RATEMAKING PROCEDURES FOR AUTOMOBILE LIABILITY INSURANCE

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PREFACE

The proceedings of the Society already contain a paper on this subject which was presented by this author at the November meeting in 1956 *(PCAS XLIII)*. In the exposition of the statistical base for ratemaking, that paper stated that "Automobile Liability Insurance is compiled on a policy year basis" with a footnote that reads:

> "Since January 1, 1953, the Statistical Plan provides also for the reporting of statistical detail for the compilation of private passenger and commercial non-fleet experience on a calendar-year accident-year basis. At the time of this writing, this method of compiling experience is in an experimental stage."

A short time after the paper was published, the decision was made by the rating organizations to adopt the accident year basis for private passenger cars and, a few years later, the same basis was extended to commercial cars. The experience of only a small portion of automobile liability insurance, that for garages, public automobiles and miscellaneous classifications, continues on a policy year basis.

The change to the accident year basis for the largest portion of the business was followed by changes in the ratemaking formulae pertaining to the experience periods used for rate level determination; the formula for the development of territory rate levels was modified and a new method was developed to measure loss cost trends. In view of these changes, it became clear to the author that his 1956 paper was in need of up-dating. It was obvious that a complete revision of the prior paper was necessary, rather than a mere substitution of chapters, to give the proper emphasis to the new statistical base of accident year data.

The new paper has the same objective as the paper in 1956, namely, to describe the ratemaking process rather than to evaluate it. The material has been completely reorganized to provide a clearer separation of material pertaining to the gathering and summarization of ratemaking statistics from the actuarial ratemaking procedure. The section on statistics explains the accident year and the policy year bases currently in use. An appendix deals with the *incomplete policy year* even though it is not used at present in everyday work, in order to preserve the concept and as a caution against

the misuse of grossly immature experience without the necessary adjustments.

A separate section is included which, for lack of a better name, is called Preliminary Ratemaking Calculations. It explains the various terms found on the ratemaking exhibits and explains the method of calculating the values used in rate level and rate calculations, such as *premiums at manual rates, expected loss ratio, loss development factors,* etc.

After dealing with these details, it was possible to keep the section on the ratemaking procedure relatively short and departures from the mainstream of thought could be avoided. The basic process of ratemaking is explained for private passenger cars dealing with statewide rate level, territory rate level and class rates, followed by additional comments to set forth any differences that apply for commercial cars and garages.

A Miscellaneous section deals with the review of experience on classifications other than the three major classification groups and rates for automobile assigned risks; it also refers to the automobile package policies for which a ratemaking procedure based on experience has yet to be developed.

The new classification plan and rating system for private passenger cars, only recently introduced in many states, is referred to in an appendix to this paper.

INTRODUCTION

This paper presents a description of basic procedures currently used in ratemaking for automobile liability insurance. It is intended to serve as an introduction to ratemaking for this line of insurance. A superficial knowledge, at least, of the automobile manuals and the statistical plan referred to in this paper is expected of the reader. Frequent reference reading from these sources will assist in the comprehension of the material discussed in the following pages.

The making of rates for automobile liability insurance, along with the other lines of casualty and fire insurance, is regulated by laws passed in the various states. These laws establish the standards rates have to meet and set forth the prerequisites for the administration of the rate regulatory function of the states. In most states, the rate regulatory law was patterned after the Casualty and Surety Rate Regulatory Bill (All-Industry Commissioners' Draft) which provides as follows in Section 3:

1. Due consideration shall be given to past and prospective loss experience within and outside this state, to catastrophe hazards, if

any, to a reasonable margin for profit and contingencies, to dividends, savings or unabsorbed premium deposits allowed or returned by insurers to their policyholders, members or subscribers, to past and prospective expenses both countrywide and those specially applicable to this state, and to all other relevant factors within and outside this state;

4. Rates shall not be excessive, inadequate or unfairly discriminatory.

In Section 4, the Bill provides:

> Every insurer shall file with the (commissioner) every manual of classifications, rules and rates, every rating plan and every modification of any of the foregoing which it proposes to use. Every such filing shall state the proposed effective date thereof, shall indicate the character and extent of the coverage contemplated and shall be accompanied by the information upon which the insurer supports the filing.

