NOTES ON SOME ACTUARIAL PROBLEMS OF PROPERTY INSURANCE

BY

LAURENCE H. LONGLEY-COOK

1. *Introduction*

Following the extension of the Objects of the Casualty Actuarial Society to embrace property insurance, two papers on fire insurance rate making were presented at a meeting of the Society in 1951: one by the author, formerly a life actuary[1]; and one by a casualty actuary[2]. Since then, the author has made a number of actuarial studies of various aspects of fire insurance and has brought some of the studies together in the following "notes."

Fire insurance has a very long history and many of its practices have often more historical than scientific foundation. These notes are mainly concerned with testing these foundations to inquire whether they can safely continue to support the vast edifice which rests upon them.

2. *The General Problem Of Fire Insurance Rate Making.*

In order to obtain a clear picture of the problem of rate making in fire insurance, it is necessary to consider, briefly, the basic principles involved in making rates for any class of insurance. The most straightforward example of rate making is a one-year temporary life insurance policy, providing for the payment of a fixed sum on the death of the insured within a year. The probability of death occurring within a year is available from past actuarial studies and, hence, the net or pure premium for the policy is immediately available by multiplying the sum payable by this probability. The gross or office premiums for the policy is then obtained by adding fixed or percentage loadings (or a combination of the two) for expenses and adding, also, a provision for profits.

The steps involved in this example of rate making are:

(1) The actuarial investigation of relevant past data, including the classification of the data. (In this case, according to age.)

(2) The use of judgment in examining and interpreting the data, including where desirable the use of development and projection factors or other such adjustments to convert past experience to current, or expected future conditions. (This adjustment is not often employed in life insurance.)

---

[1] "Problems of Fire Insurance Rate Making"—L. H. Longley-Cook, C.A.S. XXXVIII p. 94.

[2] "A Casualty Man Looks at Fire Insurance Rate Making"—M. H. McConnell, C.A.S. XXXVIII p. 103.

(3) The development, therefrom, of probabilities of loss suitable for rate making.

(4) The calculation of net or pure premiums to provide for expected losses.

(5) The addition of expense and profit loadings.

Practically every type of life insurance premium, however complicated the coverage, is developed in the same basic manner except that, since premiums and benefits may not be payable until a date many years hence, the probabilities of death and survival must be modified to reflect the operation of interest[3].

For most classes of casualty insurance, a slight modification to the above general method is necessary because the amount of benefit payable in event of loss is not fixed, as in life insurance, but varies according to the severity of the accident. For this reason, in step 3 "the expected amounts of loss" is substituted for the "probabilities of loss". The expected amount of loss is the average loss which may be expected to arise if a large number of similar risks were insured. In mathematical parlance, it is the integral of the various possible amounts of loss multiplied by the probability of each amount occurring.

In property insurance, the expected amount of loss will vary according to so many factors—occupancy, constructional features, fire protection facilities, size of risk, etc.—that it is nearly always impossible to develop a classification scheme which will subdivide our data into practical homogeneous groups. The finer we classify our data the nearer we approach homogeneity, but the smaller the amount of data in each group: What we gain in homogeneity we lose in credibility of our loss experience. Presented with the impracticability of developing useful expected amount of loss figures for property insurance, we cannot develop pure premiums and a completely different method of rate making has to be employed.

The method of rate making used in property insurance is known as the loss ratio method. In this method, sets of premiums or schedule rating plans are initially set up on a pure judgment basis. For example, a set of premiums for brick protected dwellings may be established with different rates for different classifications of protection. Premium and loss experience for brick protected dwellings are developed which enables the rates for this class of risk to be adjusted upwards or downards to insure that the rates in total are correct. No attempt is made to provide any check on the individual rates for a particular class of protection and, hence, the judgment feature of property insurance rates continues indefinitely. To take another example, a schedule rating plan with numerous credits and debits for favorable and

[3]See for example "Life and Other Contingencies" Vol. 1—Hooker and Longley-Cook-Cambridge University Press 1953—or any other textbook on Life Contingencies.

unfavorable features may be established for a certain class of mercantile or manufacturing classification. Rate level adjustments, based on loss ratio developments will be made to insure the overall adequacy of the rates, but the individual credits and debits continue to be based on judgment alone. Unless this feature of property insurance rate making is fully understood, little progress can be made in understanding many of the technical problems of fire insurance.

