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PRIVATE PASSENGER AUTOMOBILE INSURANCE RATEMAKING

A CALENDAR YEAR APPROACH

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PREFACE

The primary purpose of this paper is to describe a ratemaking procedure which begins with calendar year data and results in reasonable automobile insurance rates if the proper judgments are exercised.

The format of the paper involves a series of exhibits, supplemented by explanatory narrative. This format was chosen so that the reader can reproduce, step-by-step, all of the ratemaking calculations beginning with the underlying data and ending with the indicated rate level change.

Traditionally the underlying data for automobile insurance ratemaking has been compiled on either an accident year or a policy year basis, whereas the Annual Statement is compiled on a calendar year basis. Occasionally this difference has caused communication problems among the ratemaker, the regulator, and the public. The ratemaking procedure described here begins with Annual Statement type data. The paper explains the adjustments which must be made to the raw calendar year data in order to derive the appropriate rates. As seen in Exhibit II, the first adjustment is to convert the calendar year data into essentially accident year data. This "bridge" allows the ratemaker to reconcile his data directly to the Annual Statement.

In addition to the differences in the underlying data bases, the described ratemaking procedure differs from the traditional ratemaking approaches in several other respects. One of the principal differences is in the treatment of underwriting expenses. A separate-expense trend is calculated rather than the traditional method of "budgeting" expenses. This allows the ratemaker to reflect in the formula an expense trend which may be different from the trend which is applied to the incurred losses.

INTRODUCTION

The rate regulatory laws generally provide that rates shall not be excessive, inadequate, or unfairly discriminatory. Rates meet these criteria if they reasonably reflect the anticipated losses and expenses which will be incurred during the period for which the rates will be in effect.

Emphasis should be placed on the word "anticipated." For it is the anticipated losses and expenses, not the past losses and expenses, upon which the appropriateness of the rates is judged. In formulating this judgment, the past underwriting experience is relevant to the extent that it produces some clue as to what the loss and expense levels will be in the future. The past underwriting experience is also utilized as a starting point to which the judgments concerning the future claim costs, claim frequencies, and underwriting expenses are applied.

Over the years many arguments have been put forward as to whether the starting point (i.e. the underlying data base) for ratemaking should be policy year, calendar year, or calendar/accident year data. To some extent these arguments have been overrated because they tend to place too much emphasis upon the starting point of the ratemaking process. The important consideration is really the ending point (i.e. the anticipated losses and expenses). While it is recognized that circumstances such as availability of data may necessitate the selection of certain data bases over others, if the ratemaker utilizes the same underlying assumptions and applies the correct judgments, all three data bases will produce equally correct rate levels. In the final analysis it is the judgment which the ratemaker exercises, not the underlying data base or mechanical formulas utilized, which determines the reasonableness of the rates promulgated. While a ratemaker may favor one of the three data bases because of clarity or simplicity, clearly none is superior at predicting future rate needs.

As an illustration of the procedure, we will develop the indicated statewide rate level changes for the hypothetical Car Insurance Company. The indicated rate levels will be for the twelve month period beginning July 1, 1978. In addition to

developing the indicated rate level changes for all private passenger coverages combined, we will also develop indicated rate level changes individually for the four major private passenger coverages: Bodily Injury/Property Damage Liability, Medical Payments, Comprehensive, and Collision.

In the example the B.I. Liability and P.D. Liability coverages are being treated as a single BI/PD Liability package coverage. This is done primarily because these two coverages are predominately marketed today as a single coverage. In order to avoid getting sidetracked with a discussion of the pros and cons of the package premium approach it is sufficient to say that the calendar year ratemaking procedure is equally applicable if the ratemaker chooses to treat these two coverages separately.

EXHIBIT I

The starting point for calculating the indicated rate changes is the actual calendar year underwriting results as shown in Exhibit I. For this example we have chosen the Car Insurance Company's experience for calendar year 1977 and the first three months of calendar year 1978.

It is necessary to choose an experience period which is both responsive to current conditions and stable so as to avoid large fluctuations in the rates from year to year. Most ratemakers would consider that the Car Insurance Company's volume in State X for the latest year satisfies both requirements.

The inclusion of the most recent available experience through the first three months of 1978 may introduce some seasonal distortion since the fifteen month experience base is heavily weighted with winter months. The significance of this seasonal bias will vary with the state and coverage being considered. In the example any seasonal bias has been ignored. The three months of 1978 experience is included in the example to demonstrate how this particular ratemaking approach can be applied to the most recently available partial year underwriting results.

The calendar year ratemaking approach lends itself to directly utilizing Annual Statement data as the basic source of earned premiums and incurred losses. Unfortunately, there are some problems with directly utilizing Page 14 as the basic source of the ratemaking data in our rating example. These problems are as follows:

1. Page 14 does not provide the necessary detailed breakdown by coverage that we desire to utilize in our example.
2. Page 14 is not available on the monthly basis necessary for the Car Insurance Company to update its rate change indications each month.

3. Page 14 does not provide the experience of the voluntary risks separately from that of those risks insured through the assigned risk pool or other residual market mechanism.
4. Page 14 incurred losses may not include an IBNR amount.

To overcome these problems the Car Insurance Company records its earned premiums and incurred losses monthly for each coverage, with voluntary experience separate from assigned risk experience. This monthly data is compiled in a manner compatible with the Annual Statement data.

Strictly speaking the Exhibit I data does not come directly from the Annual Statement. Rather, the data in Exhibit I, which was recorded on a monthly basis by the Car Insurance Company, is included in the totals on page 14 of the Annual Statement.

Specifically, the BI/PD Liability and Medical Payments earned premiums and incurred losses in Exhibit I are included in the totals shown on Line 19.2, Page 14. The Comprehensive and Collision earned premiums and incurred losses in Exhibit I are included in the totals shown on Line 21.1, Page 14.

The private passenger earned premiums and incurred losses for All Coverages combined in Exhibit I include more than the summation of the four major coverages. The All Coverages data includes all those coverages ordinarily reported on Lines 19.2 and 21.1 of Page 14, excluding all assigned risk earned premiums and incurred losses.

The paid allocated loss adjustment expenses are included with the incurred losses. These expenses are treated in the ratemaking formula as a loss component, rather than an underwriting expense component, because the paid allocated loss adjustment expenses are directly related to the incurred losses. The paid allocated loss adjustment expenses are compiled by the Car Insurance Company on a by coverage, by state basis each month in a manner compatible with the Annual Statement data. These allocated loss adjustment expenses are included in the totals shown in Column 1 of Part 4 of the Annual Statement Underwriting and Investment Exhibit.

Paid rather than incurred allocated loss adjustment expenses are used in the example because the Car Insurance Company does not separately identify allocated loss adjustment expense reserves. It would be appropriate to utilize the incurred allocated loss adjustment expenses if such amounts were available.

The underwriting expenses in Exhibit I include the following incurred expense items.

1) Unallocated loss adjustment.
2) Commissions and brokerage.
3) Other acquisition, field supervision and collection.
4) General.
5) Taxes, licenses and fees.

These expense items are allocated to the lines of business in accordance with New York's Regulation 30.

In the case of the Car Insurance Company, all of the commission and brokerage, other acquisition, field supervision and collection, taxes, licenses and fees are charged directly to State X. Approximately three-fourths of the unallocated loss adjustment and general expenses are charged directly to State X. That portion of the unallocated loss adjustment expenses not charged directly by the Car Insurance Company to State X is allocated based on State X's proportional share of newly reported claims. That portion of the general expenses not charged directly to State X is allocated based on State X's proportional share of policy transactions.

The experience shown for the BI/PD Liability and Medical Payments coverages is total limits. For the Comprehensive and Collision coverages, the experience of all the various deductible options is included.

EXHIBIT II

The incurred losses and incurred claim expenses for any given calendar year include the effect of reserve changes made during that calendar year on prior accident year claims. As a result it is possible that the current calendar year incurred losses do not reflect the current level of claim severity. For instance, claims from prior accident years may have been initially under-reserved and then subsequently increased to the correct amounts during the current calendar year period. Alternately, claims from prior accident years may have been initially over-reserved with the excess amount "washed out" during the current calendar year.

