Allocated and Unallocated Claim Expenses).....	40.6	41.7
Net Claim Expenses Incurred (Allocated and Unallocated).....	9.2	9.4

Assuming that the ratio of incurred losses to earned premiums is the correct loss ratio, it will be noted that there is an error of 3.5 points (or 8.4%) in the ratio of paid losses to written premiums. If claim expenses are included with losses, the comparison is between the incurred loss-earned premium ratio of 51.1% and the paid loss-written premium ratio of 47.4%. The error here is 3.7 points (or 7.2%).

When the aggregate national experience is broken down by lines, the error in the paid loss-written premium ratio naturally tends to increase. Take, for example, the surety experience from the Casualty Experience Exhibit for calendar year 1937:

NATIONAL EXPERIENCE FOR STOCK INSURANCE COMPANIES ENTERED IN NEW YORK STATE — SURETY BONDS

Net Premiums Written..... \$39,022,963
 Net Premiums Earned \$39,742,296

	Ratio to Written Premiums	Ratio to Earned Premiums
Net Losses Paid (Excluding All Claim Expenses)	20.7%	20.3%
Net Losses Incurred (Excluding All Claim Expenses)	17.1	16.8
Net Claim Expenses Incurred (Allocated and Unallocated).....	9.6	9.4

Here conditions are reversed and the paid loss-written premium ratio exceeds the incurred loss-earned premium ratio, the comparison being between ratios of 20.7% and 16.8%, excluding claim expenses, and 30.3% and 26.2%, including claim expenses.

As a next step let us compare the two loss ratios from the national experience of a single carrier on one line of business. The line is workmen's compensation insurance and the experience record is taken year by year, beginning with the first year of the carrier's operations.

Calendar Year (Column 1)	Ratio of Paid Losses (Excl. Claim Expenses) to Written Premiums (Column 2)	Ratio of Incurred Losses (Excl. Claim Expenses) to Earned Premiums (Column 3)
1	3.7%	98.7%
2	24.4	74.6
3	37.6	66.0
4	52.9	82.3
5	70.7	59.9
6	68.4	81.0
7	79.0	61.0
8	73.7	74.6
9	55.8	60.7
10	49.4	74.7
11	44.7	63.5
12	44.8	54.2

Note the wide fluctuations between the two sets of loss ratios and the extent to which the paid loss-written premium ratios depart from the more reliable indications. Could anyone place the slightest dependability upon the erratic ratios in the second column of the exhibit?

Under the circumstances, what possible excuse exists for carrying the process further and presenting paid loss-written premium ratios by individual carriers for each line of business written in a single state? The latter loss ratios lose all meaning and closely approach absurdity when minus premium and minus loss figures are produced as is sometimes the case.

It is my hope that the paid loss-written premium loss ratio will some day disappear from the casualty insurance business! If this happy day should ever arrive, a prolific source of confusion and error will have been removed.

Before we leave the subject of loss ratios, another common error should be mentioned. It arises out of attempts to compare loss ratios for carriers whose business is not uniformly distributed by lines of coverage. Let us assume that the permissible loss ratio (excluding claim expenses) for the bonding lines is 45%, whereas the corresponding permissible loss ratio for workmen's compensa-

tion insurance is 62%. One carrier writes business exclusively in the bonding field; another specializes in workmen's compensation insurance. It is obvious that a loss ratio of 50% would produce an underwriting loss for the first carrier, whereas a loss ratio as high as 60% would produce an underwriting profit for the second carrier. Would a comparison of loss ratios for the two carriers have any evidential value whatever?

This is a simple example, but it illustrates the point exactly. Each line of business has its own permissible loss ratio and failure to give proper weight to this fact may vitiate any comparison of aggregate loss ratios for multiple-line carriers.

The extent to which the distribution of business by lines may influence the aggregate loss ratios of two carriers is shown by the following example:

Line	Casualty Experience Exhibit — 1937 Loss Ratio (Excl. Claim Expenses)	Earned Premiums	
		Carrier I	Carrier II
Automobile Public Liability.	58.9%	\$ 600,000	\$ 500,000
Automobile Property Damage Liability	53.5	150,000	150,000
Workmen's Compensation ...	61.5	3,000,000	500,000
Liability (Other than Auto) .	48.6	1,000,000	250,000
Fidelity	28.3	100,000	1,250,000
Surety	26.2	50,000	1,500,000
Plate Glass	50.4	50,000	100,000
Burglary and Robbery.....	29.0	50,000	750,000
		\$5,000,000	\$5,000,000

Here are two carriers with equal volumes of business, with identical loss ratios, line by line and with similar underwriting results. Yet if we weight these loss ratios with the earned premium figures, we find to our astonishment that the average loss ratios are as follows:

	Average Loss Ratio
Carrier I.....	56.9%
Carrier II.....	36.4

Obviously it is dangerous to compare aggregate ratios unless the distribution of business is fairly uniform from carrier to carrier: even then such comparisons will produce results only approximately accurate.