3. *The Building-Contents Rate Differential In Fire Dwelling Insurance.*

There can be no possibility of establishing by statistical methods the appropriate charge to be made in a schedule rating plan for, let us say, an unprotected floor opening and this is true of practically all debits, credits and rate differentials in fire insurance. There is one rate differential, the difference in premium rate between contents and building insurance for identical dwellings, for which ample statistical data are available and a discussion of it provides an example of what can sometimes be achieved by the analysis of loss ratio data. Separate statistics by state are available for buildings and contents insurance on dwellings subdivided into brick protected, frame protected, brick unprotected and frame unprotected.

In any particular group, say, "brick protected dwellings in Pennsylvania", there will normally be more than one premium rate, based on various degrees of protection and, in the case chosen, the part of the state in which the risk is located. However, it is possible to establish from census, housing or sample studies, reasonable figures for the ratio of the contents premium rate to the dwelling premium rate in each of the some 200* breakdowns of the nationwide data available; and hence, by reference to the actual loss ratios, what ratio of contents premiums rate to dwelling premium rate would be required to develop an equality of loss ratios for each breakdown. A study made on these lines some years ago indicated that equal loss ratios for building and contents would have been developed in practically all states and for each of the four subdivisions of construction and protection if contents rates were approximately 1.4 times building rates. It is of considerable interest to compare this rough rule, which is at least based on statistical study and which can be repeated by any fire rating bureau at any time, with the actual rate structure employed. It will be found that rate differentials are almost always less than that indicated by the statistical study and that, in many states, building and contents rates for unprotected dwellings are identical. It is believed that the use of identical rates for building and contents insurance on unprotected dwellings is based on the theory that, if the dwelling is unprotected, every fire will lead to a total loss. Much of the structure of fire insurance rates is based on such theorizing because of the lack

* Four breakdowns by construction and protection combined with 48 states plus New York City, Cook County and District of Columbia.

of statistical data. It may be noted that lack of insurance to value is more prevalent in contents insurance than in building insurance on dwellings and this influences the loss experience.

4. *Dwelling Rating Plans*

The foregoing remarks which illustrate the inherent difficulties of the loss ratio method of insurance rate making suggest a general reassessment of the method of developing rates for dwelling insurance, which, because of the marked similarities in the units involved and their large numbers, appears to offer the best field for a more scientific approach to fire insurance rate making.

It is clearly impractical to inspect each dwelling for favorable and unfavorable fire insurance features as the cost of such inspections would absorb too great a percentage of the premium. In dwelling insurance, a simple rating plan is, therefore, desirable. In the past, a large number of protection gradings have been used in certain states and a number of credits and debits have been allowed for such features as a lightning rod and a nonstandard flue. In other areas, the study of a complex series of maps is still necessary to determine the appropriate protection grading of an individual risk.

It is most doubtful that the variations in the fire fighting facilities of fire departments, important as these are for the protection of large mercantile and manufacturing buildings, have as much effect on the burning ratio for dwellings, where speed in getting to the fire and the availability of water are the only two factors of great importance. Unfortunately, it is not possible to prove this idea statistically because fire statistics are broken down into two classifications of protection only—protected and unprotected.

Similarly, two main subdivisions of construction, brick (including stone) and frame, are probably adequate and additional classifications according to roofing material or other features are hardly justified. While a wood shingle roof would appear to increase the fire hazard and contributed greatly to the severe losses of the great conflagrations of the past, what statistics are available, although not particularly credible, seem to indicate this feature is now unimportant. (It may be noted that shingle roofs are less susceptible to wind damage.) Similarly, a lightning rod will have some bearing on the hazard, but it is believed that its importance is insufficient to justify special rate treatment. Other features, such as the state of the electrical wiring and the state of the furnace, which can be determined only by inspection, are likely to be of greater importance.