Without an adjustment for the effect of reserve changes on prior accident year claims, the current calendar year incurred losses will not accurately reflect the current level of claim severity. The adjustment necessary to remove this bias from the calendar year experience is summarized in Exhibit II.

As an example of this adjustment, consider an accident year 1976 claim initially reserved for $1,000 in 1976. Assume a payment was made of $500, leaving a

$500 reserve on the claim at the end of 1976. Further, assume that during 1977 the reserve was re-evaluated and increased from $500 to $2,500. In this case, the initial estimate of the total incurred loss of $1,000 was subsequently revised to reflect a total incurred loss estimate of $3,000 (cumulative payments to date of $500 plus current outstanding amount of $2,500). The incurred loss for calendar year 1976 will be $1,000. The incurred loss for calendar year 1977 will be $2,000, reflecting the change in the total incurred loss estimate.

The effect of changes in the total incurred loss estimate for prior accident years does not reflect the current calendar year loss levels. Obviously, if the claims could initially be reserved with absolute accuracy no change in the total incurred loss estimate would be necessary.

In the hypothetical example the effect of the reserve change can be eliminated from the calendar year experience by increasing the actual calendar year 1976 incurred losses by $2,000 and reducing the calendar year 1977 incurred losses by a like amount.

The data necessary to calculate the reserve change adjustments are the outstanding loss amounts and paid loss totals as of the end of each calendar month. The outstanding loss amounts and paid loss totals are recorded separately for each accident year. To maximize the responsiveness of the calendar year ratemaking approach it is desirable to have available these accident year outstanding loss and paid loss amounts at the end of each calendar month.

The calculation of the reserve changes made on accident year y during a given calendar year x is shown by the following general formula.

Let:

P_x = Total accident year y losses paid as of end of calendar year x.

P_{x-1} = Total accident year y losses paid as of beginning of calendar year x.

R_x = Accident year y outstanding losses valued as of end of calendar year x.

R_{x-1} = Accident year y outstanding losses valued as of beginning of calendar year x.

TIL_x = Accident year y total incurred loss estimate valued as of end of calendar year x.

TIL_{x-1} = Accident year y total incurred loss estimate valued as of beginning of calendar year x.

Then:

Reserve changes made on accident year y during calendar year x

$$= [P_x + R_x] - [P_{x-1} + R_{x-1}]$$

$$= TIL_x - TIL_{x-1}$$

Only the Bodily Injury Liability and Property Damage Liability incurred losses have been adjusted for the effect of reserve changes on prior accident year claims. Theoretically the necessity of such adjustment exists for each coverage. From a practical standpoint the reserve adjustment is ordinarily significant only for the slower settling liability coverages.

The calendar year underwriting expenses are also adjusted for reserve changes, reflecting the fact that the Car Insurance Company establishes reserves for unallocated claim expenses as a function of the reserves for the outstanding losses. For those insurers which establish reserves for unallocated claim expenses by some other acceptable method, the ratemaker must be prepared to make the appropriate modifications to the ratemaking formula described in this paper.

By means of the reserve adjustments described in Exhibit II, the calendar year experience from Exhibit I is converted into essentially calendar/accident year data as shown below.

Let: $P_{x/y}$ = Paid claim amount during calendar year x on accidents occurring in year y.

$R_{x/y}$ = Outstanding reserve amount (including IBNR) as of end of calendar year x on accidents occurring in year y.

I_x = Total incurred loss for calendar year x.

Then: $I_x = [P_{x/x} + P_{x/x-1} + P_{x/x-2} + \ldots] + [R_{x/x} + R_{x/x-1} + R_{x/x-2} + \ldots]$
$- [R_{x-1/x} + R_{x-1/x-1} + R_{x-1/x-2} + \ldots]$

Let: $R'_{x-1/y}$ = Outstanding reserve amount (including IBNR) on accidents occurring in year y which should have been carried at the end of calendar year x-1 in light of subsequent developments during calendar year x.

I'_x = Total incurred loss for calendar year x after adjustment for reserve changes.

Then: $I'_x = [P_{x/x} + P_{x/x-1} + P_{x/x-2} + \ldots] + [R_{x/x} + R_{x/x-1} + R_{x/x-2} + \ldots]$
$- [R'_{x-1/x} + R'_{x-1/x-1} + R'_{x-1/x-2} + \ldots]$

Substitute:

$R'_{x-1/x} = 0$, since the beginning reserve on the current accident year is 0.

$R'_{x-1/x-1} - P_{x/x-1} = R_{x/x-1}$

$R'_{x-1/x-2} - P_{x/x-2} = R_{x/x-2}$

Then after substitution and cancellation:

$$I'_x = P_{x/x} + R_{x/x}$$

The expression $P_{x/x} + R_{x/x}$ is also equivalent to the total incurred loss for accident year x valued at the end of calendar year x.

The use of the "accident year" or "policy year" ratemaking procedure would require that a so-called "loss development" factor be applied at this point in the ratemaking formula. The primary purpose of the loss development factor is to reflect the IBNR which is not ordinarily included in the basic ratemaking data reported to the statistical agents. Since the incurred losses used by the Car Insurance Company include an IBNR amount, the use of a loss development factor is not necessary for that purpose.

In addition to the IBNR consideration, the traditional loss development factors also measure to some extent past inaccuracies in the insurer's reserve amounts. The assumption that the current reserves of the Car Insurance Company are reasonably correct allows the ratemaker to eliminate the use of the loss development factor.

EXHIBIT III

A catastrophe loss is one which should not be assigned exclusively to the year of occurrence because of its unusually large size and infrequent nature. To include such a loss in the basic ratemaking data would produce distorted projections. To penalize insureds with a rate level increase as a result of including the catastrophe loss in the basic ratemaking data would be to ignore the fundamental precept that ratemaking is prospective by nature and not a recoupment process.

Alternately, even if no catastrophe has occurred during the experience period under review, it would be a mistake to assume that the potential for a catastrophe loss is not present. Accordingly, some provision is needed in the rate to reflect the catastrophe hazard.

To properly reflect the catastrophe hazard in the Comprehensive coverage rate, it is appropriate to eliminate the actual catastrophe losses (if any) from the experi-

ence period, and then include a catastrophe hazard factor in the loss portion of the premium. Due to the infrequency of the catastrophe loss, the catastrophe hazard factor must be calculated based on a relatively long experience period. Exhibit III shows the calculation of such a factor based on a ten year experience period.

At this point in the ratemaking formula it would be appropriate to adjust the incurred losses for any changes in subrogation or salvage patterns not already reflected in the underlying incurred loss amounts. In the example, the Car Insurance Company's incurred loss amounts are net of subrogation and salvage and there have been neither recent significant changes nor anticipated future changes in the subrogation or salvage procedures which require reflection in the ratemaking data.

Another adjustment to the underlying data base which may be necessary at this point in the formula is the exclusion of any BI/PD Liability incurred losses which arose as the result of a single large claim. These unusually large BI/PD Liability claims are in the category of catastrophe losses and may cause distorted projections if no adjustments are made to the data base. The definition of a large claim will depend upon the judgment of the ratemaker and will vary depending upon the volume of experience in the state. For instance, in State X a single BI/PD Liability incurred loss of $100,000 would have increased the statewide actual loss ratio in 1977 by less than .2%. The inclusion of such a loss in the underlying data base in State X would not cause any significant distortions in the projections. However, the inclusion of a $100,000 incurred loss arising from a single claim in a state with a small volume of experience could have a substantial impact upon the projected losses.

In the example the Car Insurance Company has incurred no single BI/PD Liability claim that is catastrophic in nature during the experience period and which requires special treatment in the ratemaking data.

EXHIBIT IV

Exhibit IV summarizes the underwriting experience after adjustment for reserve changes made on prior accident year BI/PD Liability claims and the inclusion of a Comprehensive catastrophe hazard factor.