RULE II.

When using a loss ratio, make an analysis to determine the basis upon which it has been calculated and the elements which it represents. Regard with extreme skepticism any loss ratio other than a ratio of incurred losses to earned premiums. When comparing loss ratios, be certain that they are truly comparable in the sense that they both include the same elements of paid losses, claim expenses and loss reserves; that they are both related to the same premium base; that they are both on either a calendar year or a policy year basis; and that they both represent the same line of business, or, if several lines are involved, that they represent a uniform distribution of premium volume among the several lines.

V.

We come now to the interpretation of experience for underwriting and rate-making purposes. A risk is presented for consideration accompanied by a record of past experience from which loss ratios and indicated pure premiums (ratio of incurred losses to earned exposure) may be determined. Questions arise with regard to the quality of the risk and the adequacy, fairness and reasonableness of the rates which should be paid for a certain insurance coverage. Policyholder, producer and carrier representative are all interested. The interpretation of the risk experience becomes a matter of vital importance upon which all interested parties must agree.

Two methods of approach suggest themselves:

1. The loss ratio for the risk may be compared with the permissible loss ratio to determine where the risk stands with regard to the average of its class which is represented by the manual rate, or
2. The indicated pure premium for the risk may be utilized to compute a rate without regard for the manual or any other plan of rating.

In either event, the credibility of the risk experience must be established.

Of course, we have experience rating formulae which are de-

signed to measure, scientifically, the evidential value of risk experience; but, in practice, even where the risk is experience rated, it is necessary to justify the result and discussions involving risk experience cannot be avoided. The error which is most commonly made in these discussions is to place too much value upon a risk experience which, upon analysis, is found not to include a complete distribution of all types of losses. Two illustrations will demonstrate this point:

Example 1: A large Illinois bakery risk, insured for workmen's compensation insurance, is up for renewal and question arises whether the renewal rate is proper. The policyholder is considering some form of competing insurance and the agent is interested in securing the lowest possible rate. The carrier underwriting executive is sympathetic, but he insists that the risk rate shall be unqualifiedly adequate. The risk experience is available and the underwriter concedes that the rate for the risk shall be computed upon this experience. Then the fun begins.

The risk experience covers a full two-year period and discloses the following facts:

Earned Payroll	\$2,000,000
Indicated Pure Premium.....	\$.51

The benefits of the workmen's compensation law have been uniform over the experience period and no change is now contemplated.

Assuming an expense ratio of 40%, the rate indicated by the risk experience would be \$.85 ($$.51 \div .60$). The agent insists that this rate shall be promulgated; but the underwriter calls for an analysis of the losses in the risk experience and discovers that they do not include any so-called "serious" losses. Obviously the risk experience is deficient, since "serious" losses may be expected inevitably to occur if the risk is carried for a sufficiently long period of time.

How shall the missing element be supplied? In the absence of experience for the risk itself, the logical plan is to take the "serious" pure premium from the Illinois classification experience for bakeries. This is \$.15 which, when added to the \$.51 pure premium for the risk, produces a "complete" pure premium of \$.66. On this basis the risk rate would be \$1.10.

Example 2: A similar competitive situation arises on an automobile fleet of one hundred light, class four, commercial vehicles. Public liability coverage has been written at manual rates for limits of \$25,000/\$50,000 and two years of experience

are available. Thirty public liability accidents are included in this experience with an aggregate incurred cost of \$5,640 (excluding unallocated claim expense). No individual claim has produced an incurred cost in excess of \$500. The actual loss ratio is 44.4%. The agent argues that the risk has been extremely profitable (since the permissible loss ratio is 55%) and he requests a substantial credit for the renewal policy.