The author has been concerned with the design of a system of dwelling rating classification which is both simple to apply and which provides a sufficiently small number of breakdowns to enable the experience of each classification to be coded and analyzed separately. The following is the outline of such a plan:

Protection (4 classes)

A Risks located within the boundaries of well protected towns (which can be suitably defined or listed).

B Risks located within 600 feet of a fire hydrant *and* 3 miles of a fire department, not included in A.

C Risks located within 600 feet of a fire hydrant *or* 3 miles of a fire department, not included in A or B.

D Other risks

Construction (2 classes)

1 Brick

2 Frame

Debits and Credits

Nil

This plan, or variants of it, has been tried successfully in a number of states. With such a plan, each rate can have its own individual justification and much of the judgment taken out of the dwelling rating schedule. The plan is equally applicable to Homeowners business.

5. *Actuarial Aspects of Schedule Rating.*

The standard textbooks on Schedule Rating were mostly written some years ago. A. F. Dean's "The Rationale of Fire Ratios" published in 1900 is more satisfactory for the student than his later 3 volume work "The Philosophy of Fire Insurance". Other books which should be studied are: "The Experience Grading and Rating Schedule" by E. G. Richards, Revised Edition, 1924; "The Making of the Fire Insurance Rate" by E. R. Hardy, 1926; "The Principles and Mechanics of Fire Insurance Rating as Incorporated in General Basic Schedule", J. K. Woolley, 1928; "Fire Insurance Rating in Pennsylvania", M. W. Mays, 1935. The author and Mr. T. O. Carlson attempted to provide a very brief description of the principles involved in "Multiple-Line Insurance" by G. F. Michelbacher, published in 1957. The actuary finds himself rather overawed by the rate schedules even for an individual state which, with their instructions, would encompass a whole volume if bound together. The schedules vary appreciably from state to state. Some states start from the Dean system; some the Universal and one or two states use a more modern development—the Uniform Grading Schedule, but changes and additions have been made from time to time to meet national and local problems.

Fundamentally, each schedule has a key rate or key rates, to which constant or percentage credits and debits are applied to provide for a very large number of favorable and unfavorable features which are known to affect the probability or the extent of the loss. There is no statistical basis for the key rate or for the various adjustments but, as experience develops for a certain classification in an individual state, the rates may be adjusted upwards or downwards, either by a revision

in the key rate or, more usually, by a percentage adjustment to the rates produced by the schedule for a particular class of risk.

To an actuary there is apparent a fairly close parallel between schedule rating in fire insurance and the numerical system of rating used in life insurance underwriting. Both systems have credit and debit points for favorable and unfavorable features. Life actuaries have managed to develop able statistical studies to support many of the credit and debit charges, and it is not unreasonable to assume that, despite the many differences between fire and life insurance, at least some statistical support for the fire rating schedules is not beyond our skill with modern electronic equipment.

It is interesting to note some of the results which arise from the technical complexity and the inexactitudes of the system. First, we have certain classes, or sub-classes of business, which the experienced underwriter knows to be inadequately rated. He tries to discourage the acceptance of too much of this business by fixing unusually low company retentions or line levels. Similarly, preferred business may be encouraged by high line levels or increased commission rates. It must not be thought, however, that retention limits reflect only the underwriters' views on the adequacy of the rates; other considerations are often more important as, for instance, the catastrophe hazard.

Secondly, each leading company has to maintain a large "technical staff", skilled in the method of schedule rating, who can advise prospective insureds how they can obtain a reduced rate by removing or reducing fire hazards. While for the community as a whole, this fire prevention work is most valuable, it introduces an unusual competitive feature into fire insurance.