Thus far in the ratemaking formula no adjustments have been made to the actual earned premiums. As a result, the earned premiums on Exhibit IV are identical to the earned premiums on Exhibit I.

The BI/PD Liability incurred losses and paid allocated loss adjustment expenses (IL&AE) on Exhibit IV are calculated by adding the loss reserve changes from Exhibit II to the IL&AE amounts in Exhibit I.

The Medical Payments and Collision IL&AE amounts in Exhibit IV are identical to the amounts shown in Exhibit I.

The Comprehensive IL&AE amounts in Exhibit IV are calculated by adding the catastrophe hazard amounts from Exhibit III to the IL&AE amounts shown in Exhibit I.

The All Coverages IL&AE amounts in Exhibit IV are the summation of the IL&AE amounts in Exhibit I, the loss reserve changes from Exhibit II, and the catastrophe hazard amounts from Exhibit III.

The BI/PD Liability and All Coverages underwriting expenses in Exhibit IV equal the underwriting expense amounts in Exhibit I plus the underwriting expense reserve adjustment amounts from Exhibit II.

EXHIBIT V

The calculation of an indicated rate change is a test of the rates currently in effect. It is necessary that the earned premiums utilized in the calculation of the indicated rate change fully reflect the current rate levels. The current level factors set forth in Exhibit V provide this necessary adjustment to the earned premiums.

In the example, the most recent rate change was effective July 1, 1976 Assuming the issuance of only annual policies and that policy renewal dates are spread uniformly throughout the year, one-half of the policies would have been renewed at the new rates by January 1, 1977, the beginning of the experience period. All of the policies would have been renewed at the new rates by July 1, 1977. During the first six months of 1977 an average 75% of the earned premiums would have been earned at the new rates.* During the second six months of 1977 all of the premiums would have been earned at the new rates.

The fact that an average 87.5% of the premiums earned during the entire year of 1977 were earned at the new rate level is reflected in the current level factor calculation by the use of an earned factor of .875.

* Strictly speaking, 87.5% of the earned exposure, not earned premium, is at the new rate level. This is correctly reflected in the calculations on Exhibit V. As pointed out in Mr. Simon's paper "Rate Revision Adjustment Factors," *PCAS* XLV (1958), if the insurer's growth rate is very large some further adjustment in the calculation may be necessary.

Any adjustment to the earned premiums gives rise to the need for adjustments to the underwriting expense dollars because commissions, premium taxes, and some board and bureau assessments are directly related to premiums. Reflecting a commission rate of 10% and a 2½% provision for premium tax and other assessments, a total of 12½% of the premium adjustment is added to the underwriting expenses.

EXHIBIT VI

The experience set forth in Exhibit VI reflects the earned premiums and underwriting expenses adjusted to the current rate level as calculated in Exhibit V.

The IL&AE amounts in Exhibit VI come directly from Exhibit IV.

The experience summarized in Exhibit VI has no particular significance to the ratemaker since no trend factors have as yet been applied to either the losses or the expenses. The Exhibit VI experience summary is set forth in this paper only to provide a recap of all the adjustments made thus far in the ratemaking formula and assist any reader who may attempt to reproduce all the calculations in this paper.

EXHIBIT VII

In developing the projected incurred losses, the ratemaker reviews relevant external and internal statistics in an effort to make the very best prediction possible as to the future frequency and severity of claims. The external data utilized may include general price movements in the economy, the cost of medical and hospital care, new car prices, repair part prices, and garage labor rates. The review of the internal insurance statistics involves a study of the underlying trends in claim severity and claim frequency.

Exhibit VII sets forth the average paid claim costs and the incurred claim frequencies for State X for each of the coverages. The data is calendar year data for the year ending in each calendar quarter as shown. The use of the rolling year ending data eliminates any seasonal bias which might otherwise have an impact on the trend calculation. Each of the average paid claim amounts is calculated by dividing the total amount paid during the year ending in the quarter shown by the total number of paid claims during the same period. Each of the incurred claim frequency amounts is calculated by dividing the total number of incurred claims during the year ending in the quarter shown by the average number of exposures during the same period. The use of incurred claim frequencies eliminates the possibility that

any shift in the timing of claim payments could bias the calculation of the underlying frequency trends.

The desire to eliminate the effect of any shift in the timing of claim payments from the claim cost trend would dictate the use of average incurred claim costs, rather than average paid costs. On the other hand, the average incurred claim costs on a calendar year basis will be biased by reserve changes on prior accident year claims as discussed in Exhibit II. In order to circumvent the effect of reserve changes and to facilitate the calculations of the claim cost trend, it is advisable to utilize average paid claim amounts.

If the ratemaker has reason to believe that there has been a recent shift in claim settlement patterns which would bias a cost trend based upon average paid claim costs, then the bias should be measured and the trend adjusted accordingly.

There are many other biases for which the ratemaker should be on the alert and ready to make the appropriate adjustments in the trend data. For instance, a shift in the marketing of deductible physical damage coverages from low deductibles to high deductibles would theoretically decrease the claim frequencies and most likely increase the claim severities. A shift in marketing away from geographical areas or classes of business with high claim frequencies and/or claim severities will also require some adjustment in the trend data. Similarly, catastrophe type losses, such as the 1973 Comprehensive catastrophe loss of $1,000,198 from Exhibit III, should be eliminated from any trend data.

One of the advantages of analyzing the claim frequency and claim severity trends separately, rather than as a combined pure premium trend, is that any distortions in the trend data, such as those listed above, can be more readily recognized. If the ratemaker desires, a good estimate of the underlying pure premium trend can be derived by combining the average paid claim amounts and the incurred frequency amounts, after adjustment for any known biases. Pure premiums so determined will have significance only for the calculation of the trends.

In the example there have been no Comprehensive catastrophe losses (see Exhibit III) during the period covered by the trend. Additionally, the Car Insurance Company has made no changes in its claim settlement procedures or marketing emphasis which would distort the trend. As a result we are able to use the data in Exhibit VII to determine reasonable estimates of the trend without making any adjustments in the underlying claim severity or claim frequency data.

One of the distinct advantages of making rates based on the Car Insurance Company's data, rather than on a combination of data reported by several insurers,

is in the determination of the trends. When working with a single insurer's data it is possible to identify and measure changes in claim settlement practices and marketing emphasis. The ratemaker is usually aware of the nature and timing of such changes.

When determining trends based on the combination of data from several companies it is especially difficult to recognize and measure any distortions in the trend data. This is true because each of the reporting insurers tends to manage its portfolio a little differently and generally does not report the nature and timing of its marketing adjustments.

EXHIBIT VIII

There will never exist a single mathematical formula which will produce the correct rates every year. Accordingly, the question as to whether the underlying claim severity and claim frequency trends are best approximated by fitting data to a straight line, exponential curve, or sine curve is a matter that is left to the ratemaker's best expert judgment after weighing all the evidence. Similarly, the length of the experience period over which the trends are calculated is a matter of expert judgment. Such judgment may vary from year to year.

In Exhibit VIII the ratemaker has calculated the trends by fitting a straight line to the data from Exhibit VII utilizing the least squares method. After analyzing the trends from various length experience periods and considering any relevant external trend data, the ratemaker has selected trends, based on his judgment, which will be used to derive the projected incurred losses.

A thorough understanding of the judgment exercised by the ratemaker in selecting the trends in Exhibit VIII would be instructive, but not pertinent to an understanding of the calendar year ratemaking approach, which is the primary purpose of this paper. In order to further the primary purpose of this paper we will assume that the selected trends are reasonable and proceed with a discussion of their application in the formula.

EXHIBIT IX

The selected claim cost and claim frequency trends in Column 2 from Exhibit VIII are applied to the latest available average claim cost and claim frequency data in Column 1 from Exhibit VII in order to derive the projected claim costs and claim frequencies in Column 3.

The average loss level for the calendar year 1977 is represented by the pure premium in Column 4. The average loss level for the first quarter of 1978 is represented by the pure premium in Column 5. It should be noted that the pure premium in Column 5 is for the first quarter of 1978 only, and not for the year ending in the first quarter of 1978. The year ending point would not be representative of the loss levels underlying the incurred losses for the first quarter of 1978.

