TITLE: ACTUARIAL ISSUES TO BE ADDRESSED IN PRICING INSURANCE COVERAGES

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A Statement of The Problem

A recent article in the Journal of Commerce cited an address given at the convention of The National Association of Casualty & Surety Agents by its President, Mr. John S. Childress, Vice President of Marsh & McLennan. His remarks emphasized the value of educating the public regarding casualty ratemaking procedures and company needs.

Speaking before NACSA, Mr. Childress noted that bills are being introduced at both federal and state levels "by legislators of Senator Metzenbaum's persuasion" that would substantially restructure the insurance business. He went on to say that, "Not only is the way insurance operates being questioned, but its credibility is on the line as well. We need to better explain ourselves, as there are those who question the integrity of our business simply because they do not understand it. That is clearly our fault. We must educate the public, the legislatures, and other government officials, who are all demanding accurate, credible and understandable answers to their questions. They have a need to know why we use certain rating classifications and not others." He indicated that we must make a genuine effort to understand the need of our insureds and help them comprehend

the breadth as well as the limitations of their insurance policies. At the same time, Mr. Childress states "we must thoroughly examine our industry and find a reasonable balance between the profit motive of private enterprise and our responsibility to society at large. Society has changed faster than we expected, and we will have to adjust ourselves to the needs of the society in which we live. However, before we do that, the public must also be made to understand the price they will have to pay for these changes. Once consumers have a clearer picture of what is involved, they may be able to judge better what changes are either necessary or desirable, especially when they desire the same degree of protection and service or better, than what they already receive."

We believe Mr. Childress accurately gauges what one of the main challenges to the insurance industry will be in the 1980's. It is our responsibility as actuaries to explain to outside sources (state agencies, consumer groups, etc.) the factors that are (or should be) considered in rate reviews and filings and quantify them as much as possible. This paper begins to respond to this challenge by first describing the variables which should be expressly considered in rate filings, discussing the reasons for their inclusion and quantification and finally

suggesting guidelines for the structuring of rate filings in a manner that will assist all sides (state departments, consumer groups and the company) to properly evaluate an entity's rate level requirements.

Introduction

During the course of our actuarial careers, many of us face the prospect of having our rate filings challenged by a State Insurance Department, a consumer bureau or our company management. The depth and level of the questions posed depend upon the quality and quantity of the reviewer's actuarial knowledge and/or personnel. This is true even when formal rate filings are not produced and rate changes are obtained via informal rate reviews not submitted to outside sources.

Some of these questions deal with the standard issues that have traditionally been considered when analyzing a filing. These are:

(1) The derivation of Loss Development Factors.

(2) The derivation of Trend Factors.

(3) Expense Provisions, including those for Loss Adjustment Expenses and the reflection of Investment Income.

(4) Reconciliation of filing results with those of the Annual Statement.

Until recently, the treatment of these variables was rather perfunctory in nature, and is summarized in Part 1 of this paper. However, there are several hidden

variables which impact on insurer results and therefore affect each of these four items. Unfortunately, these hidden variables have, in many instances, not been analyzed carefully during the preparation of the rate revision and this has caused state agencies and consumer advocates particularly to contest rate filings and criticize ratemaking procedures. In the absence of this outside criticism, omission of the consideration of these variables can often lead to an inadequate, excessive or unfairly discriminatory rate structure.

The problem cannot be attributed to a lack of understanding since most, if not all, ratemakers are familiar with these missing factors. Instead, the blame lies with their lack of quantification and reflection in the rate structure through the filing's statistical support.

The first part of this paper consists of a discussion of the present methodologies underlying a rate filing. In the second part the author illustrates, by means of hypothetical examples, biases resulting from the application of these current treatments which affect the calculation of the factors enumerated in items (1)-(3) above. Part three suggests various tests that should be administered during the preparation of a rate filing or review in order to anticipate any questions that may arise.

included in that section is a proposed list of interrogatories to be answered concerning the filer's reserving, claim settlement rate, changes in its business mix and other relevant factors.

Part four consists of a sample newsletter written in laymen's language containing a brief description of ratemaking procedures along with an explanation for rate adjustments. Distribution to policyholders of this summary might help educate the general public about insurance projections and remove some of the potential causes of consumer dissatisfaction and distrust of the industry.

Part I: The Traditional Approach

A. Loss Development Factors

The loss development model usually followed in the past and, still employed to a great extent presently, calls for an age-to-age valuation of incurred losses over an experience period. This typical loss development exhibit is similar to that shown in Part A of Exhibit I. The selected "link" ratios, displayed on the bottom of Part B of that table, are frequently the result of computing the mean of those determined arithmetically above for the particular maturity studied. From these results, completion ratios are calculated. Application of these factors to the losses reported to date would yield a projection of ultimate incurred losses for each accident or policy year, as displayed in Part C of Exhibit I.

Conspicuously absent in this treatment are explicit measures of the variables which impact greatly on the loss growth curves defined by the link ratios. These variables reflect the following changes during the experience period (or expected to occur subsequently) used in the filing or subsequent thereto:

(i) filer's reserving policy and claim settlement procedures

(ii) policyholder profile such as the book of business such as by classification, territory, liability limit

(iii) propensity of late reported claims and all variables attendant thereto based on (i) and (ii) above

(iv) cause of loss for packaged policies

It would be desirable, therefore, to include within the filing or review analysis, statistical support quantifying each of the above variables in order to properly gauge the company's need for a rate revision.

All of these are combined and hidden by the simplistic traditional loss development method described above, resulting in possible biases in the results. In view of these possible distortions, therefore, it is not surprising that, in this age of consumerism, the past has finally caught up. Insureds and their political representatives have become more adept at discerning these inherent biases and have of late been requesting measurements of the effects of these variables on loss growth patterns and therefore on loss development factors.

B. Trend Factors

Traditionally, calendar year trend data of the type displayed in Exhibit II have been used to derive factors

reflecting insurance inflation. This measure is comprised of two aspects: frequency and severity of claims and increases in fixed and variable expense costs.

As is seen, Exhibit II utilizes calendar year paid (i.e., closed) claim data usually fitted to an exponential curve to project measures of average frequency and severity.

However, any such treatment and calculation of trend is faulty because it ignores variables which impact on a filer's implicit trend data, viz:

(i) No determination is made as to whether the average maturity level of the closed claims in Exhibit II has changed over time. Hence, it is possible that at any point in time, there might be a large number of either older or younger claims being settled which might in turn yield larger or smaller than usual claim sizes. This, naturally, would throw off the results significantly. Claims closed during an accident year's first maturity may exhibit different claim cost trends than those closed later and there might have been a shift in the average age of closure during the experience period. It would therefore seem desirable to include a trend exhibit showing changes in frequency and severity by maturity within accident year, for example.