It is of interest to draw up a list of the steps which would be required to introduce a more accurate method of schedule rating of fire insurance. Such a plan will, of course, reflect the personal bias of the author.

1. Substitute a single nationwide rating bureau for the individual state bureaus.
2. Standardize the rate making schedules. (Territorial rate adjustment factors will be necessary.)
3. Simplify the schedules by omitting minor debits and credits.
4. Revise the fire statistical plan so that the classifications coincide with the various rating schedules and the major subdivisions of occupancy within those schedules.
5. Subdivide the statistical data, within the classifications, according to three broad classifications; non-hazardous, medium hazard and severe hazard; thus, providing an overall check on the spread of the rating plan.
6. Use nationwide data to maintain rate levels and hazard differentials (where practical) subject to territorial credits and debits.

It is, of course, appreciated that the work involved in carrying out such a plan would be stupendous and such changes could only be carried out gradually over a long period of time.

A fitting quotation to close this brief note comes from the first paper[4] presented to the Casualty Actuarial Society on Fire Insurance Rate Making:—"If to the problem of a statistical basis for the making of fire insurance rates we can bring the skill of the Actuary and also the scientific outlook, much, I believe, can be accomplished". This paper was presented in 1924 and I do not believe fire insurance was again considered in the proceedings of the Society until 1951.

6. *Term Rule, Installment Plans, etc.*

In order to understand some of the difficulties in interpreting fire insurance statistics for rate making and other purposes, a clear picture of the operation of the term rule and also the installment and other premium payment plans is necessary.

For very many years, a three-year policy was sold in nearly all states for 2½ times the annual premium and a five-year policy for 4 times the annual premium. Certain classes of business were originally excluded from the operation of the rule, but these restrictions have now largely disappeared. It is not possible to justify discounts of this size on expense savings and in 1957, steps were taken to modify the rule to 2.7 times the annual premium for a three-year policy and 4.4 times the annual premium for a five-year policy.

The size of the discounts and the unwillingness of the industry to modify the term rule led in 1945 to the introduction of an installment plan which originally provided for the three-year premium of $250. (corresponding to $100. annual premium) to be payable in three annual installments of $100., $78., $78. This installment plan was modified in some states and was further modified when the three-year term discount was altered as just described.

In certain states, the "annual renewal plan" was introduced as an alternative to, or instead of, the installment premium plan. This plan provides that an annual policy may be renewed at 78%, 80%, 88% or 90% of the one-year premium, the percentage varying from state to state.

On the West Coast, a new installment plan has been introduced which provides an initial one-year installment less than the one-year premium rate!

It is not at all surprising that, with the many changes in term, installment and annual renewal plans which have occurred in recent years, the written-paid loss ratios developed by the National Board of Fire Underwriters are not immediately useful for rate making and even the earned-incurred loss ratios cannot always be accepted at their face value.

[4] "Some Random Thoughts Concerning Fire Insurance. Is a Statistical Basis for Rating Possible?" E. R. Hardy, C.A.S. Vol. X p. 119.

Because of a New York Insurance Department regulation (since withdrawn), many companies entered three-year and five-year installment business as though it were a series of one-year policies. If the first installment on this basis is $100. and subsequent installments are $78., $100. is earned in the first year and $78. in subsequent years. One or two companies took steps to avoid this by treating the excess of the first year premium over the subsequent annual premium as a term policy, others applied a percentage adjustment to the unearned premium reserve, but the vast majority followed the annual booking plan. The effect of this was to increase earned premiums appreciably above their true figure in the years immediately after the introduction of the installment plan or annual renewal plan in any state, and part of the bad underwriting experience in the years 1957 and 1958 can almost certainly be attributed to reductions in premium rates based on the incorrect interpretation of loss data developed in this manner.