By comparing the projected pure premiums (Column 3) to the actual pure premiums (Column 4 and Column 5) the loss projection factors in Columns 6 and 7 can be determined for each of the individual coverages. The loss projection factors for the individual coverages are averaged using the distribution of paid losses to derive the All Coverages loss projection factors. The loss projection factors are applied to the 1977 and first quarter 1978 incurred losses and paid allocated loss adjustment expenses from Exhibit VI in order to bring those amounts up to the projected loss levels for the year ending December 31, 1979.

The choice of the correct loss projection date is based on the assumption of an annual policy and regular annual rate revisions. As stated earlier, we are developing rates for the twelve month period following the planned rate change effective date of July 1, 1978. The average loss level for the twelve month calendar year period beginning July 1, 1978 is the midpoint of that period, which is January 1, 1979. If one were to project loss levels to the midpoint of the period, the Car Insurance Company would not achieve the profit level anticipated in the rates because of the lag in earning the rate change. Assuming policy renewals are uniform throughout the year, only one-half of the rate change would be actually earned by the Car Insurance Company during the twelve month period following July 1, 1978. In order to offset this lag in earning rate changes and to realize the anticipated profit, it is necessary to project the loss levels twelve months beyond the effective date.

Perhaps the clearest way to visualize this concept is to consider the problem on a policy year basis. The policies issued during the twelve month period following July 1, 1978, for which the new rates will be effective, will provide coverage for claims during the twenty-four calendar months beginning July 1, 1978. Assuming that policies are written uniformly throughout the policy year and that claims are incurred uniformly over the policy term, it follows that the average loss level for the policy year beginning July 1, 1978 is represented by July 1, 1979, or twelve months beyond the planned effective date.

If rates are calculated by trending twelve months beyond the effective date, then the rates will produce the anticipated profit for each policy year. If the rates

produce the anticipated profit for each policy year, it follows that each calendar year will also produce the anticipated profit.

We have projected pure premiums in Exhibit IX Column 3 for the year ending December 31, 1979. These pure premiums represent the average loss level for the calendar year 1979. This is equivalent to projecting loss levels to the average loss level of the policy year beginning July 1, 1978.

EXHIBIT X

The basic data for determining the underlying trend in the average underwriting expenses per policy is the type of data reported on Part 4 of the Annual Statement Underwriting and Investment Exhibit.

The method of calculating the expense trend in Exhibit X recognizes that the commissions, premium taxes, and some board and bureau assessments vary directly with the premium dollar and that the claim, other acquisition, general and other tax expenses are not directly related to premium.

By fitting the data to a straight line, the average annual dollar change per policy is calculated for those expenses not directly related to premiums. In the example the average annual dollar change in the expenses not related to premiums is $1.106. In relation to the total average expenses per policy, the average annual change of $1.106 represents an annual trend of +2.1%.

Applying the expense trend to the underwriting expenses from Exhibit VI produces the projected incurred underwriting expenses assuming no change in the current rate level. These projected underwriting expenses reflect only the trend in the expenses not related to premiums. Anticipated changes in the premium related expenses are taken into account in Exhibit XII.

EXHIBIT XI

The experience from Exhibit VI, with incurred losses and paid allocated loss adjustment expenses and underwriting expenses at their projected July 1, 1979 levels, is set forth in Exhibit XI.

The significant items in Exhibit XI are the ratios of IL&AE, Underwriting Expense, and Underwriting Gain or Loss to Earned Premiums. The dollar amounts have no particular significance because there has been no attempt to annualize the amount or estimate policy growth. The ratios reflect the anticipated loss ratio, expense ratio, and resulting per cent of underwriting gain or loss assuming no change in the current rate level.

For instance, based on the first quarter of 1978 experience only, we have predicted an All Coverages underwriting loss of 18.7% for the policy year beginning July 1, 1978 if there is no change in the current rates. Based on the longer 15 month experience period of 1977 and first quarter 1978, we have predicted an All Coverages underwriting loss of 15.2%.

EXHIBIT XII

Before calculating the indicated rate level changes, the proper allowance in the rates for underwriting gain is determined based upon the Car Insurance Company's total financial need. The total financial need of the Car Insurance Company is determined by considering such factors as the expected rate of inflation and the expected real growth (measured by the increase in the number of policies or cars insured). Assuming, for instance, an expected rate of inflation of 6% and real growth of 6%, it will be necessary to increase the Car Insurance Company's surplus by 12% in order to maintain its current financial strength.

Having established quantitatively the total financial need of the Car Insurance Company for the forthcoming year, an amount equivalent to the expected investment income and, if applicable, expected proceeds from the sale of capital stock is deducted. The remainder is the amount of money that must be generated from the Car Insurance Company's underwriting operations.

The determination of the appropriate provision in the rates for underwriting profit has received considerable attention from many authors over the years. While the determination of the Car Insurance Company's total financial need and the resulting indicated provision in the rates for underwriting profit are important subjects, they are not particularly pertinent to an understanding of the mechanics of the calendar year ratemaking approach. Having mentioned the important considerations in determining the total financial need and observing that this figure will vary over time, we will proceed with the assumption that an allowance of 5.0%, before federal taxes, is appropriate for underwriting gain and contingencies in the rates for the Car Insurance Company.

The Loss Ratio Test is defined as the division of the projected loss ratios by the permissible loss ratio.

The permissible loss ratio is dependent upon the projected expense ratio and the desired underwriting profit provision. The projected expense ratio cannot be determined until the indicated rate level is determined because a portion of the underwriting expenses varies directly with premium. The projected expense ratios in

Exhibit XI are correct only if there is no change in the current rates. As a result, the Loss Ratio Test cannot be applied directly to the experience in Exhibit XI.

The way around this problem is to calculate the indicated rate change as a solution to the following algebraic equation. This equation recognizes that 12.5% of the premium change flows into expenses to pay for the commissions (10%) and premium taxes and some board and bureau assessments (2½%), and the remaining 87.5% of the rate change flows into underwriting profit.

Let:
- I.C. = Indicated rate level change.
- g = Projected underwriting gain or loss as a percent of premium, assuming no rate change.
- G = Desired underwriting gain ratio = 5.0%.
- C.L.E.P. = Current level earned premium.
- .125 = Expenses directly variable with premium.
- I.L. & A.E. = Projected incurred losses and paid allocated loss adjustment expenses.
- U.E. = Projected underwriting expenses.

Then:

$$(C.L.E.P.)(1.000 + I.C.) = (I.L. \& A.E. + U.E.) + (.125)(C.L.E.P.)(I.C.) + (G)(C.L.E.P.)(1.000 + I.C.)$$

or,

$$1.000 + I.C. = (1 - g) + (.125)(I.C.) + (G)(1.000 + I.C.)$$

or,

$$I.C. = \frac{G - g}{1.000 - .125 - G} = \frac{G - g}{.875 - G}$$

Having determined the indicated overall rate level change, it is possible to calculate a projected expense ratio. The projected expense ratio is the expense ratio which will result if the indicated rate change is implemented. This projected expense ratio can be used in the application of the Loss Ratio Test. The projected expense ratios for the individual coverages are determined based on the historical relationship of the expense ratio for each coverage to the expense ratio for All Coverages combined.

In practice the Car Insurance Company allocates the underwriting expenses of State X to the individual coverages in State X based on the monthly distribution of written premiums by coverage. The one exception is the unallocated claim expense reserves which are allocated to the individual coverages based on the distribution of indemnity reserves.

If the above algebraic formula were applied to each of the individual coverages, the resulting projected expense ratio for each coverage would not be consistent with the expense ratio actually produced by the company's expense allocation formula. As a result, the algebraic formula described above can be applied only to the Car Insurance Company's experience for All Coverages combined. For the individual coverages, the correct rate change indication can be derived utilizing a Loss Ratio Test based upon the projected expense ratio for each coverage from Exhibit XII.

