

of the professional acts of the assured are covered. The critical conditions consist in defects in the material, errors in treatment, negligence, or lack of ability of the assured. It is obviously most difficult, if not impossible, to get an exposure medium responsive to all these factors. As the hazard is rather small it is not practical to have a complex exposure medium. The following are considered for measuring exposure:

1. PHYSICIANS AND SURGEONS, DENTISTS, OPTOMETRISTS, AND DRUGGISTS.

Man-Year. This medium for measuring exposure like unit-year in other lines based on unit-years is chosen primarily because of its practicability. The underlying assumption is that professional men within the admitted class do not vary enough from the average to make it advisable to adopt either refined classifications within a profession or to select a more responsive but less practical exposure medium. This basis which is quite practical is used for physicians and surgeons, dentists, optometrists, and druggists. In drug stores there are, in addition to the first charge on the store, supplementary charges for additional employees, making the exposure vary somewhat with the volume of business.

Other media for measuring exposures that might be considered are: *number of treatments*, *number of patients*, and *professional income*. Each of these media lacks in complete responsiveness to the hazard and requires additional records. In view of the small hazards these media are considered impractical.

2. HOSPITALS.

Bed-Year. It is apparent that variations in the total hazard between small and large hospitals are too large to be left unrecognized. The bed-year medium for hospitals provides a premium basis which reflects directly the difference in the size of the hospital and indirectly the number of treatments or the number of patients. The magnitude of this exposure is readily obtained, making its use quite practical. There are other conceivable media like *number of patients*, *income* for non-charitable hospitals, *number on staff*, or *payroll* of the hospital. Considering both responsiveness to hazard and practicality, these media just mentioned are deemed inferior to hospital *bed-years*.

INCURRED BUT NOT REPORTED CLAIM RESERVES

BY

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The subject of reserves for incurred but not reported claims has received very scant consideration in our *Proceedings*, nor is there available to the writer's knowledge any written material of consequence on either the theoretical or practical aspects of the subject.

A Committee of the Association of Casualty and Surety Accountants and Statisticians studied the subject in 1927 as respects the fidelity and surety lines and submitted a report recommending that such reserves be determined as a function of premiums in force. Specifically, the Committee recommended the following minimum percentages of in-force premiums: fidelity—10% ; surety—3.5%.

The writer, in conjunction with his office associates, has given considerable study to this subject during recent years and has maintained numerous records designed to aid in the calculation of this particular reserve liability. While no claim is made that an entirely complete solution has been reached, the results of our methods have been so generally satisfactory as to encourage a discussion of the subject before this Society.

For the purposes of this paper an incurred but not reported claim is defined as a claim arising out of an event or accident which occurred on, or prior to, a certain date, but notice of which was not received by the home office of the company until after such date. The date we usually associate with this definition is December 31, since this date is of particular significance from the annual statement viewpoint. Unless otherwise stated, the subject will be considered from the standpoint of this date.

The definition submitted is inclusive and specific and covers all situations and practices, in that the governing condition is the fact of notice of the claim being received or not received on or before the particular date. It is assumed that all notices received as of the particular date will be recorded as of such date, although the actual physical recording may take place at a subsequent date—i.e., that notices received up to and including December 31 will

be recorded as December notices, although the actual recording may not be completed until the first day or two of January.

It is the opinion of the writer that the problem of incurred but not reported claim reserves is essentially actuarial or statistical. Of course a certain part of the reserve can be determined from notices of prior accidents received after the close of the year up to and including the date of closing the annual statement records, but for most lines of business this period is ordinarily too short to produce more than a small part of the reserve and the amounts so determined must be supplemented by additional amounts determined from experience or judgment.