(ii) No correlation is made between changes in claim cost and frequency and changes in the company's policyholder profile during the experience period. A shift in the mix of insureds may affect loss growth patterns in the areas of propensity to sue and rapidity of reporting. The influence of these changes by classification and territory is obvious. It is, for example, known that urban insured's claim costs are higher than those of rural policyholders and that younger drivers tend to sue for less than those of middle age (i.e., or higher wage earning) group.

(iii) With respect to packaged policies, most filings do not include a cause of loss data breakdown. Such an analysis would provide trends of exactly where the loss dollars are coming from. Then, separate trend factors could be computed, using the filer's actual state experience or industrywide data in that particular state for that specific cause of loss (fire, liability, theft, etc.). Such cause of loss data would also be helpful in predicting trends in loss development patterns. Just as different loss development patterns are applicable for each cause of loss, so are different trend factors, both with respect to frequency and severity.

Once again, the problem with the traditional statistical support, as shown in Exhibit II, centers around the fact that the impact of these important variables, (i) - (iii) above, is not quantified. As in the case of loss development factors, severe biases can result when there has been a change in a particular aspect contributing to the final result.

C. Expense Provisions

The method traditionally used to quantify overhead expenses is illustrated in Exhibit III. Frequently, a provision for each expense item is developed using ratios of costs to written and/or earned premiums for the most recent several years.

However, there are two significant shortcomings in this method:

(i) Expenses are taken as a percentage of past calendar year collected earned premiums. The effect of prior year rate changes on these ratios and a list of budgetary estimates for the coming year are not considered.

(ii) The traditional loss ratio method of ratemaking, by which expense provisions are reflected in the rate structure in deriving a gross rate or level change, assumed that all expenses vary directly with

losses. In fact, only some of the total insurer's expenses vary with premiums while others are relatively fixed. Separate treatments of these different types of overhead costs are required in order to arrive at a fair rate level.

Several states have begun recognizing the need and propriety of separating fixed from variable expenses and territorial flattening of fixed costs in their ratemaking models. This has proven beneficial to insureds who, in the past, might have faced as large an increase in the expense portion of the rate, which often totaled 35% of the total rate, as they did in the loss portion. This was particularly true in the professional liability area during the middle 1970's.

D. Reconciliation of Filer's Results With Those Shown In The Annual Statement

Increased consumer consciousness has given rise to policyholder indignation regarding companies' financial results. Insureds, cognizant of satisfactory earnings records enjoyed by insurance companies, fail to comprehend the necessity for large rate increases. It is vital that we in the insurance industry be equipped to explain this seeming contradiction.

In actuality, Annual Statement results are not and should not be used as statistical support for rate filings. Statement losses reflect countrywide data with

all coverages, voluntary and assigned risk, Bodily Injury and Property Damage, net as to reinsurance, and so on, combined. If premiums and losses shown in the Statement were required to be as detailed (or anywhere near so) as those required in a rate filing or review, an eighteen wheel Mack truck would be needed to deliver a company's Statement to the insurance department.

Be that as it may, there is no doubt that some important parts of rate filings do not appear to be treated anywhere near as rigorously as they are on the filer's Statement. The main reference herein concerns reserve levels. A company's Annual Statement contains reserves which, in most cases, have been calculated with the utmost care to reflect the items of Subsection A above. Input from actuarial and other departments is used to properly evaluate a company's loss and loss adjustment reserve requirements, particularly in the area of case reserving adequacy, rate of settlement, trends and changes in the book of business. On the other hand, the derivation of loss development factors shown in rate filings (Exhibit 1) is comparatively cursory in nature. If one performed such an analysis using the data in Part 2 of Schedule P of a company's Statement, the resulting ultimate losses and/or statement reserves would, in most cases, be far different than those predicted in the

company's balance sheet. As we stated earlier, this often results from not analyzing separately the above variables.

The above Subsections A - D of Part One have summarized the major issues the writer feels should be addressed when preparing a rate analysis or filing.

Part 2 will examine, for each of the three major adjustments (loss development, trend and expenses) discussed above, some of the biases which can occur without a complete and thorough review of the variables which impact on these factors.

Part 2: Discussion of Hidden Biases in The Traditional Approach

A. Loss Development Factors

(i) Changes in a filer's reserving policy

Consider the situation where a company has altered its reserving policy and is now reserving more adequately at the case level than it was in the past. At this particular point in time, therefore, the company's incurred losses are at a more mature level than at comparable dates in the prior accident or policy years.

However, application of historically derived loss development factors, particularly using the method described in Exhibit I, to the present, more adequate valuation of incurred losses would bias the filer's estmate of ultimate losses dramatically upward.

We describe below an example of how changes in the reserving policy of the filer can affect results. Part A of Exhibit IV displays the outstanding loss portion of the Exhibit I incurred development. Using the claim counts in Part B of Exhibit IV, average outstanding loss costs are computed in Part C. As evidenced upon examination of the last diagonal, a significant increase in this average outstanding loss cost appears to have occurred during the latest, 1978, calendar year. This, in the absence of large claims (for which these average

reserves should always be examined for bias), may mean that the insurer has begun to reserve more adequately during 1978. Before any subsequent adjustment is made, this should be confirmed by questioning company personnel in the claim or underwriting area.

The Exhibit I completion ratio of 2.137 for example, which is applied to the 1978 incurred losses to date of $400,000 results from past reserve deficiencies. Applying it to the 1978, more adequate, first maturity incurred losses results in the possibly overstated ultimate loss projection of $854,800 produced in Column (3) of Exhibit I.

It is important to realize that, in any test of reserve adequacy similar to that shown in Exhibit IV, allowance must be made to reflect normal inflationary pressures that manifest themselves in rising claim costs. In Exhibit IV we notice that 1974-78 calendar year changes in the first maturity (i.e., 12 months) hovered in the 25% to 35% area. If we assume that external sources indicate that company claim costs are increasing 10% per year, we may conclude that the insurer has adopted a policy, express or implied, increasing its reserve adequacy.

This apparent strengthening at the case reserve level will greatly affect the future incurred loss growth pattern and should be recognized when selecting completion ratios. As we indicated earlier, any failure to reflect these changes will bias the projection of ultimate incurred losses dramatically upward. An adjustment should therefore be made to the link ratios produced in Exhibit 1 to reflect this change in the reserving policy of the carrier.

It is, therefore, imperative to include, in the rate filing or review, an exhibit measuring explicit or implied changes in the company's reserving policy.

One way to correct these biases is suggested in the description and numerical example shown in Exhibit V-A, wherein the most recent average outstanding loss cost for each past accident or policy year is used and prior year's average outstanding losses (for the same maturity) are adjusted backward by an estimated inflation factor. These "smoothed" average costs are then multiplied by the corresponding outstanding claim counts for the maturity/accident year cell to obtain total "adjusted" outstanding losses. When paid losses are added in the corresponding cells, the resulting artificial incurred development pattern can be used to calculate development factors and finally, ultimate incurred losses.