If different accounting procedures were utilized by the Car Insurance Company, then an alternate approach in deriving the indicated rate changes would be dictated. For instance, if the company assumed that all underwriting expenses vary directly with the premium dollar, then our algebraic equation could be used for each individual coverage by substituting the projected expense ratio for the 12.5% factor utilized in our formula.

EXHIBIT XIII

The Loss Ratio Test, applied to the projected loss ratios in Exhibit XI and the projected expense ratios in Exhibit XII, results in the indicated rate level changes for each of the individual coverages and for All Coverages combined. One should note that the indications for All Coverages combined are identical to the All Coverages indication utilizing the algebraic formula in Section I of Exhibit XII (the slight variation in the indication for 1977 is due to rounding).

CONCLUSION

In an effort to restrict this paper to only those matters directly related to the mechanics of a calendar year ratemaking formula, the author has admittedly given only brief reference to some important areas.

The sources of the underlying data and the format and frequency of the necessary internal statistical reports are worthy of greater discussion. The use of total limits BI/PD Liability experience, the rating of BI/PD Liability as a package premium, the precise calculations used in adjusting the loss trends for any distortions

due to catastrophe losses or shifts in claim settlement practices, the judgment process used in determining the finally selected trend factors and the specific calculations used in determining the underwriting profit provision are also areas which need to be treated more thoroughly. However, these areas deal with questions that are general and not limited to any particular ratemaking formula. As such, these areas would best be treated as supplements to this paper.

Perhaps the next chapter should carry the ratemaking formula to its next logical step and describe the derivation of the final rates and the preparation of the rate filing. Such a chapter would discuss the allocation of the indicated statewide rate level changes to the various territories, classes of business, limits of coverage, and deductibles.

EXHIBIT I

CAR INSURANCE COMPANY

STATE X

ACTUAL PRIVATE PASSENGER UNDERWRITING EXPERIENCE
(Assigned Risk Experience Excluded)

Calendar Year	Item	BI/PD Liability	% E.P.	Medical Payments	% E.P.	Comprehensive	% E.P.	Collision	% E.P.	All Coverages	% E.P.
1977	E.P.	$ 52,955,922		$ 6,933,324		$ 7,382,934		$ 24,315,485		$ 95,245,692	
	IL & AE	34,103,614	64.4%	4,236,261	61.1%	7,478,912	101.3%	22,856,556	94.0%	72,386,726	76.0%
	U.E.	13,397,848	25.3	1,712,531	24.7	2,141,051	29.0	7,027,175	28.9	26,097,320	27.4
	G or L	5,454,460	10.3	984,532	14.2	-2,237,029	-30.3	-5,568,246	-22.9	-3,238,354	-3.4
1978/3	E.P.	$ 15,348,871		$ 1,972,851		$ 2,235,456		$ 7,425,375		$ 27,161,781	
Mos.	IL & AE	13,890,728	90.5	1,179,765	59.8	2,273,459	101.7	6,660,561	89.7	22,870,220	84.2
	U.E.	4,174,893	27.2	508,996	25.8	643,811	28.8	2,145,933	28.9	7,686,784	28.3
	G or L	-2,716,750	-17.7	284,090	14.4	-681,814	-30.5	-1,381,119	-18.6	-3,395,223	-12.5
TOTAL	E.P.	$ 68,304,793		$ 8,906,175		$ 9,618,390		$ 31,740,860		$122,407,473	
	IL & AE	47,994,342	70.3	5,416,026	60.8	9,752,371	101.4	29,517,117	93.0	95,256,946	77.8
	U.E.	17,572,741	25.7	2,221,527	24.9	2,784,862	29.0	9,173,108	28.9	33,784,104	27.6
	G or L	2,737,710	4.0	1,268,622	14.2	-2,918,843	-30.3	-6,949,365	-21.9	-6,633,577	-5.4

E.P. = Earned Premiums
IL & AE = Incurred Losses and Paid Allocated Loss Adjustment Expenses
U. E. = Underwriting Expenses
G or L = Underwriting Gain or Loss

EXHIBIT II

CAR INSURANCE COMPANY

STATE X

ADJUSTMENTS TO REFLECT RESERVE CHANGES ON PRIOR ACCIDENT YEAR BODILY INJURY AND PROPERTY DAMAGE LIABILITY CLAIMS

I. Adjustments on Prior Accident Year Bodily Injury Liability Claims

A. Adjustments to Calendar Year 1977 Actual Incurred Losses

Loss Reserve Changes during Calendar Year 1977 on Prior Accident Years:

Accident Years 1974 and Prior	$+ 750,371
Accident Year 1975	$−3,300,764
Accident Year 1976	$+2,800,452
TOTAL	$+ 250,059

Loss Reserve Changes During 1st Quarter of 1978 on Accident Year 1977	$+1,111,000
Net Adjustment to Calendar Year 1977 Incurred Losses ($1,111,000 - $250,059)	$+ 860,941

B. Adjustments to 1st Quarter of Calendar Year 1978 Actual Incurred Losses

Loss Reserve Changes during 1st Quarter of Calendar Year 1978 on Prior Accident Years:

Accident Years 1974 and Prior	$− 37,257
Accident Year 1975	$− 211
Accident Year 1976	$+ 373,000
Accident Year 1977	$+1,111,000
TOTAL	$+1,446,532

Net Adjustment to 1st Quarter of Calendar Year 1978 Incurred Losses	$−1,446,532

EXHIBIT II
Continued

ADJUSTMENTS TO REFLECT RESERVE CHANGES ON PRIOR ACCIDENT YEAR BODILY INJURY AND PROPERTY DAMAGE LIABILITY CLAIMS

II. Adjustments on Prior Accident Year Property Damage Liability Claims

A. Adjustments to Calendar Year 1977 Actual Incurred Losses

Loss Reserve Changes during Calendar Year 1977 on Prior Accident Years:

Accident Years 1974 and Prior	$+ 89,452
Accident Year 1975	$ 0
Accident Year 1976	$+ 213,619
TOTAL	$+ 303,071

Loss Reserve Changes During 1st Quarter of 1978 on Accident Year 1977	$+ 287,647
Net Adjustment to Calendar Year 1977 Incurred Losses ($287,647-$303,071)	$− 15,424

B. Adjustments to 1st Quarter of Calendar Year 1978 Actual Incurred Losses

Loss Reserve Changes during 1st Quarter of Calendar Year 1978 on Prior Accident Years:

Accident Years 1974 and Prior	$+ 14,619
Accident Year 1975	$+ 27,342
Accident Year 1976	$ 0
Accident Year 1977	$+287,647
TOTAL	$+329,608

Net Adjustment to 1st Quarter of Calendar Year 1978 Incurred Losses	$−329,608

EXHIBIT II
Continued

ADJUSTMENTS TO REFLECT RESERVE CHANGES ON PRIOR ACCIDENT YEAR BODILY INJURY AND PROPERTY DAMAGE LIABILITY CLAIMS

III. Total Reserve Adjustments to Actual Incurred Losses and Underwriting Expenses

A. Adjustments to Incurred Losses

Calendar Year 1977:

Net B.I. Liability Loss Reserve Change	$+ 860,941
Net P.D. Liability Loss Reserve Change	$− 15,424
TOTAL	$+ 845,517

Calendar Year 1978–1st Quarter:

Net B.I. Liability Loss Reserve Change	$− 1,446,532
Net P.D. Liability Loss Reserve Change	$− 329,608
TOTAL	$− 1,776,140

B. Adjustments to Underwriting Expenses*

Calendar Year 1977	$+ 213,693
Calendar Year 1978–1st Quarter	$− 394,594

* Adjustment to underwriting expenses equals 25% of the B.I. Liability loss reserve change plus 10% of the P.D. Liability loss reserve change.