7. *Earned-Incurred Loss Ratios*

The National Board develops calendar year earned premiums and incurred losses by state, class, construction and protection on the assumption that writings are evenly spread over the year and that cancellations and alterations of premiums occur on a policy anniversary, so that all policy terms are expressible in exact number of years. These assumptions are perfectly acceptable, except for the error arising from the treatment of installment business as a series of one-year policies which was discussed in the preceding note.

A serious error arises, however, in adjusting earned premiums to the current rate level. One method used extensively proceeds as follows:

(1) Calculate a series of factors to adjust the rate level in force for each of the previous calendar years to current rate levels

(2) Apply these factors to the earned premiums in successive years developed by the National Board.

A similar procedure is described by C. O. Shaver[5]. In this case, step (2) becomes:

> Calculate the adjusted written premiums for each calendar year and multiply the total earned for the 5-year period under review by the ratio of Adjusted Written Premiums to Actual Written Premiums.

Both procedures produce serious errors when rate revisions of any magnitude are involved since they ignore the fact that premiums earned in any year are a result of writings in earlier years. It is of some interest to illustrate this point mathematically. Let us assume a level volume of business, all on a 3-year basis subject to a rate revision of –20% as at 1/1/1956. Written premiums will be

[5]"Revision of Rates Applicable to a Class of Property Fire Insurance"—C. O. Shaver, C.A.S. Vol. XLIV p. 63.

assumed to be $600,000. prior to the revision and $480,000. (i.e., $600,000. x 80%) after the revision. Clearly, if current rate levels had always applied, writings would have always been $480,000. per annum and earned premiums a similar sum. The methods described above would develop the following figures:

Method I

Year	*Written Premiums*	*Earned* Premiums*	*Rate Reductions*	*Adjusted Earned Premiums*
1953	$600,000.	$600,000.	−20%	$ 480,000.
1954	600,000.	600,000.	−20%	480,000.
1955	600,000.	600,000.	−20%	480,000.
1956	480,000.	580,000.	0	580,000.
1957	480,000.	540,000.	0	540,000.
				$2,560,000.

Method II

Year	*Written Premiums*	*Adjusted Written*	*Earned* Premiums*
1953	$ 600,000.	$ 480,000.	$ 600,000.
1954	600,000.	480,000.	600,000.
1955	600,000.	480,000.	600,000.
1956	480,000.	480,000.	580,000.
1957	480,000.	480,000.	540,000.
	$2,760,000.	$2,400,000.	$2,920,000.

Adjusted earned premiums

$$\$2{,}920{,}000. \times \frac{\$2{,}400{,}000.}{\$2{,}760{,}000.} = \$2{,}539{,}130.$$

*Calculated by National Board Statistical Plan for Earned Premiums using factors of 1/6, 1/3, 1/3 and 1/6[6].

With true earned premiums of $2,400,000., it will be seen that Method I will overstate the earned premiums and understate the loss ratio by 6.7% and Method II by 5.8%. Errors of this magnitude are most unsatisfactory.

To obtain correct earned premiums the written premiums must be adjusted to current rate levels *before* the earned premiums are calculated.

A further consideration of some importance is that when the "written premiums" for a particular year include subsequent installments on policies written in prior years, even the application of rate level adjustment factors to written premiums is incorrect[7].

In conclusion, much of the current inadequacy of the rate levels in fire insurance may be attributed to the following snowball effect:

[6]"Statistics of the National Board of Fire Underwriters"—J. H. Finnegan, C.A.S. Vol. XLIII p. 82.

[7]"Rate Revision Adjustment Factors"—L. J. Simon, C.A.S. Vol. XLV p. 196.

(1) the recording of installment business on an annual basis leading to overstatement of earned premiums and an understatement of loss ratios

(2) the reduction in premium rates as a result of (1)

(3) the further overstatement of earned premiums and understatement of loss ratios because of the inaccurate method of calculating adjusted earned premiums where there has been a previous downward rate revision.

(4) the further reduction in rates or inadequate increase in rates as a result of (3).

It is hoped that the change in the term rule which was made in many states in 1957-8, and represented an increase in rates of about 6%, will be sufficient to offset these reductions.