As can be seen from Exhibit V-B, this would result in incurred losses smaller by about $262,000 (i.e., $3,194,746 per Exhibit V-B compared with $3,456,639 per Exhibit I) or 8% as compared with the unadjusted results using the traditional approach in Exhibit I.

Of course, the above example may be an over simplification of the approach needed to be taken. However, the fact remains that, currently, little effort is expended by filers in the determination and quantification of changing reserving practices. This failure leaves the industry susceptible to criticism from state agencies and consumer groups.

(ii) Changes in the filer's rate of settling claims

A situation similar to that described above can result from a modification in the rate of claim settlement.

As before, application of historically derived paid and/or incurred development factors to present, more mature or adequate valuation of paid or incurred losses would likewise bias the results.

To illustrate, Part A of Exhibit VI has been prepared to test paid loss development data. Normally, in a fast closing line like Homeowners or Physical Damage, such paid loss input can be used in estimating a carrier's ultimate losses. Parts B and C of Exhibit VI display the projection of ultimate losses of $3,154,653 resulting from these empirical results using the traditional

development approach. No test has yet been made to ascertain whether the company's claim settlement pattern has changed. Let us assume we perform such a study in Exhibits VII-A and VII-B.

Exhibit VII-A sets forth a simple age-to-age pattern displaying ratios of the number of paid claims during a period to the total number of incurred claims by maturity within accident year. Although use of report year data in the manner described in Part 3 of this paper is preferable, many insurers do not have such data readily available. However, the Exhibit VII-A calculation is usually available and can be used for our purpose. As can be seen in Exhibit VII-A, therefore, these "disposal" ratios indicate an increase in the rapidity rate of claim settlements.

If we reflect this speed-up in a modified paid development approach in the manner described beginning in Sheet 1 of Exhibit VII-A, we would apply a factor smaller than that employed in Part C of Exhibit VI for each year. The change in the ultimate loss projection between Exhibits VII-B and VI exceed $600,000 or about 19% due to this adjustment. Basically, the method involves an adjustment using the same ratio of paid to total losses going back in time by maturity within accident or policy year.

Changes in the reserving and claim settlement policy of the filer, either explicit or implied, constitute the two most prolific influences in a historical loss growth pattern. Estimation of these influences would greatly aid in providing a more accurate loss and, therefore, rate picture.

Unfortunately, most companies make no effort, at the present time, to explain and document these variables in their filings.

The above studies to determine changes in reserving policy or settlement rates do not have to be confined to state data. Regional or countrywide data could be used to determine a filer's reporting pattern and its reserving and claim settlement policies. The broad conclusions reached from these studies can be applied to the statewide data used in the filing, when relevant. The main point here is that these items should be considered since they do eventually impact on rate levels. Inclusion of some of these studies can improve a filer's credibility with its insureds and state agencies.

(iii) Changes in the policyholder profile

Loss growth patterns are significantly affected by the territorial and classification mix of the insurer. A shift in the policyholder profile will obviously bear

on the results. Illustratively, a more urban insured profile will give rise to a more litigious claims picture in the future. This will in turn cause a more protracted loss growth pattern for the more recent accident years and hence, greater weight should be placed thereon (or alternatively projected loss development factors should be used) if this type of insured profile will continue in the future.

Similarly, if the filer has changed its policyholder profile by classification and is, for example, insuring more young drivers, the loss growth pattern should be different in the future than was the case historically.

These policyholder mixes would affect implicitly both claim settlement and reserving policies and to the extent possible their influence within these areas should be studied.

Statistical tests of significance can be made to determine if a correlation might exist between territorial or class splits and changes in the insurer loss growth pattern. The input for such tests may be in the form presented in Exhibit VIII and either a judgmentally or statistically based adjustment may be made in the filer's loss development factor.

In rate filings there is little, if any, evidence of this type of analysis at the present time. There is usually no indication as to what the current policyholder

profile is, vis-a-vis territory and classification and how it has changed during the experience period. Furthermore, no attempt is made to correlate and quantify changes in the policyholder mix with factors affecting loss development patterns, such as propensity to sue and early reporting of claims.

(iv) Propensity for late reported claims

When performing a comprehensive reserve study, the actuary usually separates loss data by report year to determine and quantify changes in the development patterns of losses for claims reported early as compared with those reported late. The same type of analysis should be done for rate filings. Usually, late reported claims will exhibit characteristics different with respect to both development and trend from those which are reported during the accident year. As we indicated in the preceding subsection, such a study can and should be considered with changes in the exposure profile of a company. As a minimum, loss development data already submitted in a filing or prepared for a rate review should be broken down between claims reported within the accident or policy year and late reported to allow for a more detailed study. If these data lack sufficient credibility, regional or countrywide statistics could be used to document these effects.

(v) Packaged policies

With respect to packaged policies, we believe that cause of loss data should be made available so that the reviewer can make a determination as to exactly which direction the preponderance of losses are taking. If the liability component is increasing, for example, a more protracted loss growth pattern can be expected in the future and vice-versa. An exhibit such as that shown herein, i.e., Exhibit IX, could be prepared when reviewing a rate structure.

All of the above items are considered carefully when quantifying a particular company's reserve level for Annual Statements or other purposes. It seems logical to expect that similar care be given to quantifying these reserves on a by-state and subline basis for rate filing purposes.

B. Trend Factors

The current valuation of trend factors, in most cases, leaves much to be desired. Ordinarily, a table such as that set forth in Exhibit II is displayed and the problems attendant with the procedure followed using this table were discussed in Part 1 of this paper.

A demonstration of the biases caused by combining claims of different age groups is seen from Exhibit II-A. This table displays average paid claims cost data by

maturity within accident year. It is demonstrated that there are different trends existing at various maturity levels. If we ascertain that the most recent average cost corresponds to an average settlement date of 2.0 years as compared with say an historical average of 3.0 years prevailing during the past, the implied trend factor would be different by, say, 10%. This is extremely prevalent where there has been a shift toward a policyholder profile of insureds who tend either to have their case closed earlier or later than in the company's past profile.

It must be recognized that there are multiple components comprising the trend factor. Each of the issues addressed above should be quantified, as much as possible, with respect to both loss frequency and severity. Furthermore, when exposure is measured by the amount of insurance purchased, premium trend factors must be used as an offset to the loss costs in order to recognize inflation resulting in increasing insurance-to-value.

When government indices are used, the filing should statistically correlate insurance company results (severity and frequency) with those using Consumer Price or related indices. Such a correlation can take the form described in Exhibit II-B by maturity within accident year. Once we establish this correlation, these

external indications can be used and the argument that they are not relevant to insurance industry data can be diffused. Of course, these severity trends should always be used in conjunction with frequency trends to obtain a total pure premium trend picture.