EXHIBIT III

CAR INSURANCE COMPANY

STATE X

ADJUSTMENTS TO THE COMPREHENSIVE INCURRED LOSSES TO REFLECT THE INCLUSION OF THE CATASTROPHE HAZARD FACTOR

Calendar Year	(1) Comprehensive Incurred Losses and Paid Alloc. Loss Adj. Expenses	(2) Comprehensive Catastrophe Losses	(3) Non-Catastrophe Comprehensive Losses	(4) Column (2) ÷ Column (3)
1968	$3,617,714		$3,617,714	.000
1969	4,630,461		4,630,461	.000
1970	5,796,797		5,796,797	.000
1971	6,363,917		6,363,917	.000
1972	6,557,846		6,557,846	.000
1973	6,361,982	$1,000,198	5,361,784	.187
1974	5,006,674		5,006,674	.000
1975	6,866,817		6,866,817	.000
1976	8,513,478		8,513,478	.000
1977	7,478,912		7,478,912	.000
TOTAL				.187

Catastrophe Hazard Factor = Column (4) total ÷ 10 years = .019

Adjustment to 1977 Comprehensive and All Coverages Incurred Losses to Reflect Catastrophe Hazard

$7,478,912 (Actual 1977 Comprehensive IL & AE) x .019 = $ + 142,099

Adjustment to 1978–1st Quarter Comprehensive and All Coverages Incurred Losses to Reflect Catastrophe Hazard

$2,273,459 (Actual 1978–1st Quarter Comprehensive IL & AE) x .019 = $ + 43,196

EXHIBIT IV

CAR INSURANCE COMPANY

STATE X

PRIVATE PASSENGER UNDERWRITING EXPERIENCE
ADJUSTED FOR RESERVE CHANGES AND THE
COMPREHENSIVE CATASTROPHE HAZARD

Calendar Year	Item	BI/PD Liability	% E.P.	Medical Payments	% E.P.	Comprehensive	% E.P.	Collision	% E.P.	All Coverages	% E.P.
1977	E.P.	$ 52,955,922		$ 6,933,324		$ 7,382,934		$24,315,485		$ 95,245,692	
	IL & AE	34,949,131	66.0%	4,236,261	61.1%	7,621,011	103.2%	22,856,556	94.0%	73,374,342	77.0%
	U.E.	13,611,541	25.7	1,712,531	24.7	2,141,051	29.0	7,027,175	28.9	26,311,013	27.6
	G or L	4,395,250	8.3	984,532	14.2	−2,379,128	−32.2	−5,568,246	−22.9	−4,439,663	−4.7
1978/3 Mos.	E.P.	$ 15,348,871		$ 1,972,851		$ 2,235,456		$ 7,425,375		$ 27,161,781	
	IL & AE	12,114,588	78.9	1,179,765	59.8	2,316,655	103.6	6,660,561	89.7	21,137,276	77.8
	U.E.	3,780,299	24.6	508,996	25.8	643,811	28.8	2,145,933	28.9	7,292,190	26.8
	G or L	−546,016	−3.6	284,090	14.4	−725,010	−32.4	−1,381,119	−18.6	−1,267,685	−4.7
TOTAL	E.P.	$ 68,304,793		$ 8,906,175		$ 9,618,390		$31,740,860		$122,407,473	
	IL & AE	47,063,719	68.9	5,416,026	60.8	9,937,666	103.3	29,517,117	93.0	94,511,618	77.2
	U.E.	17,391,840	25.5	2,221,527	24.9	2,784,862	29.0	9,173,108	28.9	33,603,203	27.5
	G or L	3,849,234	5.6	1,268,622	14.2	−3,104,138	−32.3	−6,949,365	−21.9	−5,707,348	−4.7

E.P. = Earned Premiums
IL & AE = Incurred Losses and Paid Allocated Loss Adjustment Expenses
U. E. = Underwriting Expenses
G or L = Underwriting Gain or Loss

EXHIBIT V

CAR INSURANCE COMPANY

STATE X

ADJUSTMENTS TO REFLECT
EFFECTS OF PAST RATE CHANGES

I. Rate Change effective July 1, 1976:

BI/PD Liability	+ 4.8%
Medical Payments	0.0
Comprehensive	+11.0
Collision	+15.5
All Coverages	+ 7.2%

II. Current Level Factor $= \dfrac{1 + \text{Rate Change}}{1 + \text{Earned Factor x Rate Change}}$

1977 Current Level Factors:

BI/PD Liability: $\dfrac{1 + .048}{1 + (.875)(.048)} = \dfrac{1.048}{1.042} = 1.006$

Medical Payments: $= 1.000$

Comprehensive: $\dfrac{1 + .110}{1 + (.875)(.110)} = \dfrac{1.110}{1.096} = 1.013$

Collision: $\dfrac{1 + .155}{1 + (.875)(.155)} = \dfrac{1.155}{1.136} = 1.017$

All Coverages: $\dfrac{1 + .072}{1 + (.875)(.072)} = \dfrac{1.072}{1.063} = 1.008$

1978 Current Level Factors are 1.000 for each coverage.

ADJUSTMENTS TO REFLECT
EFFECTS OF PAST RATE CHANGES

EXHIBIT V
Continued

III. Calculation of Current Level Earned Premiums

Coverage	Year	(1) Actual Earned Premiums	(2) Current Level Factor	(3) Current Level Earned Premiums (1) x (2)
BI/PD Liability	1977	$52,955,922	1.006	$53,273,658
	1978/3 mos.	$15,348,871	1.000	$15,348,871
Medical Payments	1977	$ 6,933,324	1.000	$ 6,933,324
	1978/3 mos.	$ 1,972,851	1.000	$ 1,972,851
Comprehensive	1977	$ 7,382,934	1.013	$ 7,478,912
	1978/3 mos.	$ 2,235,456	1.000	$ 2,235,456
Collision	1977	$24,315,485	1.017	$24,728,848
	1978/3 mos.	$ 7,425,375	1.000	$ 7,425,375
All Coverages	1977	$95,245,692	1.008	$96,007,658
	1978/3 mos.	$27,161,781	1.000	$27,161,781

IV. Calculation of Adjusted Underwriting Expenses

Coverage	Year	(1) Underwriting Expenses*	(2) Amount of Premium Change**	(3) Expense Factor Directly Variable with Premium	(4) Adjusted Underwriting Expenses Col(1) + [Col(2)xCol(3)]
BI/PD Liability	1977	$13,611,541	$317,736	.125	$13,651,258
	1978/3 mos.	$ 3,780,299	$ 0	.125	$ 3,780,299
Medical Payments	1977	$ 1,712,531	$ 0	.125	$ 1,712,531
	1978/3 mos.	$ 508,996	$ 0	.125	$ 508,996
Comprehensive	1977	$ 2,141,051	$ 95,978	.125	$ 2,153,048
	1978/3 mos.	$ 643,811	$ 0	.125	$ 643,811
Collision	1977	$ 7,027,175	$413,363	.125	$ 7,078,845
	1978/3 mos.	$ 2,145,933	$ 0	.125	$ 2,145,933
All Coverages	1977	$26,311,013	$761,966	.125	$26,406,259
	1978/3 mos.	$ 7,292,190	$ 0	.125	$ 7,292,190

*Expenses from Exhibit IV.
**Column (3) minus Column (1) from Section III.