Again the underwriter goes to work. He discovers that there is experience available showing the distribution of public liability losses for commercial vehicles by amounts of loss. This experience discloses that commercial vehicles, during one complete calendar year, produced 36,862 public liability claims of \$500 or under against 5,487 such claims between \$501 and \$5,000. The amounts expended were \$3,732,073 for "under \$500" claims and \$9,461,473 for "over \$500" claims, or a total of \$13,193,546. Eighty-seven percent of the public liability claim settlements were under \$500 and 13% were over \$500, but the percentages of monetary losses were 28.2% for the former and 71.8% for the latter.

Fortified by this information, the underwriter is prepared to analyze the risk experience. He first divides the premium received into two parts (a) for manual limits of \$5,000/\$10,000 (b) for excess limits, and considers each element separately. These amounts for the two-year period are (a) \$10,000 and (b) \$2,700. Obviously the risk experience provides no basis for determining the cost of insurance for that part of the coverage for limits in excess of \$5,000/\$10,000 since it contains no losses in excess of \$500. The \$2,700 premium for excess limits, therefore, is not affected by the risk experience.

The two-year manual premium received for standard limits is \$10,000. On the basis of the general experience above referred to, 28.2% of \$10,000, or \$2,820, represents expected losses "under \$500." This compares with losses actually produced by the risk of \$5,640. The risk having produced actual losses double the expectancy, it is certain that it is not entitled to rates below manual. If any adjustment in rates is indicated, it should be in the nature of a debit rather than a credit.

While these examples deal with individual risk experience, the same line of reasoning is applicable, of course, to the interpretation of experience for classes of risks, territories and lines of coverage, particularly where the volume of data is limited.

RULE III.

Before attempting to interpret the indications of an experience exhibit, establish the degree of dependability of the data. Where actuarial formulae are not available for measuring the credibility of statistical information, a simple rule is this: never accept an experience indication as definitely reliable unless an examination discloses that the data are completely representative of losses of all types which may reasonably be expected to occur. Any deficiency discovered in the process of analysis must be supplied by personal judgment or from another statistical source before the experience can be accepted as a basis for forming an opinion.

VI.

In appraising the financial strength or the underwriting results of a carrier, it is essential that the analyst should be able to determine the adequacy or redundancy of the aggregate loss reserve. If the management of a carrier fails to establish sufficient reserves, its underwriting results actually are less favorable than they are represented to be and the "policyholders' surplus," constituting the cushion behind its obligations to policyholders, is something less than the figure published in its financial statement. It is easy to understand, therefore, why there is a widespread demand for a rule-of-thumb method of testing the adequacy of loss reserves. Unfortunately, however, this is another problem for which there is no such simple, "short-cut" solution.

A method widely used by chart makers is this :

1. Select a group of carriers whose loss reserves are assumed to be unqualifiedly adequate. Obtain a ratio by relating the aggregate loss reserves of this group to the aggregate written premiums for the latest calendar year.
2. Calculate the corresponding ratio for the carrier whose loss reserve is being analyzed.
3. Compare the two ratios. If the ratio for the carrier whose loss reserve is being tested is equal to or in excess of the group ratio, the loss reserve of the carrier is adequate; otherwise, the likelihood is that the reserve is inadequate.

There are obvious reasons why such a comparison is worse than useless. Incidentally, this is a good place to introduce a rule which, if universally accepted, would save all of us many unnecessary explanations.

RULE IV.

In making analyses between insurance carriers of underwriting experience or financial statements, the use of written premium figures should be limited to comparisons of (a) aggregate premium volume and (b) distribution of premium volume by lines of coverage.

Any comparison of two carriers' ratios of loss reserves to written premiums (or earned premiums, for that matter) is of no value whatever unless four factors are uniform in the two organizations—and since, in the very nature of things, this condition infrequently exists, it follows that such comparisons should be scrupulously avoided. The four factors are as follows:

1. *Premium distribution by lines of coverage.*

This is important where the aggregate loss reserve is compared with the aggregate premium volume, for the loss reserve varies materially according to the obligations assumed under the different types of insurance contracts.

In lines such as burglary and robbery insurance or plate glass insurance, losses are promptly adjusted after the loss occurs. The claim occurs; as a rule, the liability of the carrier may be easily and quickly determined; and the claim is paid. There is no necessity to accumulate a large reserve against deferred loss liabilities.