C. Expense Provisions

The insuring public and state agencies will, for the most part, no longer accept the old notion that all expenses can be assumed to vary with losses and premiums as implied by the formula dictated by the old loss ratio method, viz:

$$\text{Indicated Rate Change} = \frac{\text{Rate Level Loss Ratio}}{\text{Expected Loss Ratio}} - 1.000$$

Recent rate models allow for a breakout between fixed and variable expenses and include the following general models:

a) $$\text{Indicated Rate Chg.} = \frac{\text{Rate Level Loss Ratio + Fixed Expense Ratio}}{1 - \text{Variable Expense Ratio}} - 1.000$$

b) $$\text{Indicated Rate Chg.} = \frac{\text{Rate Level Loss Ratio}}{1 - \text{Variable Expense Ratio}} + \left(\text{Fixed Expense Ratio} \times \text{Inflation Factor}^{x}\right) - 1.000$$

It seems logical that a breakdown between fixed and variable costs would be appropriate. Certain expenses, such as taxes, underwriting profit and a portion of production costs are and should be computed as a percentage of premium. On the other hand, a portion of others,

such as general overhead expenses (salaries and rent), are relatively fixed in nature and should be treated as such.

In addition to the above treatment of fixed and variable costs, it is important to point out that the present system of determination of expense provisions, as a ratio to premiums, leaves much to be desired. Normally an historical three year ratio of various expenses to written or earned premiums is examined as a provision selected for use in the future.

A more appropriate way to estimate this provision would be to project a budget for the coming year (the estimated dollars needed for various expense categories in a line for a state). This would result in a flat policy fee to be charged on each policy to be supplemented by other variable costs. The formula then for each class premium would be as follows:

$$\text{Gross Class Premium} = \frac{\text{Indicated Loss Cost For That Class}}{1 - \text{Variable Expense Ratio}} + \text{Policy Fee}$$

The above would remove the inconsistency of obtaining percentages of expenses to past calendar year premiums, which may be composites of many different rate levels for the particular year. For instance, if a company intends to increase its rates by 20% beginning next year and its general expense costs by only 10%, the general expense

ratio should change from that estimated the year before.

The percentage used in the separating of expenses into the fixed and variable components can and should be quantified. These affect rate levels by a significant degree, as Exhibit III-A shows, using hypothetical data.

D. Reconciliation Between Rate Filings and Annual Statement Results

We indicated in Part 1 of this paper that if the methods used to estimate loss development factors had been followed in setting reserves on the financial level (i.e., for the Annual Statement) those liabilities might be much different than would presently be the case. In order to obviate this problem, a quantification of the various adjustments that are used in the calculation of Annual Statement reserves should be made and included as a separate memorandum in the rate filing.

Explicitly, then, the methodology used and in fact, the bottom-line reserves appearing in the Statement will tie in with those shown in the rate filing and a consistency would result. This consistency will serve to counter-balance the argument that consumer groups have in terms of the anomaly between Statement "profits" and losses claimed in rate filings. It will also allow for a more accurate representation of insurer results in the rate review process by reflecting the most likely more

sophisticated techniques that were employed in the development of annual statement reserves.

In order to accomplish this goal, we suggest that a supplemental memorandum be included within each filing or rate review describing the reserving process used in the Statement and showing how the variables reflected therein were introduced as input in the filing or rate review under examination. Studies such as those explicitly set forth in Part 3 could be included in this analysis. Inclusion of such exhibits can ease approval of the filing and satisfy departmental inquiries regarding loss development and trend.

The issues of reflecting investment income in the ratemaking process has heretofore not been addressed because of the author's wish to keep within underwriting and actuarial areas. However, regardless of whether or not such income to whatever degree is reflected, it is important that insurers quantify this aspect correctly in rate filings or reviews. Exhibit X presents a brief description of the familiar cash flow approach and quantifies investment earnings on both loss and unearned premium reserves.

All of the above would, in the judgment of the writer, serve to ameliorate the relationship between the insurance company and the public and/or regulatory body.

The Casualty Actuarial Society in recent years has been blessed with numerous excellent studies regarding reserving methodologies. It is our belief that some part of these can and should be integrated in the rate-making process and in the actual filings to help estimate the insurer's liability for claims. This will provide a more accurate picture of ultimate losses and ultimately rate levels.

The report formats in Part 3 of this paper serve to highlight the information process which should, if possible, be included in rate filings and reviews and allow for reflection of these aforementioned studies.

Part 3: Recommended Report Formats To Be Included In Rate Filings

This section discusses tests which should be performed at every rate and reserve evaluation.

These two studies cannot be separated because, in most lines, losses normally comprise at least 60% of any insurer's gross rate and proper estimation of these losses requires production of an actuarially accurate reserve level by accident or policy year.

It is felt that these tests or reports could be used to help answer the following questions regarding an insurer's loss experience and the variables influencing this experience, particularly in the area of loss development, viz:

(1) Change in the company's reserving policy.

(2) Change in the company's claim settlement rates.

(3) Change in the company's policyholder profile (by class and territory).

(4) Change in the company's cause of loss for packaged policies.

(5) Change in the company's reporting patterns and trend factors (frequency & severity) by report year.

In order to be able to explicitly measure each of these variables and respond accurately to the changing

conditions of the insurer in terms of the claim climate and policyholder mix, the following tests must be performed:

Test 1. Calculation of Reserve Adequacy

This test will estimate the effect of any changes in the filer's reserving policy affecting the adequacy of the case reserves. It is important, of course, that the data be presented separately by layer of losses (i.e., basic limits only, losses for amount of insurance range x to y, etc.) so that large claims do not distort the results.

The following format is suggested:

Average Year	Average Outstanding Cost For Limit at: 12 Mos.	24 Mos.	...	60 Mos.	72 Mos.
X					
X + 1					
.					
.					
.					
X + 9					

The average annual changes can be computed by dividing the "n"th average outstanding loss cost at each maturity by the "n-1"st as described in Exhibit IV of this paper to determine if a large change occurs at any one point.

Test 2. Calculation of Claim Disposal (or Settlement) Rate

As stated, this measures the filer's rate of settling claims and has an effect on both paid and incurred loss growth patterns. A calculation of disposal rate of claims to measure claim settlement practices of rate filers follow.

A. Definition of Disposal Rate (DR)

$$DR = \frac{NS}{NOB + NR}$$

where DR = Disposal Rate

NS = Number of Claims settled during calendar period

NOB = Number of Claims that were outstanding at the beginning of the period

NR = Number of Claims reported during the peirod

B. The following table would be prepared by the filer:

(1) Period (normally an accident year)	(2) Disposal Rates 0-12 Mos.	12-24 Mos.	24-36 Mos.
X			
X + 1			
X + 2			
X + 3			
.			
.			
.			

If report year data are unusable, then ratios of paid to total reported claims by maturity within accident

years can be developed as described by Exhibits VII-A.