8. *Rate Revision Techniques.*

In 1955, the Inter-Regional Insurance Conference prepared a set of basic principles for the guidance of Fire Rating Organizations[8]. They were

1. The principle of a 6% underwriting profit factor (5% profit plus 1% catastrophe) as set forth in the 1921 Profit Formula of the National Board of Fire Underwriters as modified in the 1949 Sub-Committee Report of the NAIC shall be maintained. No overall rate level adjustment shall be made if the indicated profit is within a tolerance zone of two percentage points above or below such 6% factor.
2. Review of overall rate level shall be annual; however, it is not the intent to require annual adjustment of rate levels.
3. Underwriting profit as referred to above shall be determined with use of direct earned premiums and incurred loss and incurred expense figures without regard to reinsurance.
4. As to loss experience, all available and relevant premium and loss statistics, including loss adjustment expenses, shall be used, to include both member and subscriber (including deviating) Company figures adjusted to reflect current rate levels. Due consideration shall also be given to other available and relevant statistics in the interest of securing the widest possible base of loss experience. In the case of fire rate levels, the loss experience of not less than the most recent five-year period shall be used, while in the case of windstorm or extended coverage including the windstorm peril, the loss experience of not less than the most recent ten-year period shall be used.
5. As to expenses other than loss adjustment expenses, only the experience of member and subscriber stock Companies during

[8]"Rate Making for Fire Insurance"—J. J. Magrath, C.A.S. Vol. XLV p. 176.

the most recent period of years shall be used, reflecting comparable methods of operation and acquisition costs. Such expense figures shall not be separated as between commissions and premium taxes and all other expenses.

6. Due consideration shall be given to loss experience, expenses and to credibility and all other relevant factors within and outside the State, including the important element of informed judgment in reflection of economic trends, social conditions, new processes and inventions and other factors which may affect prospective loss experience and expenses.

Some of these principles call for critical comment.

The third principle will seem strange to actuaries as it means that *all* expenses are to be expressed as a ratio to earned premiums. To relate commissions and taxes to earned premiums is most difficult to justify. Taking the New York Department stock company aggregate expense ratios, this would mean that the expense ratio of Homeowners business in 1956 was 98% with commissions and taxes absorbing 64½% of the premiums. Clearly, an impossible basis for rate making. Further, with the continued increase in Homeowners and Commercial Multiple Line, pure fire premiums are likely to decline and earned premiums for fire insurance will be greater than written premiums, owing to the run-off of business. The use of earned premiums as the basis for measuring profit could, therefore, lead to inadequate fire rates in the future.

There can be no doubt that commissions and taxes should be related to written premiums. For Other Acquisition and General Expenses, written premiums are, I believe, the generally preferable basis, but the greater stability of earned premiums makes their use sometimes desirable, particularly for Bureau filings.

The fourth principle is open to criticism in that it advocates the use of stock and mutual loss experience combined. Provided the experience of these two groups is the same (except for chance variation) the use of the combined figures provides a broader base and is to be preferred. However, in many states, the local mutual companies concentrate on certain classes of risk with particularly favorable loss ratios. In lines where the mutuals write, say, 25% of the business with, say, a 10 percentage point more favorable loss ratio, this procedure produces unfortunate results. Thus, if the rate making formula is:

Provision for Losses	47.5%
Provision for Expenses	46.5%
Provision for Profit and Catastrophe	6.0%
	100.0%

we can assume that the overall loss ratio for stock and mutual companies will be keyed to 47.5%. On the assumptions mentioned, this can be achieved only as follows:

	Stock	*Mutual*
Loss Ratio	50%	(50-10) % = 40%
Proportion of Business	75%	25%
Combined Loss Ratio	47.5%	

Hence, for stock companies we have:

Provision for Losses	50.0%
Provision for Expenses	46.5%
Provision for Profit and Catastrophe	3.5%
	100.0%

An actual provision for profit and catastrophe of 3.5% is very different from the 6% loading intended.