In lines such as workmen's compensation insurance and liability insurance, on the other hand, losses may not be disposed of so expeditiously. In workmen's compensation insurance, barring lump sum settlements and compulsory payments into State Funds, serious injury and fatal cases may involve pension payments extending over long periods of time. The reserve required to provide funds for these future payments gradually accumulates and in time assumes large proportions. In liability insurance, litigation may be necessary to determine questions of liability and amount of claims and since the legal mills generally grind slowly, the deferred liability in this line grows with the passage of time and adequate provision must be made for future liquidation of claims as they mature. (Incidentally, the valuation of pending liability claims involves the exercise of personal judgment to a greater extent than does the valuation of claims of any other type).

Now assume that one carrier specializes in burglary, robbery and plate glass insurance and another in workmen's

compensation and liability insurance: would any sane person place the slightest value on a comparison of ratios of loss reserves to written premiums for the two carriers?

"Well," say the rule-of-thumb advocates, "we recognize the validity of this criticism and we will overcome it by making separate comparisons for individual lines of coverage. Will that make the test acceptable?" The answer is "no" for other reasons which will now be discussed.

2. *Territorial distribution of premium volume by lines of coverage.*

Let us assume that comparisons are made by lines of coverage: then the geographical distribution of business becomes of extreme importance. Take workmen's compensation insurance for illustration.

Each state has its own workmen's compensation law which prescribes benefits and claim procedure. If one carrier has the bulk of its business in a state with high benefits for serious injury or death, involving the payment of pensions for long periods of time, and another carrier has the bulk of its business in another state with low benefits where no claim can possibly involve pension payments extending beyond a limited period of time (say, six years), the loss reserve of the first carrier will soon bear a much higher relationship to its current premium writings than will the loss reserve of the second carrier.

There are similar considerations in the field of liability insurance where such conditions as average claim cost, frequency of litigation, attitude of the legal profession and functioning of the courts vary widely from one section of the country to another and even from one city to another. If one carrier has its liability business largely concentrated in Boston and New York City and another carrier obtains the bulk of its liability premium income from the Pacific Coast states, the liability loss reserve of the first carrier will soon outstrip that of the second carrier even though both may write equal volumes of business.

3. *Age of carrier.*

A carrier transacting such lines of coverage as workmen's compensation and liability insurance over an extended period of time gradually accumulates a large number of long-term pension cases and lawsuits, involving serious injuries and fatalities. As these expensive claims accumulate, the car-

rier's loss reserves will naturally reflect this condition. A younger carrier, in the process of building its business, during its early years will have in its files a distribution of claims which will not be normal in the sense that the ratio of serious long-term, expensive claims will be low in comparison with the total number of open claims awaiting final disposition.

Obviously it would be wrong, even if the comparison were made by lines of coverage, to compare the ratio of the loss reserve to current premium income of a carrier celebrating its twenty-fifth anniversary with the corresponding ratio of another carrier just entering the fifth year of its existence.

In this connection a recent development in the field of workmen's compensation insurance may be mentioned. The laws of several states now require carriers to commute pension claims and to pay the present value of future payments into a State Fund from which claimants will henceforth receive benefits as they fall due. A new carrier restricting its business to one of these states would have absolutely no loss reserves on its books for serious workmen's compensation claim, whereas an older carrier which had been doing business long before this procedure became effective would have on its books many hold-over claims from the period prior to its inauguration.

4. *Trend of premium income.*

This factor is important because while the loss reserve is necessarily a growing and expanding account because it represents an ever increasing accumulation of liabilities from past operations, the method of testing the loss reserve under discussion consists of a comparison of the accumulated reserve with *current, annual premium income*.

If one carrier having reached its peak of production five years ago, is today writing only half as much business as it wrote at the zenith of its career and another carrier has gradually and consistently increased its premium volume over the years and is today writing twice as much business as it wrote five years ago, even if both carriers are of exactly the same age and have exactly the same distribution of business by lines and territories, it is obviously improper to compare their accumulated loss reserves with their *present-day premium volumes*.

It must be concluded, I believe, that such comparisons as between carriers are improper. This rule is particularly true for multiple-line carriers, whose workmen's compensation and liability

loss reserves usually aggregate seventy-five percent or more of the total loss reserves. Does this mean that there is no method by which the loss reserves of a carrier may be tested for adequacy? Not at all; but the procedure is a laborious one. A method exists and the material for its application may be found in Schedules "G," "O," and "P" of the Annual Statement; which brings me to the next rule:

RULE V.