Test 3A. Calculation of Implicit Average Annual Change In Claim Costs

Implicit changes in claim costs could be obtained by examining the average incurred claim cost (by amount of insurance range x to y, basic limits losses, etc.) by maturity within accident year. The following table would be produced:

TABLE A

Accident Year	Average Loss Cost Reported (or closed) In 12 Mos. Ending With			
	12 Mos.	24 Mos.	... 60 Mos.	72 Mos.
X				
X + 1				
.				
.				
.				
X + 9				

The average cost at each maturity could be computed as a weighted arithmetic mean or by fitting a curve to the average costs at each maturity. Thus, claims reported or closed during the first 12 months may average an annual increase in cost of 5%, those closing the second 12 months, 10% and so on. An overall average annual change in cost would then be computed by obtaining a weighted average date of reporting or closure (i.e., payment) underlying the historical period studied. This "average" maturity in the past could be compared to that

estimated presently on reflecting the current disposal rate to estimate the overall value of the trend factor to be used.

Hence, if Test 2 results indicate a speedup of about 12 months in the average date of settlement and historical data indicated a trend factor of 10% on an average 36 month closure and a 5% trend on a 24 month closure, then a trend factor closer to 5% might be indicated.

The above trend calculation only refers to claim severity and hence measures only one-half of the insurance inflation index. Claim frequency should also be considered and this could be determined by maturity within accident year in Test 3B.

Test 3B. Calculation of Average Claim Frequency Per Exposure

Accident Year	No. of Earned Exposures	Ratio of the No. of Claims Rptd. (or Settled) To Column (1) as of: 12 Mos.	24 Mos.	...60 Mos.	72 Mos.
X					
X + 1					
.					
.					
.					

The combination of the maturity changes of frequency with those of costs in Test 3A would determine the insurance inflation component separately for each maturity

keeping in mind the basic laws of ratemaking: Pure Premium = Claim Severity x Claim Frequency and Total Insurance Inflation = Claim Cost Trend x Claim Frequency Trend.

Test 4. Compilation of Data Reflecting Changes In A Company's Book of Business

This is a very critical area which, unfortunately, has not received the attention it should have in the past.

If a filer has changed its book of business in the most recent year, the experience for years prior thereto becomes much less relevant to future situations and an adjustment (either qualitatively or quantitatively) must be made to reflect these changes. Some of the data required which would determine whether the filer has changed its book follows:

(1) Distribution By Class

(2) Distribution By Territory

(3) Distribution By Liability Limits or Deductible

The above are all very important in analyzing experience. When considering the situation by class, different types of insureds have different propensities to sue and if there has been a class shift, then the development factors obtained would be affected. The

insurer should be prepared to correlate changes in its business mix with changes in its trend, development and other results. Following are types of formats which should be presented as part of any rate filing.

Compilation of Data Used To Determine
A Shift In The Book of Business

	Number of Car Years Earned (or Other Exposure Measure) During Year				
Class	X	X+1	X+2	X+3	X+4
1					
.					
.	A. Distribution By Class				
.					
n					

Territory	X	X+1	X+2	X+3	X+4
1					
.					
.	B. Distribution By Territory				
.					
n					

These are only "marginal" distributions in statistical terminology, hence would not disclose an interchange of classes of insureds between territories where territorial totals and class totals remained unchanged. If such a development is suspected, a two-way classification should be prepared for each year.

Year	Basic	50/100	100/300	50 Ded. Coll.	100 Ded. Coll.
X					
X+1					
X+2					
.	C. Distribution By Liability Limits or Deductible Coverage				
.					
.					
X+4					

Test 5. Interrogatories

The tests usually performed produce a number of questions, the answers to which should be made part of each report. Suppose the data seem to imply that a reserve policy change took place during the experience period. The company should have the opportunity to respond to the indications. It is possible that the data may be misleading and the company should have a chance to rebut.

The following questions may be included in an Interrogatory section:

1) Has there been any change in reserving policy during the experience period to make reserves more or less adquate?

2) Has there been a change in company's claim settling policy, either faster or more slowly?

3) Has there been any change in the company's system of reporting claims?

4) Has there been a change in the company's claim adjustment procedures, tactics, or policies?

5) Has there been any change in the book of business by territory, classification or by policy offering (higher or lower deductibles, policy limits)?

6) How have the above been reflected explicitly in the development of historical incurred losses to an ultimate settlement basis?

Exhibit I

Derivation of Reserves Using Historical Incurred Losses

PART A. Losses Incurred as of Maturity

Year	1	2	3	4	5
1974	250,000	375,000	487,500	560,625	588,656
1975	300,000	435,000	543,750	598,125	
1976	325,000	463,125	567,328		
1977	350,000	481,250			
1978	400,000				

Link Ratios

Year	1-2	2-3	3-4	4-5
1974	1.500	1.300	1.150	1.050
1975	1.450	1.250	1.100	
1976	1.425	1.225		
1977	1.375			

PART B. Average Link Ratios

	1-2	2-3	3-4	4-5
Selected:	1.438	1.258	1.125	1.050

Completion Ratios

1-Ult.	2-Ult.	3-Ult.	4-Ult.
2.137	1.486	1.181	1.050

PART C. Calculation of Ultimate Losses & Reserve Levels

Year	(1) Losses Incurred To Date	(2) Completion Ratio	(3) Ultimate Incurred Losses	(4) Losses Paid To Date	(5) Indicated Reserve
1974	588,656	1.000	588,656	588,656	0
1975	598,125	1.050	628,031	541,875	86,156
1976	567,328	1.181	670,014	450,328	219,686
1977	481,250	1.486	715,138	319,250	395,888
1978	400,000	2.137	854,800	188,950	665,850
TOTAL			3,456,639		1,367,580

Exhibit II

AUTOMOBILE LIABILITY INSURANCE
Private Passenger Cars

Average Paid Claim Cost Data

Year Ended	$10,000 Bodily Injury	Total Limits Property Damage	Total Limits Medical Pymts.
6/30/75	1,623	373	403
9/30/75	1,666	383	407
12/31/75	1,721	391	411
3/31/76	1,771	399	416
6/30/76	1,811	407	423
9/30/76	1,836	417	434
12/31/76	1,867	429	446
3/31/77	1,901	440	459
6/30/77	1,946	453	468
9/30/77	1,990	467	475
12/31/77	2,025	480	483
3/31/78	2,047	494	491
3/31/78 Claims	202,333	1,446,868	91,464
Avg. Annual Chg.	+8.7%	+10.7%	+8.1%

Average Paid Claim Frequency Data

(Claim Frequency Per 100 Cars)