With regard to the fifth principle, the use of only stock company expense is, of course, essential if the agency stock companies are to operate at a profit. In general, mutual companies operate at a lower expense ratio than stock companies and these savings are passed on to the members in the form of dividends. It is not practical to take dividends into account in rate making and, hence, mutual expenses must be excluded.

In 1957, Inter-Regional adopted a recommendation by its Actuarial Subcommittee on Trends that the most recent 6 years' ratios of incurred losses to earned premiums adjusted to current rate level should be used, weighted as follows:

Latest Year	30%
2nd Latest Year	25%
3rd " "	15%
4th " "	10%
5th " "	10%
6th " "	10%
	100%

The figures for the latest year are available only from the annual statements of the companies and the inclusion of this year in addition to the 5 years for which classified data are available is sound.

In view of the eminent actuaries who served on the Subcommittee, it is with considerable diffidence that the author criticizes this plan. If the loss ratios adjusted to current rate level could be accepted at their face value, the plan would be entirely satisfactory, but when we remember the errors which can occur in these ratios due to recording installment business yearly and the current inaccurate method of passing to adjusted earned premiums, I dread to think of the inadequate rates which may develop after two years of particularly favorable experience. I strongly believe that in the current state of development of fire insurance rate making, trends must be allowed for on a judgment basis rather than by any formula.

9. *Credibility*

What do we mean by credibility? Credibility is nothing more or less than the credence that the rate maker believes should be attached to a particular body of experience. Clearly, if we only have one loss in a year in a particular classification and territory, practically no credence can be attached to the loss experience for rate making, while if we have a thousand losses, the loss experience will have considerable credibility.

If data are given 100% credibility, we imply that if it were possible to study a larger volume of similar data, the rates developed from such larger volume of data would be no more accurate than the rates developed from the actual data. In other words, the data are sufficiently extensive to remove for practical purposes the effects of chance variation due to sampling. 0% credibility, or no credibility, implies that the data are too limited to be of any use for rate making. Occasionally, one hears a reference to the credibility of expense data. It follows from what has been said above that this expression is meaningless.

Given two bodies of experience, each with the same premiums, rates and total amount of losses, but one consisting of a large number of small losses and the other a smaller number of large losses, the former will have the higher credibility. Unfortunately, we do not normally have available the number of losses in fire insurance statistics so that this most important measure of credibility is not available. Because a number of companies may each insure part of a risk, there does not appear to be any practical way of developing this data for the combined experience of a number of companies.

Theoretically, it should be possible to establish from a study of the distribution of losses by size, a scale showing the number of losses required to meet a particular statistical tolerance standard, and it would be valuable to have some studies of this calculated from a plausible model. In practice, it is usual to accept, as has been customary for some years in New York State, some arbitrary standard measured by the premium volume. In New York, 100% credibility was originally fixed at $5,000,000. in written premium over a 5-year period, but was increased in 1953 to $6,000,000. Because credibility depends on number rather than the amount of loss, a lower limit should be used for dwelling risks than for commercial risks[9].

An alternative approach to this subject, which on its face is most attractive, is to examine earned-incurred loss ratios year by year in a particular classification[10]. The loss ratios should be first adjusted for trend as indicated by the all classifications' loss ratios and also for

[9]"A Credibility Framework for Gauging Fire Classification Experience"—R. L. Hurley, C.A.S. Vol. XLI p. 161.

[10]The approach was, I believe, first suggested in 1949 in a memorandum prepared by Mr. Carlyle H. Hill, Executive Manager of the Middle Department Association of Fire Underwriters.

rate revisions. If more confidence could be placed in the calculation of these loss ratios, the variance in the loss ratio would provide an excellent measure of credibility. However, changing conditions could cause this test to suggest a lack of credibility where the volume of business should make the results fully credible.