The fundamental principles underlying the establishment of reserves for incurred but not reported claims involve the use of the experience of the immediate past, modified to reflect the effect of current conditions or trends upon such experience. By the experience of the immediate past is meant the amount of incurred but not reported claims of the preceding year developed down to the end of (or for the first eleven months of) the current year, modified, if necessary, by a factor to project such claims to an ultimate basis, and it is assumed that such a record is available. It is not material how this record is maintained. The basic data may be obtained by keeping an itemized record of all such paid cases plus reserve values of all such outstanding cases brought down to the end of November or December, or in the aggregate by recording a symbol on the paid punch cards to indicate an incurred but not reported case and a similar ear marking of outstanding cases whether or not these are recorded on punch cards.

For the more important lines of business the method followed by the company with which the writer is associated is to keep such record on an aggregate incurred loss basis. A card is punched for each notice of loss or accident and the cards for those cases with date of accident December 31 or prior and reported subsequently carry both the accident year and the report year. The card shows the original estimate. For every subsequent change two additional cards are punched, one charging up the changed estimate (or final amount paid) and the other crediting the last previous estimate. The record is maintained on this basis for compensation, automobile liability and liability other than auto. For the other casualty lines only the original estimates are re-

corded; changes are disregarded. It has been found that for such lines the original estimates produce a satisfactory reserve—in the aggregate slightly redundant. The record of the incurred but not reported claims is tabulated monthly on an accumulative basis.

Current factors affecting past experience are:

- (1) Comparative volume of exposure
- (2) Comparative accident frequency
- (3) Comparative average notice or claim costs

The Committee of the Association of Casualty and Surety Accountants and Statisticians attempted to reflect the effect of current conditions by basing the reserve for incurred but not reported fidelity and surety claims on the volume of business in force. The method should produce satisfactory results provided the percentages reflect previous experience and there is no change in accident (or claim) frequency, or in average claim cost, but these factors do not remain constant for many of the casualty lines over any considerable period.

✓ It has also been contended that the incurred but not reported
✓ reserve may be determined as a function of the reserve for known cases. This is more or less correct for lines of business where the average claim is small and varies within rather narrow limits and if, further, claims are liquidated rather speedily—
✓ such for example as automobile property damage and plate
✓ glass—but does not apply to the major casualty lines, compensation, auto liability and other liability, where there is a lag in the liquidation of claims. For the major lines the reserve will be too low if the volume of business is increasing and conversely, if the volume of business is decreasing the reserve will be too high.

It has, therefore, been our theory that having determined the amount of reserve for incurred but not reported claims for the previous year, the reserve for the current year may be determined by modifying such amount by those factors which most nearly reflect the modifications required in the light of current conditions—change in volume of business, change in accident frequency and change in average notice (or claim) cost. The comparative number of notices reflects not only change in volume of business, but change in accident frequency. The trend in claim cost or claim severity is reflected in the average notice cost.

The general method may be expressed in formula form, as follows:

$$\text{Reserve} = \frac{N_{0-11-12}^y}{N_{0-11-12}^{y-1}} \times \frac{C_{0-11-12}^y}{C_{0-11-12}^{y-1}} \times I_{(1)-(12)}^{y-1}$$

Where N = number of notices

C = Average incurred cost per notice

I = Amount of incurred but not reported claims

y designates the current calendar year

$y - 1$ designates the previous calendar year

Subscripts designate calendar months

It will be noted that the comparative number of notices and average notice costs are based upon statistical data for the last three months of each calendar year. This is purely arbitrary and should be varied according to the volume of the particular line of business being dealt with. The period should be such as to include sufficient statistical data to produce dependable results. Obviously, the theory of credibility may be applied to the problem. The basic factor—the amount of incurred but not reported claims at the end of year ($y - 1$) as disclosed by developments during year (y)—embraces a full year's development of claims modified to an ultimate basis, if necessary, in order to produce as accurate an ultimate incurred amount as possible.

The formula as stated contains three factors. It is quite obvious that it can be reduced to two factors:

$$\text{Reserve} = \frac{A_{0-11-12}^y}{A_{0-11-12}^{y-1}} \times I_{(1)-(12)}^{y-1}$$

Since $N \times C = A$ (The amount of incurred losses)

It is desirable, however, as will be brought out later, to provide for the determination of both the N and C factors.