The proper method of checking the adequacy of loss reserves is to study the reserve for each line separately and to develop at successive intervals the incurred cost of the claims of a group of policies or of a certain period of time. As time passes and the facts with regard to these claims become more and more definitely established, it is possible to make an increasingly accurate appraisal of their ultimate value. A comparison of the latest estimate of incurred losses with estimates which were established at previous intervals will show the extent to which outstanding claims were properly appraised in their earlier stages.

VII.

The corresponding "rule-of-thumb" method commonly used for testing the adequacy of the unearned premium reserve of an individual carrier produces similarly erroneous conclusions.

Upon analysis, two facts immediately stand out:

1. The unearned premium reserve is calculated by mathematical formula, so that the element of personal judgment which is such an important factor in determining the aggregate loss reserve, does not enter into the transaction at all. For this reason, there really is no point in attempting to test the adequacy of the reserve.
2. The unearned premium reserve is based not upon the premiums written by the carrier during a given calendar year, but upon a special premium exhibit which produces what is known as the "Insurance in Force." Invariably a wide difference exists between "Written Premiums" and "Insurance in Force."

The purpose of the "Insurance in Force" exhibits being to determine the unearned premium reserve, it follows that it should repre-

sent premiums on policies under which there is future coverage. For it is only in these cases that a portion of the premium must be held in reserve to meet future losses and expenses and to provide for the ever-present possibility that the individual policy may be cancelled by one party or the other, thus necessitating the return to the policyholder of a portion of the deposit premium. On this theory, there are two types of transactions which affect written premiums and premiums in force in entirely different ways.

1. *The first is audit and installment premiums.* Assume that an interim audit on a workmen's compensation insurance policy develops an additional premium: this is added to the written premium account; but since it is already fully earned when the additional premium is established, it does not affect the premiums in force account at all.
2. *The second is return premiums on cancelled policies.* Assume an annual policy with a deposit premium of \$1,000 is cancelled by the carrier at the end of six months of coverage; a return premium of \$500 must be paid to the policyholder. This is deducted from the written premium account; but because the policy is no longer in force, the necessity of maintaining an unearned premium reserve against it has terminated and the full deposit premium of \$1,000 is deducted from the premium in force account.

There are, of course, other differences in the two accounts; but these two factors will largely explain the reasons for the discrepancy between them.

Obviously the differences between written premiums and insurance in force will depend upon the distribution of the business of the carrier because the conditions with regard to audit and installment premiums and cancellations are not uniform from line to line.

One carrier may specialize in large workmen's compensation insurance risks, all written at nominal deposit premiums and subject to monthly audits of payroll exposure. This carrier's premiums in force will be small in comparison with its written premiums, and the ratio of unearned premiums to written premiums would be low.

Another may write exclusively public liability insurance on buildings of various types with policies issued for annual terms at definitely determined premiums payable at the inception of coverage. This carrier's premiums in force would approximate its writ-

ten premiums, and the ratio of unearned premiums to written premiums would be considerably higher.

Assuming an accurate calculation of the unearned premium reserve by both carriers, could anyone properly place the slightest value on the ratios of unearned premium reserve to written premiums as measuring the adequacy of the unearned premium reserves of the two carriers?

The insurance in force of a carrier must be separately established for:

1. Unexpired risks "running one year or less from date of policy," and
2. Unexpired risks "running more than one year from date of policy."

A choice of two methods of calculating the unearned premium reserve is available for premiums in force of the first class; the management of the carrier may select either the "Pro-Rata" or the "50%" method.* But with regard to premiums in force of the second class, the pro-rata method is prescribed.

Here is another factor which may vitiate a comparison of ratios of unearned premium reserve to written premiums for two carriers. If one carrier writes business exclusively on an annual basis and uses the 50% method, and if there is some margin of difference between its insurance in force and its written premiums, the ratio of the unearned premium reserve to written premiums may be 40%. If another carrier writes business exclusively on a three-year basis, it must establish its unearned premium reserve on the pro-rata method and the ratio of its reserve to current written premiums may be 90% or more.