EXHIBIT VI

CAR INSURANCE COMPANY

STATE X

CURRENT LEVEL PRIVATE PASSENGER
UNDERWRITING EXPERIENCE

Calendar Year	Item	BI/PD Liability	% E.P.	Medical Payments	% E.P.	Comprehensive	% E.P.	Collision	% E.P.	All Coverages	% E.P.
1977	E.P.	$ 53,273,658		$ 6,933,324		$ 7,478,912		$24,728,848		$ 96,007,658	
	IL & AE	34,949,131	65.6%	4,236,261	61.1%	7,621,011	101.9%	22,856,556	92.4%	73,374,342	76.4%
	U.E.	13,651,258	25.6	1,712,531	24.7	2,153,048	28.8	7,078,845	28.6	26,406,259	27.5
	G or L	4,673,269	8.8	984,532	14.2	−2,295,147	−30.7	−5,206,553	−21.1	−3,772,943	−3.9
1978/3 Mos.	E.P.	$ 15,348,871		$ 1,972,851		$ 2,235,456		$ 7,425,375		$ 27,161,781	
	IL & AE	12,114,588	78.9	1,179,765	59.8	2,316,655	103.6	6,660,561	89.7	21,137,276	77.8
	U.E.	3,780,299	24.6	508,996	25.8	643,811	28.8	2,145,933	28.9	7,292,190	26.8
	G or L	−546,016	−3.6	284,090	14.4	−725,010	−32.4	−1,381,119	−18.6	−1,267,685	−4.7
TOTAL	E.P.	$ 68,622,529		$ 8,906,175		$ 9,714,368		$32,154,223		$123,169,439	
	IL & AE	47,063,719	68.6	5,416,026	60.8	9,937,666	102.3	29,517,117	91.8	94,511,618	76.7
	U.E.	17,431,557	25.4	2,221,527	24.9	2,796,859	28.8	9,224,778	28.7	33,698,449	27.4
	G or L	4,127,253	6.0	1,268,622	14.2	−3,020,157	−31.1	−6,587,672	−20.5	−5,040,628	−4.1

E.P. = Earned Premiums
IL & AE = Incurred Losses and Paid Allocated Loss Adjustment Expenses
U. E. = Underwriting Expenses
G or L = Underwriting Gain or Loss

EXHIBIT VII

CAR INSURANCE COMPANY

STATE X

CLAIM COST AND CLAIM FREQUENCY

Year Ended	Average Paid Claim Costs					Incurred Claim Frequency				
	Bodily Injury	Property Damage	Medical Payments	Comprehensive	Collision	Bodily Injury	Property Damage	Medical Payments	Comprehensive	Collision
6/30/75	$2,355.76	$289.79	$410.98	$ 94.01	$386.44	.00949	.05603	.01139	.07791	.06054
9/30/75	2,355.59	298.89	429.30	96.51	396.97	.00916	.05529	.01137	.07732	.06035
12/31/75	2,439.40	303.68	433.76	95.17	404.48	.00904	.05522	.01093	.07781	.06056
3/31/76	2,572.09	308.30	476.72	97.90	398.83	.00919	.05538	.01077	.07715	.06058
6/30/76	2,684.17	312.77	485.82	99.38	402.82	.00899	.05398	.01020	.07534	.05965
9/30/76	2,742.65	317.40	491.62	101.08	407.87	.00929	.05478	.00986	.07456	.06022
12/31/76	2,894.73	324.65	503.33	106.73	425.28	.00932	.05387	.00970	.07457	.05994
3/31/77	2,923.55	331.41	482.00	108.22	448.17	.00930	.05315	.00983	.07517	.06088
6/30/77	2,953.02	339.40	491.17	112.41	456.42	.00916	.05352	.01001	.07741	.06194
9/30/77	2,986.18	342.22	499.22	117.16	464.11	.00909	.05295	.01040	.07963	.06202
12/31/77	3,008.88	347.57	508.55	123.01	464.39	.00910	.05332	.01085	.08234	.06266
3/31/78	2,909.29	355.82	511.59	126.23	477.31	.00893	.05313	.01072	.08471	.06272

CAR INSURANCE COMPANY

STATE X

TREND FACTORS

	Claim Cost				Claim Frequency			
	Average Change in Best Fit Line			Change in	Average Change in Best Fit Line			Change in
Coverage	12-Point	8-Point	6-Point	Latest Year*	12-Point	8-Point	6-Point	Latest Year*
Bodily Injury	+8.4%	+ 5.1%	+ 1.4%	− 0.5%	− 0.9%	− 1.2%	− 3.3%	− 4.0%
Property Damage	+6.5	+ 6.9	+ 6.7	+ 7.4	− 2.1	− 1.4	− 0.8	0.0
Medical Payments	+6.3	+ 2.5	+ 2.9	+ 6.1	− 2.9	+ 4.9	+ 9.0	+ 9.1
Comprehensive	+9.7	+12.6	+13.3	+16.6	+ 2.3	+ 7.0	+10.1	+12.7
Collision	+7.3	+ 9.2	+ 7.6	+ 6.5	+ 1.5	+ 3.1	+ 3.5	+ 3.0

*Year Ended 3/31/78 ÷ Year Ended 3/31/77.

	Selected Trends	
Coverage	Claim Cost	Claim Frequency
Bodily Injury	+ 5.0 %	− 2.0%
Property Damage	+ 6.5	− 2.0
Medical Payments	+ 6.0	0.0
Comprehensive	+10.0	+ 5.0
Collision	+ 7.5	+ 3.0

EXHIBIT IX

CAR INSURANCE COMPANY
STATE X
CALCULATION OF PROJECTED INCURRED LOSSES AND ALLOCATED LOSS ADJUSTMENT EXPENSES

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Selected	Projected Year			Loss Projection Factors		Paid Loss Distribution	
		Year End	Annual Trend	End 12/31/79 Col(1)x[1 +	Year End	Annualized	1977	1978/3mos.**		1978/3
Coverage	Item	3/31/78	Factor	Col(2)x1.75*]	12/31/77	1978/3 mos.**	Col(3) ÷ Col(4)	Col(3) ÷ Col(5)	1977	mos.
Bodily Injury	Cost	$2,909.29	+ 5.0%	$3,163.85	$3,008.88	$2,363.25				
	Frequency	.00893	− 2.0	.00862	.00910	.00756				
	Cost x Freq.			$ 27.27	$ 27.38	$ 17.87				
Property Damage	Cost	$ 355.82	+ 6.5	$ 396.31	$ 347.57	$ 363.08				
	Frequency	.05313	− 2.0	.05127	.05332	.05348				
	Cost x Freq.			$ 20.32	$ 18.53	$ 19.42				
BI/PD Liability				$ 47.59	$ 45.91	$ 37.29	1.037	1.276	.586	.516
Med. Pay.	Cost	$ 511.59	+ 6.0	$ 565.31	$ 508.55	$ 511.70				
	Frequency	.01072	0.0	.01072	.01085	.01084				
	Cost x Freq.			$ 6.06	$ 5.52	$ 5.55	1.098	1.092	.061	.065
Comprehensive	Cost	$ 126.23	+ 10.0	$ 148.32	$ 123.01	$ 123.33				
	Frequency	.08471	+ 5.0	.09212	.08234	.09964				
	Cost x Freq.			$ 13.66	$ 10.13	$ 12.29	1.348	1.111	.105	.120
Collision	Cost	$ 477.31	+ 7.5	$ 539.98	$ 464.39	$ 492.91				
	Frequency	.06272	+ 3.0	.06601	.06266	.07032				
	Cost x Freq.			$ 35.64	$ 29.10	$ 34.66	1.225	1.028	.248	.299
All Coverages							1.120	1.170		

*Factor of 1.75 extends the annual trend for seven calendar quarters.

**Annualized by multiplying quarterly frequency by four.

EXHIBIT IX
Continued

CAR INSURANCE COMPANY

STATE X

CALCULATION OF PROJECTED INCURRED
LOSSES AND ALLOCATED LOSS ADJUSTMENT EXPENSES

Coverage	Year	(1) Adjusted IL & AE From Exhibit VI	(2) Projection Factors	(3) Projected IL & AE (1) x (2)
BI/PD Liability	1977	$34,949,131	1.037	$36,242,249
	1978-¼	12,114,588	1.276	15,458,214
Medical Payments	1977	4,236,261	1.098	4,651,415
	1978-¼	1,179,765	1.092	1,288,303
Comprehensive	1977	7,621,011	1.348	10,273,123
	1978-¼	2,316,655	1.111	2,573,804
Collision	1977	22,856,556	1.225	27,999,281
	1978-¼	6,660,561	1.028	6,847,057
All Coverages	1977	73,374,342	1.120	82,179,263
	1978-¼	21,137,276	1.170	24,730,613

EXHIBIT X

CAR INSURANCE COMPANY

STATE X

PROJECTED UNDERWRITING EXPENSES

Year	Average Expense Per Policy Not Premium Related*
1966	$19.09
1967	19.04
1968	20.00
1969	20.71
1970	22.36
1971	23.93
1972	25.97
1973	28.52
1974	28.34
1975	28.31
1976	29.66
1977	28.53