Year Ended	Bodily Injury	Property Damage
6/30/72	1.9487	7.2151
9/30/72	1.9103	7.2084
12/31/72	1.8622	7.2010
3/31/73	1.7924	7.0722
6/30/73	1.8091	7.3311
9/30/73	1.7845	7.3780
12/31/73	1.7018	7.1910
3/31/74	1.6591	7.0924
6/30/74	1.5682	6.9167
9/30/74	1.5408	6.8727
12/31/74	1.5824	7.0670
3/31/75	1.5831	7.0202
6/30/75	1.6222	7.1884
9/30/75	1.6269	7.2716
12/31/75	1.6018	7.2865
3/31/76	1.5720	7.2697
6/30/76	1.5608	7.1284
9/30/76	1.5569	6.9747
12/31/76	1.5729	6.7731
3/31/77	1.5765	6.7320
6/30/77	1.5397	6.5212
9/30/77	1.5019	6.3103
12/31/77	1.4598	6.1057
3/31/78	1.4330	5.9851
3/31/78 Claims	202,333	1,446,868
Avg. Annual Chg.	-4.1%	-2.3%

Exhibit II-A

Accident Year	Average Paid* Claim Cost For Claims Closed In Maturity			
	1	2	3	4
1974	100	115	160	170
1975	110	135	210	290
1976	121	159	280	
1977	133	188		
1978	145			
Avg. Annual Chg.	10%	+20%	+30%	+60%

* or incurred

Exhibit II-B

Date 1	Insurance Company Claim Costs*			Government Index **
	Acc.Yr. 1977	Acc.Yr. 1978	Acc.Yr. 1979	
3/77				
6/77				
9/77				
12/77				
3/78				
6/78				
9/78				
12/78				
3/79				
6/79				
9/79				
12/79				

* Adjusted for changes in the deductible mix.

** Such as Modified Consumer Price Index, Construction Cost Index, etc.

Exhibit III

Historical Derivation of Expense Ratios and Reflection In The Traditional Loss Ratio Method of Ratemaking

	1977	1978	1979
Written Premium	1,000,000	1,200,000	1,500,000
Earned Premium	900,000	1,100,000	1,400,000
Total Production Costs	200,000	252,000	300,000
General Expense	100,000	110,000	130,000

Expense Ratio

				Mean
Production Costs of Written Premium	20.0%	21.0%	20.0%	20.3%*
**General Expense of Earned Premium	11.1%	10.0%	9.3%	10.1% Ø

* Use 20%

** Ø Use 10%

Exhibit III-A

	Percentage of Premium		
	Variable Data	Fixed Data	TOTAL
a) Commission & Brokerage	20%	0%	20%
b) Other Acquisition	1-1/2%	1-1/2%	3%
c) General Administration	5%	5%	10%
d) Taxes	2%	0%	2%
e) Profit	5%	0%	5%
f) Total Expense Ratio	33-1/2%	6-1/2%	40%
g) Expected Loss Ratio			60%

If the rate level loss ratio is 70%, the indicated change under the old loss ratio methods is +16.7%, viz:

$$\text{Indicated Rate Change} = \frac{.700}{.600} - 1.000 = .167$$

If we split between fixed and variable expense, we would obtain a +15.0% change, viz:

$$\text{Indicated Rate Change} = \frac{.700 + .065}{1.000 - .335} - 1.000 = .150$$

If we accept the idea that producers should receive at least a partially fixed commission for each policy (say 10% fixed, 10% variable instead of 20% variable as above), we obtain a +13.1% change, viz:

$$\text{Indicated Rate Change} = \frac{.700 + .065 + .100}{1.000 - .235} - 1.000 = .131$$

Exhibit IV

Derivation of Rate of Change of Outstanding Loss Cost

PART A. Losses Outstanding as of Maturity

Year	1	2	3	4	5
1974	75,000	80,000	75,000	45,000	0
1975	86,250	100,000	90,000	56,250	
1976	125,050	120,000	117,000		
1977	156,350	162,000			
1978	211,050				

PART B. Number of Losses Outstanding as of Maturity

Year	1	2	3	4	5
1974	50	40	30	15	0
1975	50	40	30	15	
1976	50	40	30		
1977	50	40			
1978	50				

PART C. Average Outstanding Loss Cost as of Maturity

Year	1	2	3	4
1974	1,500	2,000	2,500	3,000
1975	1,725	2,500	3,000	3,750
1976	2,501	3,000	3,900	
1977	3,127	4,050		
1978	4,221			

PART D. Rate of Change of Outstanding Loss Costs

Year	1	2	3	4
74-75	1.150	1.250	1.200	1.250
75-76	1.450	1.200	1.300	
76-77	1.250	1.350		
77-78	1.350			

Average Change

1	2	3	4
1.300	1.267	1.250	1.250

Test For Change In Adequacy of Case Reserves

Incurred losses are composed of both paid and outstanding losses. Hence, any change in the strength of case reserves will affect incurred losses and, therefore, will distort any analysis performed on them. The way to test for changes in the adequacy of case reserves is to examine trends in the size of average outstanding loss costs over time. Such changes can occur in two ways. First, there can be a slow increase in the strength of reserves over a number of years. If this is the case, then average outstanding loss costs will be increasing at a rate faster than total average loss cost. For instance, the former may be increasing at 25% a year while the latter increases at only 10% a year. In contrast to this, the reserves strengthening may be a one time phenomenon. This would show up as a large increase in the average outstanding loss costs for all accident years in one particular calendar year. The way to correct this is to adjust all case reserves to the same adequacy level. This is usually done by starting with the most recent average outstanding loss cost for each maturity and then trending back over time using an appropriate factor. When dealing with workmen's compensation insurance, the same procedure would be utilized except that law amendment benefit factors would be utilized in place of trend factors.

An example will help clarify these concepts. Exhibit I shows the derivation of loss reserves utilizing actual incurred losses. In Exhibit IV, the rate of change of average outstanding losses is determined. The change is in the area of 25% to 30%. Let us assume that external data show that costs are increasing only 10% a year. From this we can conclude that the company has adopted a policy of gradually increasing its reserve adequacy. In Sheet 3 of this exhibit a set of adjusted average outstanding loss costs are derived. This was done by trending the latest average outstanding loss cost back in time at 10% a year. These adjusted outstanding losses were then utilized to derive adjusted incurred losses. The latter are shown in Exhibit V-B. Application of the link ratio technique to the adjusted losses yields a reserve 19% lower (or incurred losses 10% lower) than that obtained in Exhibit I using the unadjusted losses.

Derivation of Adjusted Average Outstanding Losses

Adjusted Outstanding Loss Cost as of Maturity*

Year	1	2	3	4	5
1974	2,883	3,043	3,223	3,409	0
1975	3,171	3,347	3,545	3,750	
1976	3,488	3,682	3,900		
1977	3,837	4,050			
1978	4,221				

Adjusted Outstanding Losses as of Maturity**

Year	1	2	3	4	5
1974	144,150	121,720	96,690	51,135	0
1975	158,550	133,880	106,350	56,250	
1976	174,400	147,280	117,000		
1977	191,850	162,000			
1978	211,050				

* Using the latest calendar year's (i.e., last diagonal) average outstanding loss cost from Part C of Exhibit IV trended back by 10% per year by maturity within accident year. Thus, 4,221 ÷ 1.10 = 3,837, 3,837 ÷ 1.10 = 3,488, etc. for maturity 1. For maturity 2, 4,050 ÷ 1.10 = 3,682, etc.