Again assuming accuracy in the calculation of reserves, would it be reasonable to conclude from a comparison of these ratios

* The unearned premium reserve on the 50% method is obtained by taking 50% of the aggregate insurance in force on the date of calculation. This is sometimes referred to as the "half-yearly method" since it is based on the theory that policies are issued more or less uniformly throughout the year and it may be assumed, therefore, that the average date of issue is the middle of the year. The pro-rata method involves a closer approximation to the theoretically correct reserve because it takes the insurance in force by calendar months of issue and assumes that the average effective date for each month is the middle of the month. The computation of the reserve on this basis is a more laborious process because it involves an analysis of insurance in force by months of issue and the calculation of unearned premiums for each separate month.

that the unearned premium reserve of the first carrier is woefully inadequate or that the second carrier is secreting a large share of its underwriting profits in its reserve?

Finally, there is an additional factor which is inherent in the establishment of the insurance in force. To explain it, we must first examine the formula used for this purpose.

$$\begin{array}{r}
 \text{Insurance in Force December 31, 1938} \\
 \text{equals} \\
 \text{Insurance in Force December 31, 1937, without deducting} \\
 \text{Reinsurance} \\
 \text{plus} \\
 \text{Premiums on policies written or renewed during 1938} \\
 \text{minus} \\
 \text{Premiums on expiring policies and cancelled policies during 1938} \\
 \text{minus} \\
 \text{Reinsurance premiums (Schedule F) at December 31, 1938}
 \end{array}$$

Note that the insurance in force is carried over from the preceding year and that premiums are added for policies which are written or renewed and premiums are subtracted for policies which are expiring. Assuming a normal status where the premium volume has reached a uniform level: the premiums on expiring policies tend to offset the premiums on new and renewed policies. One hundred thousand dollars of business goes off the books in a given month and \$110,000 of business, let us say, goes on the books: the net result is an increase of \$10,000 in the insurance in force.

This procedure may be badly upset, however, if the terms of insurance policies are changed for any reason such, for example, as the requirement imposed upon carriers writing automobile insurance under the compulsory automobile insurance law of Massachusetts. In that state the date of insurance coverage must be synchronized with the date on which the insured vehicle is licensed and since all licenses are issued annually to expire December 31, all insurance policies must also expire on the latter date.

How does this affect the insurance in force? A carrier writes \$1,000,000 of compulsory automobile insurance premiums in Massachusetts: its policies must expire uniformly on December 31. The carrier is not required to maintain any unearned premium

reserve against this business on December 31 (since on that date none of it is in force); but it is required to carry a reserve at other dates during the year which, on either method of computation, is very substantial at the beginning of the year and is reduced to zero at December 31. For in this case, since all the coverage issued in the preceding year expired on or before December 31, as the business is renewed and as new business is written during the current year, there is no offsetting amount of expiring business going off the books.

As the compulsory automobile business goes on the books, beginning with January 1, the insurance in force climbs rapidly and the result is that even if the total volume should be nearly constant from year to year (and the written premiums, therefore, stable), the unearned premium reserve increases sharply until some date near the middle of the year.

Thus, one carrier with a large volume of Massachusetts compulsory automobile business on its books may show a large increase in its unearned premium reserve at June 30, when semi-annual underwriting results are published, in spite of a generally declining or a stationary volume of written premiums. Another carrier with substantially the same volume and distribution of business by lines but with all its automobile business in other states shows no increase, or possibly a decrease, in unearned premium reserve. Since the change in unearned premium reserve vitally affects the carrier's earned premiums and is thus reflected in the published underwriting results at June 30, these two carriers, on the basis of their June 30 statements, appear to be enjoying widely different underwriting results when, in fact, the actual experience of the two carriers may be fairly similar. This difference will vanish by December 31—and the clever analyst will not be misled by the abnormal showing of one carrier at June 30.

RULE VI.

The unearned premium reserve of any reputable carrier may be accepted, without question, as being adequate. Any attempt to judge the adequacy of the reserve by comparing it with written premiums can prove absolutely nothing. Comparisons of ratios of unearned premium reserve to written premiums as between carriers may well be avoided as a waste of time.

VIII.

Casualty actuaries cannot escape responsibility for the widespread use of statistics in our business. Prior to their advent, an occasional crop of annual statements provided the statistically-minded persons of those early days with their only opportunity for mathematical exercise. Actuaries changed all this by insisting that the fundamental principles of our business must rest upon a statistical foundation. In this new order of things, all participants must become reasonably proficient in the simpler forms of statistical analysis. They require guidance and it is only proper that the members of this Society should share the burden of educating them.

The future will bring bigger and better compilations of statistics; the need for enlightenment in their proper uses was never more urgent than it is today.