In general, the Fire Rating and Advisory Bureaus have apparently given little attention to the question of credibility. A notable exception is a report by an actuarial subcommittee on credibility for Homeowners business. However, these proposals in this report were revised quite drastically by the introduction of a "seasoning factor" before being released as an industry report[11].

10. *Extended Coverage*

The first uniform extended coverage endorsement was introduced in 1937 replacing the supplemental contracts which varied considerably from territory to territory. The endorsement is attached to fire insurance policies and provides coverage against windstorm, hail, explosion, riot, aircraft vehicle and smoke damage. The peril of windstorm is by far the most important peril covered. At the present time, about 60% of the business is in respect of insurance on dwellings. The business was first recorded on a separate line in the Annual Statement in 1940.

The volume of extended coverage business has risen very rapidly in recent years so that the annual premiums of all stock companies now exceed $500,000,000. which is approximately 40% of the total pure fire premiums. The business has, however, proved unprofitable. Earned premiums for the 18 years, 1940-57, amounted to $3,840,-000,000. and incurred losses to $2,170,000,000. giving a loss ratio of 56.5%. Adding 9.5% for loss adjustment expenses, this gives 66.0% for loss and loss adjustment. Stock Company expenses (other than loss adjustment) for the years 1951 to 1957, inclusive, averaged 47.5% and, if this percentage is considered suitable for the whole period, the total loss plus expense ratio is 113.5%. This represents a loss by the Companies on the business of $520,000,000. compared to the "expected" 5% profit of $190,000,000.

The expense figures used above were those prepared by the New York Insurance Department and may be considered slightly unrealistic for an expanding line, since they relate "Other Acquisition and General Expenses" to earned premiums. Using a written premium base for all expenses other than loss adjustment expenses, the expense ratio is reduced to 45.3%, the total loss plus expense ratio becomes 111.3%, and the loss on the business to $430,000,000.

Following the severe hurricane losses of 1954, in particular, rates have been increased considerably and deductibles have been intro-

[11]"Proposed Rating Procedure. Homeowners Policy" Multiple Peril Insurance Conference 1958, discussed in Mr. Dudley M. Pruitt's Presidential Address to the Casualty Actuarial Society. 1958. C.A.S. Vol. XLV p. 11

duced in nearly all states, and it is hoped the business can be profitable in the future.

Rate making for extended coverage abounds with interesting actuarial problems many of which have received little attention. Since windstorm is by far the major peril, it is important to realize that owing to the correlation between losses—one storm involving many thousands of losses—normal standards of credibility do not apply. This is being recognized by using 10 years rather than 5 years loss experience for rate adjustment. However, in states exposed to hurricanes, the 10-year loss experience may have an abnormal or subnormal number of such storms, and even longer term weather studies make it difficult to establish the normal frequency of hurricanes. The problem is further complicated by the conflicting views of weather men on the relative bearing on trends of sunspot cycles and longer term climatic changes.

Except for certain sea coast territories, a single rate is charged for all dwelling risks in a state. This is in marked contrast to the large number of classifications of fire insurance rates. An attempt is at last being made to compare the experience of building and contents insurance, as there can be no question that the use of the same rate for these two classes of risk is most inequitable. It seems inevitable that if rating is to become scientific, territorial zones will be required for most states and possibly different rates for urban and rural risks. What little data are available suggest that the risk for rural dwellings is rather greater than for cities in the same area.

11. *Conclusion*

No attempt has been made to cover all the actuarial problems of property insurance in these notes. In particular, the most interesting problems of the Homeowners policy have been excluded as they would provide the material for a whole paper of their own.

Can any conclusions be drawn from this brief examination of the foundations of the vast edifice of fire insurance? The author is drawn irresistibly to the following conclusions:

(1) In much of the rating work, complexity has been accepted as synonymous with accuracy;

(2) Insufficient use has been made of the statistical data which are available;

(3) There is a real need for the employment of actuarial talent at the highest level in determining future rate making techniques and in developing more useful statistics for rate making.