** Adjusted average outstanding loss cost multiplied by corresponding outstanding claim count from Part B of Exhibit IV.

Exhibit V-B

Derivation of Reserves Using Adjusted Incurred Losses

Adjusted Losses Incurred as of Maturity

Year	1	2	3	4	5
1974	319,150	416,720	509,190	566,760	588,656
1975	372,300	468,880	560,100	598,125	
1976	374,350	490,405	567,328		
1977	385,500	481,250			
1978	400,000				

Adjusted Link Ratios

Year	1-2	2-3	3-4	4-5
1974	1.306	1.222	1.113	1.039
1975	1.259	1.195	1.068	
1976	1.310	1.157		
1977	1.248			

Adjusted Average Link Ratios

1-2	2-3	3-4	4-5
1.281	1.191	1.091	1.039

Adjusted Completion Ratios

1-Ult.	2-Ult.	3-Ult.	4-Ult.
1.729	1.350	1.134	1.039

Year	Losses Incurred To Date	Adjusted Completion Ratio	Adjusted Ultimate Incurred Losses	Losses Paid To Date	Adjusted Indicated Reserve
1974	588,656	1.000	588,656	588,656	0
1975	598,125	1.039	621,452	541,875	79,577
1976	567,328	1.134	643,350	450,328	193,022
1977	481,250	1.350	649,688	319,250	330,438
1978	400,000	1.729	691,600	188,950	502,650
Total			3,194,746		1,105,687

Exhibit VI

Derivation of Reserves Using Historical Paid Losses

PART A. Losses Paid as of Maturity

Year	1	2	3	4	5
1974	100,000	250,000	350,000	420,000	462,000
1975	150,000	330,000	429,000	493,350	
1976	175,000	350,000	437,500		
1977	200,000	390,000			
1978	250,000				

Link Ratios

Year	1-2	2-3	3-4	4-5
1974	2.500	1.400	1.200	1.100
1975	2.200	1.300	1.150	
1976	2.000	1.250		
1977	1.950			

PART B. Average Link Ratios

1-2	2-3	3-4	4-5
2.163	1.317	1.175	1.100

Completion Ratios

1-Ult.	2-Ult.	3-Ult.	4-Ult.
3.682	1.702	1.293	1.100

PART C. Calculation of Ultimate Losses and Reserves

Year	Losses Paid To Date	Completion Ratio	Indicated Reserve	Ultimate Losses
1974	462,000	1.000	0	462,000
1975	493,350	1.100	49,335	542,685
1976	437,500	1.293	128,188	565,688
1977	390,000	1.702	273,780	663,780
1978	250,000	3.682	670,500	920,500
TOTAL	2,032,850		1,121,803	3,154,653

Test For Change In Rate of Payment

In this method, the ratio of the number of paid claims to ultimate claims is measured by maturity within accident year. An upward trend in the data indicates that claims are being disposed of more rapidly and vice-versa. The way to correct for this is to adjust the paid loss data so that the same proportion of claims are paid for all accident years at each maturity stage. The procedure to be followed can be illustrated by a single example using the hypothetical paid loss development data set forth in Exhibit VI. These data were analyzed using the normal paid link ratio pattern described earlier for incurred losses. Use of the average growth factors yielded a reserve level in Exhibit VI of $1,121,803 and ultimate incurred losses of $3,154,653.

Sheet 4 of Exhibit VII-A displays the accident year/maturity fractions of paid to incurred number of claims underlying the Exhibit VI data. Examination of this table illustrates that the insurer whose data are used is apparently paying claims at a more rapid rate than it has in the past.

Using these results, we produce an adjusted set of paid loss data in Exhibit VII-B by interpolation. For

example, the adjusted accident year 1974 paid losses as of maturity 1 are calculated as follows:

$$200{,}000 = 100{,}000 + \frac{.50 - .30}{.60 - .30} \times (250{,}000 - 100{,}000)$$

where

100,000 = losses paid for accident year 1974 as of maturity 1

250,000 = losses paid for accident year 1974 as of maturity 2

.50 = adjusted ratio of number of paid to ultimate losses as of maturity 1

.30 = ratio of number of paid to ultimate losses for accident year 1974 as of maturity 1

.60 = ratio of number of paid to ultimate losses for accident year 1974 as of maturity 2

Similarly, the adjusted losses paid as of maturity 2 for accident year 1975 is calculated as follows:

$$396{,}000 = 330{,}000 + \frac{.75 - .65}{.80 - .65} \times (429{,}000 - 330{,}000)$$

These adjusted losses are analyzed in Exhibit VII-B in developing an alternative reserve level. It should be noted that link ratios derived using the adjusted losses are much more stable than those calculated using historical losses. This is to be expected since the adjusted losses reflect the same rate of claim payment for all accident years. The reserve derived utilizing the

adjusted data is only $521,559. This is a reduction of 54% below the figure obtained before in Exhibit VI.

It should not be construed from this example that all changes in payment rate will produce such dramatic reserve changes. However, it should be obvious that significant distortions can arise when historical data are employed without adjustment.

Hence, the general procedure that emerges when employing paid data is:

(1) Test to see if the rate of payment of claims has changed. If so, then

(2) Derive an adjusted loss payment data set.

(3) Use the adjusted figures to determine the reserve requirements.

A more exact way to determine claim settlement rates utilizes report year data. This technique involves measurement of the fraction of claims available for payment in a given time period that are actually paid. The number of claims available for payment is usually taken as the number of claims outstanding at the beginning of the period plus the number of claims reported during the period. Sheet 6 of Exhibit VII-A displays the calculation of disposal rates for the hypothetical company already used. As can be seen, this test confirms the fact that

claims are currently being paid off faster than in the past. Therefore, this technique also implies that the historical paid losses should be adjusted.