Last Point on Line of Best Fit	$30.62
Average Annual $ Change	$1.106
Annual Trend: Expenses Not Premium Related	$1.106 \div 30.62 = +3.6\%$

Average Annual Premium Per Policy = $173.57
Average Premium Related Expense Per Policy = $173.57 x .125 = $21.70

$$\text{Annual Total Expense Trend} = \frac{\$1.106}{\$21.70 + \$30.62} = \frac{\$1.106}{\$52.32} = .021, \text{ or } +2.1\%.$$

*Source: Annual Statement Underwriting and Investment Exhibit Part 4

EXHIBIT X
Continued

CAR INSURANCE COMPANY

STATE X

PROJECTED UNDERWRITING EXPENSES

Coverage	Year	(1) Annual Trend	(2) Time Extension Factor	(3) Trend Factor 1 + [Col(1)xCol(2)]	(4) Adjusted Underwriting Expenses From Exhibit VI	(5) Projected Underwriting Expenses Col(3) x Col(4)
BI/PD Liability	1977	+2.1%	2.000 yrs.	1.042	$13,651,258	$14,224,611
	1978-¼	+2.1	1.375 yrs.	1.029	3,780,299	3,889,928
Medical Payments	1977	+2.1	2.000 yrs.	1.042	1,712,531	1,784,457
	1978-¼	+2.1	1.375 yrs.	1.029	508,996	523,757
Comprehensive	1977	+2.1	2.000 yrs.	1.042	2,153,048	2,243,476
	1978-¼	+2.1	1.375 yrs.	1.029	643,811	662,482
Collision	1977	+2.1	2.000 yrs.	1.042	7,078,845	7,376,156
	1978-¼	+2.1	1.375 yrs.	1.029	2,145,933	2,208,165
All Coverages	1977	+2.1	2.000 yrs.	1.042	26,406,259	27,515,322
	1978-¼	+2.1	1.375 yrs.	1.029	7,292,190	7,503,664

EXHIBIT XI

CAR INSURANCE COMPANY

STATE X

PROJECTED PRIVATE PASSENGER
UNDERWRITING EXPERIENCE

Calendar Year	Item	BI/PD Liability	% E.P.	Medical Payments	% E.P.	Comprehensive	% E.P.	Collision	% E.P.	All Coverages	% E.P.
1977	E.P.	$53,273,658		$6,933,324		$ 7,478,912		$24,728,848		$ 96,007,658	
	IL & AE	36,242,249	68.0%	4,651,415	67.1%	10,273,123	137.4%	27,999,281	113.2%	82,179,263	85.6%
	U.E.	14,224,611	26.7	1,784,457	25.7	2,243,476	30.0	7,376,156	29.8	27,515,322	28.7
	G or L	2,806,798	5.3	497,452	7.2	−5,037,687	−67.4	−10,646,589	−43.1	−13,686,927	−14.3
1978/3 Mos.	E.P.	$15,348,871		$1,972,851		$ 2,235,456		$ 7,425,375		$ 27,161,781	
	IL & AE	15,458,214	100.7	1,288,303	65.3	2,573,804	115.1	6,847,057	92.2	24,730,613	91.0
	U.E.	3,889,928	25.3	523,757	26.5	662,482	29.6	2,208,165	29.7	7,503,664	27.6
	G or L	−3,999,271	−26.1	160,791	8.2	−1,000,830	−44.8	−1,629,847	−21.9	−5,072,496	−18.7
TOTAL	E.P.	$68,622,529		$8,906,175		$ 9,714,368		$32,154,223		$123,169,439	
	IL & AE	51,700,463	75.3	5,939,718	66.7	12,846,927	132.2	34,846,338	108.4	106,909,876	86.8
	U.E.	18,114,539	26.4	2,308,214	25.9	2,905,958	29.9	9,584,321	29.8	35,018,986	28.4
	G or L	−1,192,473	−1.7	658,243	7.4	−6,038,517	−62.2	−12,276,436	−38.2	−18,759,423	−15.2

E.P. = Earned Premiums
IL & AE = Incurred Losses and Allocated Adjustment Expense
U.E. = Underwriting Expenses
G or L = Underwriting Gain or Loss

EXHIBIT XII

CAR INSURANCE COMPANY

STATE X

CALCULATION OF PROJECTED EXPENSE RATIO

I. All Coverages Indicated Rate Change = (G-g) ÷ (.875-G)

$$\text{1977:} \quad \frac{5.0\% - (-14.3\%)}{.875 - .050} = \frac{19.3\%}{.825} = +23.4\%$$

$$\text{1978/3 mos:} \quad \frac{5.0\% - (-18.7\%)}{.875 - .050} = \frac{23.7\%}{.825} = +28.7\%$$

II. All Coverages Projected Expense Ratio

Year	(1) Current Level Earned Premium	(2) Indicated Rate Change	(3) Indicated Premium Level [1+Col(2)] × Col (1)	(4) Premium Change Col(3) − Col(1)	(5) 12.5% of Premium Change	(6) Expenses from Exh. XI	(7) Projected Expenses Col(5) + Col(6)	(8) Projected Expense Ratio Col(7) ÷ Col(3)
1977	$96,007,658	+23.4%	$118,473,450	$22,465,792	$2,808,224	$27,515,322	$30,323,546	25.6%
1978/3 mos.	27,161,781	+28.7	34,957,212	7,795,431	974,429	7,503,664	8,478,093	24.3

III. Projected Expense Ratios for Individual Coverages

Coverage	1977 (1) Expense Ratio Exh. IV	1977 (2) Relation to All Coverages Expense Ratio Col(1)	1977 (3) Projected Expense Ratio All Cov. × Col(2)	1978/3 mos. (1) Expense Ratio Exh. IV	1978/3 mos. (2) Relation to All Coverages Expense Ratio Col(1)	1978/3 mos. (3) Projected Expense Ratio All Cov. × Col(2)
BI/PD Liability	25.7%	.931	23.8%	24.6%	.918	22.3%
Medical Payments	24.7	.895	22.9	25.8	.963	23.4%
Comprehensive	29.0	1.051	26.9	28.8	1.075	26.1
Collision	28.9	1.047	26.8	28.9	1.078	26.2
All Coverages	27.6	1.000	25.6	26.8	1.000	24.3

EXHIBIT XIII

CAR INSURANCE COMPANY

STATE X

CALCULATION OF INDICATED
RATE CHANGES—LOSS RATIO TEST

Projected Loss Ratios from Exhibit XI

Year	BI/PD Liability	Medical Payments	Comprehensive	Collision	All Coverages
1977	68.0%	67.1%	137.4%	113.2%	85.6%
1978/3 mos.	100.7	65.3	115.1	92.2	91.0
TOTAL	75.3%	66.7%	132.2%	108.4%	86.8%

Projected Expense Ratios from Exhibit XII

Year	BI/PD Liability	Medical Payments	Comprehensive	Collision	All Coverages
1977	23.8%	22.9%	26.9%	26.8%	25.6%
1978/3 mos.	22.3	23.4	26.1	26.2	24.3
TOTAL	23.5%	23.0%	26.7%	26.7%	25.3%

*The average expense ratio for the total 15 month period is an average of the 1977 and 1978-1st quarter expense ratios calculated by utilizing the current level earned premiums, by coverage, from Exhibit XI as weights.

Desired Profit level = 5.0%, before Federal Income Tax, from Exhibit XII.

Loss Ratio Test: $\frac{\text{Projected Loss Ratio}}{1 - \text{Projected Expense Ratio} - \text{Desired Profit Level}} - 1$, expressed as a %.

Indicated Rate Change—Loss Ratio Test

Year	BI/PD Liability	Medical Payments	Comprehensive	Collision	All Coverages
1977	− 4.5%	−6.9%	+101.8%	+66.0%	+23.3%
1978/3 mos.	+38.5	− 8.8	+ 67.1	+34.0	+28.7
TOTAL	+ 5.3%	−7.4%	+ 93.6%	+58.7%	+24.5%