It is at once apparent to anyone who has dealt with the practical aspects of the problem that the foregoing is not an inflexible formula to be applied without modification to each casualty line. It should rather be considered as a formula which furnishes an approach to the desired result rather than the result itself. The formula is not applicable to lines having a low accident frequency and a large factor of variation in average claim costs, such for example as death and dismemberment claims under personal accident policies, burglary, boiler and machinery; but for most

other lines and coverages, provided the volume of business is substantial enough, the formula can be used without material modification. As a rule the formula can be used without much modification for accident and health indemnity claims, compensation, plate glass, auto property damage, auto collision and miscellaneous property damage and collision.

For auto liability, other liability, fidelity and surety it will frequently be desirable to amend the average cost factors by eliminating any abnormal claims. No fixed rule can be given as the limitation depends upon volume of business and the effect of one or more large claims upon the average costs. Notice averages should be developed on a net retention basis and if a company reinsures liability losses in excess of standard limits and its net retention on fidelity and surety business is comparatively low, no modification of averages will, in general, be necessary.

In the case of death and dismemberment claims under accident policies, burglary, boiler and machinery, there is probably no better method of determining the incurred but not reported reserve than that of accumulating the amounts or estimates on such claims reported during the period immediately following the close of the year with the addition of such amount as a factor of safety as past experience indicates to be necessary.

While the above formula is designed primarily for the determination of the reserve at the end of the year, it may be used with certain changes for the monthly reserve during the following year. It is frequently desirable to make such modification so that in event of changes in volume of exposure, accident frequency and accident severity, any change from one year-end to the next may be reflected gradually rather than abruptly.

Since the formula at the end of the next calendar year will be

$$\text{Reserve} = \frac{N_{10-11-12}^{y+1}}{N_{10-11-12}^y} \times \frac{C_{10-11-12}^{y+1}}{C_{10-11-12}^y} \times I_{(1) \dots (12)}^y$$

it follows that the formula for the end of any month of year $(y + 1)$ will be

$$\frac{N_{(n-2)-(n-1)-n}^{y+1}}{N_{10-11-12}^y} \times \frac{C_{(n-2)-(n-1)-n}^{y+1}}{C_{10-11-12}^y} \times I_{(1) \dots (n)}^y \times P_n$$

Where n designates the calendar month of reserve,

$$I_{(1) \dots (n)}^y$$

the incurred but not reported claims reported to end of month n ,

and P_n the factor based upon experience necessary to project $I_{(1)\dots(n)}^y$ to an ultimate basis.

The foregoing formula reduces to

$$\frac{A_{(u-2)-(n-1)-n}^{y+1}}{A_{10-11-12}^y} \times I_{(1)\dots(n)}^y \times P_n$$

It is obvious that considerable judgment must be exercised in using the results obtained by this formula, since the factor $I_{(1)\dots(n)}^y \times P_n$ is not subject to accurate statistical determination. In fact it has been found in practice that for the first three months of the year it is better to substitute for this factor the factor $I_{(1)\dots(12)}^{y-1}$.

For such lines of business as automobile property damage and plate glass where the average claim costs do not vary materially during a twelve months period, the variation in the monthly reserve for incurred but not reported claims will be satisfactorily reflected for practical purposes by disregarding the change in average notice cost; that is, by use of the formula —

$$\frac{N_{(n-2)-(n-1)-n}^{y+1}}{N_{10-11-12}^y} \times I_{(1)\dots(n)}^y \times P_n$$

In conclusion the writer wishes to emphasize the fact that the formulae presented and discussed are not put forward as furnishing a complete solution of the problems under consideration, but it is believed, as a result of experience, that they may contribute to at least a partial and in many cases a satisfactory solution of a difficult problem which admittedly is not susceptible of accurate solution.