Test For Changes In Rate of Claim Payment

Assumed Ratio of Number of Paid To Number of Ultimate Total Losses As of Maturity

Year	1	2	3	4	5
1974	.30	.60	.75	.90	1.00
1975	.35	.65	.80	.95	
1976	.40	.70	.85		
1977	.45	.75			
1978	.50				

Calculation of Disposal Rate

Number of Losses Paid as of Maturity

Year	1	2	3	4	5
1974	30	60	75	90	100
1975	35	65	80	95	
1976	40	70	85		
1977	45	75			
1978	50				

Number of Claims Outstanding as of Maturity

Year	1	2	3	4	5
1974	50	35	25	10	0
1975	45	30	20	5	
1976	40	25	15		
1977	35	20			
1978	30				

Number of Claims Reported During Maturity

Year	0-1	1-2	2-3	3-4	4-5
1974	80	15	5	0	0
1975	80	15	5	0	
1976	80	15	5		
1977	80	15			
1978	80				

Disposal Rate During Maturity

Year	0-1	1-2	2-3	3-4	4-5
1974	0.375	0.462	0.375	0.600	1.000
1975	0.438	0.500	0.429	0.750	
1976	0.500	0.545	0.500		
1977	0.563	0.600			
1978	0.625				

Exhibit VII-B

Derivation of Reserves Using Adjusted Paid Losses

Adjusted Losses Paid as of Maturity

Year	1	2	3	4	5
1974	200,000	350,000	396,667	441,000	462,000
1975	240,000	396,000	450,450	493,350	
1976	233,333	379,167	437,500		
1977	231,667	390,000			
1978	250,000				

Adjusted Link Ratios

Year	1-2	2-3	2-3	4-5
1974	1.750	1.133	1.112	1.048
1975	1.650	1.138	1.095	
1976	1.625	1.154		
1977	1.683			

Adjusted Average Link Ratios

1-2	2-3	3-4	4-5
1.677	1.142	1.104	1.048

Adjusted Completion Ratios

1-Ult.	2-Ult.	3-Ult.	4-Ult.
2.216	1.321	1.157	1.048

Year	Paid Losses To Date	Adjusted Completion Ratio	Adjusted Indicated Reserve	Ultimate Losses
1974	462,000	1.000	0	462,000
1975	493,350	1.048	23,681	517,031
1976	437,500	1.157	68,688	506,188
1977	390,000	1.321	125,190	515,190
1978	250,000	2.216	304,000	554,000
TOTAL	2,032,850		521,559	2,554,409

Exhibit VIII

Territory Groupings	(1) Policyholder or Premium Concentration 1977	1978	1979	Changes In * Between Accident Years (a)	(b)
(a) Rural					
(b) Suburban					
(c) Urban					

Note: In this example, territories have been placed in one of three broad groups: Rural, Suburban, and Urban.

* Can either be average outstanding loss costs at comparable maturities, average settlement rates or other measures affecting loss growth patterns.

Exhibit IX

Cause of Loss	Percentage of Ultimate Losses For Accident Year 1976	1977	1978	Projected 1979	Selected Loss * Dev. Factor
1. Liability	10	15	20	25	1.60
2. Theft	40	30	35	35	1.00
3. Fire	40	35	35	30	1.00
4. Other	10	20	10	10	1.00

Overall Development Factor:

25% of 1.60 + 35% of 1.00 + 30% of 1.00 + 10% of 1.00 = 1.15

* After consideration of the variables discussed in Part 2 concerning claim settlement rates, reserving policy, policyholder mix, etc.

The cash flow discount model shown for the experience of a company in Sheet 3 of Exhibit X produces an investment income offset to the gross premium to reflect reserves for losses and unearned premiums.

Column (b) of Sheet 3 sets forth expected percentages of ultimate losses paid during each of the calendar year periods beginning with day 1 of the policy year studied. Thus, 3% of the ultimate losses are paid within 12 months after the start of the year, 7% from month 13-24, etc.

Column (c) estimates the amount of time from the start of the policy year the money was available for investment. Columns (d) and (e) represent the discounted payments at 9% and 10% rates of return, respectively.

Losses and loss expenses (Line (14)) comprise 86% of the total premium dollar for the client and thus, taxes and general expenses production and profit are considered separately in Lines (16) and (17).

Premiums are normally received between 60 and 90 days after inception of a policy. We have assumed 2/10ths of a year as the average. Regular commissions (zero, in our case) are deducted from premiums remitted by agents. Hence, the insurer never holds this money.

Taxes are paid following the end of the year and we have assumed March 1st of the following year as the date of payment.

In accordance with this schedule, all loss and expense payments and underwriting profit are discounted for interest back to the mid-point of the policy year to give us the Present Value of Outgo. Subtracting this from the correspondingly discounted value of premiums less commissions gives the Present Value of Income Less Present Value of Outgo.

Calculation of Potential Income Through Present Values as of the Midpoint of a Policy Year (July 1) of All Income and Outgo @9% and 10% Interest

Line		(a) Years From Start of Policy Year	(b) Yearly Percent of Losses Paid	(c) Years of Interest Discount	(d) Discount @9%	(e) Payments @10%
(1)		1	3%	.2	2.95	2.94
(2)		2	7	1.0	6.42	6.36
(3)		3	14	2.0	11.78	11.57
(4)		4	20	2.9	15.58	15.17
(5)		5	16	3.9	11.43	11.03
(6)		6	11	4.9	7.21	6.90
(7)		7	8	5.9	4.81	4.56
(8)		8	7	6.9	3.86	3.63
(9)		9	5	7.9	2.53	2.35
(10)		10	3	8.9	1.39	1.28
(11)		11	3	9.9	1.28	1.17
(12)		12	3	10.9	1.17	1.06
(13)	Total				70.41	68.02
(14)	Expected loss and loss expense ratio				.860	.860
(15)	Present value of payments (13) x (14)				60.55	58.50
(16)	Taxes, as percent of Premium		2.0	.667	1.89	1.88
(17)	General expenses, other production and profit		12.0	0	12.0	12.0
(18)	Total present value of outgo (15) + (16) + (17)				74.44	72.38
(19)	Premiums less commissions		100.0	.2	98.29	98.11
(20)	Present value of income less present value of outgo (19) - (18)				23.85	25.73
(21)	Line 20 as a percentage of losses (20) ÷ (14)				27.7%	29.9%

NOTE: $(d) = (b) \times \left(\frac{1}{1.09}\right)^{(c)}$ // $(e) = (b) \times \left(\frac{1}{1.10}\right)^{(c)}$

Part 4: Sample Explanation of Ratemaking Procedures

Insurance rates in general consist of two parts:

1) Expected Losses

2) Expenses

Unfortunately, although losses normally make up approximately 70% of the total premium dollar, they are not fully known by the time rates are set.

Rather, actuaries have to go through a projection process to estimate what the losses will be for a particular year of coverage. Such losses are an approximation of results from past years. Hence, actual losses from these past years are adjusted for the following items.

1) Development Factors

These are historically-derived ratios which adjust losses arising from claims reported to date to reflect losses from claims not yet reported and changes in the valuation of known claims. Insurance company claims personnel initially estimate the ultimate value of claims based on data which are not yet complete. The difference between these estimates and the first value of claims is referred in the insurance industry as "development on known claims".

Thus, loss development factors adjust historical losses for a particular year of coverage to reflect losses not yet reported and changes in the valuation of known claims.

2) Trend Factors

Trend factors are used to project ultimate losses to claim severity and frequency levels expected to prevail to the future. There are two types of insurance inflation:

a) claim frequency = the probability of having a claim

b) claim severity = the cost of the claim once it occurs

Each component varies and is projected separately to reflect these future conditions.

3) Expenses

After losses are adjusted using development and trend factors, expenses of an insurer's operation are added in to arrive at a gross premium value.