The Rate Administration section of that Bill provides (Section 13):

> The (commissioner) shall promulgate reasonable rules and statistical plans, reasonably adapted to each of the rating systems on file with him, which may be modified from time to time and which shall be used thereafter by each insurer in the recording and reporting of its loss and countrywide expense experience, in order that the experience of all insurers may be made available at least annually in such form and detail as may be necessary to aid him in determining whether rating systems comply with the standards set forth in Section 3. Such rules and plans may also provide for the recording and reporting of expense experience items which are specially applicable to this state and are not susceptible of determination by a prorating of countrywide expense experience. In promulgating such rules and plans, the (commissioner) shall give due consideration to the rating systems on file with him and, in order that such rules and plans may be as uniform as is practicable among the several states, to the rules and to the form of the plans used for such rating systems in other states. No insurer shall be required to record or report its loss experience on a classification basis that is inconsistent with the rating system filed by it. The (commissioner) may designate one or more rating organizations or other agencies to assist him in gathering such experience and making compilations thereof, and such compilations shall be made

> available, subject to reasonable rules promulgated by the (commissioner) to insurers and rating organizations.

Accordingly, statistical plans have been promulgated or approved by the regulatory authorities in almost all states, and statistical agents have been appointed who collect and compile the loss experience which provides the basis for rate review and ratemaking.

The Mutual Insurance Rating Bureau and the National Bureau of Casualty Underwriters function as statistical agents for the states and they are national rating organizations that develop and file rates for automobile liability insurance, and other lines of casualty insurance, on behalf of their respective members and subscribers.[1] Generally, a formula ratemaking procedure is used in the course of this activity; the two Bureaus cooperate in the development of manual rates in a limited number of states; however, they use the same formula generally throughout the country. It is this formula which will be described in this paper.

The reader should be aware of the fact, however, that the rates developed by the two rating organizations are not the only rates used by companies writing automobile liability insurance.

The percentage of total premium written at Bureau rates varies greatly by state, as can be seen from the following examples of distribution of premiums by company groups:

Percent Distributions of Earned Premiums
Automobile Bodily Injury Liability Insurance—Calendar Year 1961

State	Members & Subscribers of N.B.C.U.	Members & Subscribers of M.I.R.B.	Other Companies
Connecticut	49.1%	17.8%	33.1%
Iowa	11.0%	4.8%	84.2%
New York	52.2%	24.0%	23.8%
Washington	14.7%	3.7%	81.6%

Companies that are not members or subscribers of a rating organization file their rates individually.

Moreover, even a member or subscriber of a Bureau may depart from the Bureau rates: by way of a *deviation* it may make application to the

[1] A member company of a rating organization generally utilizes the services of the Bureau for all states and all lines in which the Bureau functions; a subscriber company may select states and lines for which it receives Bureau services, and may function independently in other areas.

rate regulatory authority for a percentage departure (upward or downward) from the rates approved for the rating organization. In recent years, a method has evolved by which the rating organization makes a separate filing that produces rates, rules or classifications different from those of the Bureau on behalf of a member or subscriber requesting it; since the Bureau, in such case, merely acts as a conduit for the company's application, this type of filing is referred to as an *agency filing*. Thus, there may be a variety of rate schedules used in a state at the same time, in addition to those developed by the National Bureau or by the Mutual Bureau.

Yet, even in a state in which only a small proportion of the total business is written at Bureau rates, these rates have a direct effect upon the total rate structure. Many Non-Bureau companies use rates promulgated by a Bureau, frequently with percentage departures from the Bureau rates more in the nature of a deviation, or with selective departures from such rates. Apparently, such filings are supported, though by means different and presumably less exacting than is required of the rating organizations. The use of Bureau manuals by Non-Bureau companies is so extensive that rating organizations in recent years took steps to protect their work product, at the same time making available the manuals to Non-Bureau users at a charge.

In view of this wide use of the Bureau rates, a study of the Bureau rate structure and the methods used in developing Bureau rates is necessary for an understanding of present ratemaking practices for automobile liability insurance in general.

RATEMAKING STATISTICS

Although past experience is only one of the several factors that shall be given "due consideration" in the making of rates, actual practice has given it an eminent role in the ratemaking process. Reliance upon past experience is based upon the expectation that the most recent past experience will repeat itself in the immediately following period during which the rates to be determined will apply.

A rate consists of the expense portion and the loss portion; correspondingly, separate statistics are compiled on expense experience and on loss experience.

The basis for the expense experience is the Insurance Expense Exhibit which provides countrywide premium, loss and expense data by line of insurance, including automobile bodily injury and automobile property damage liability insurance. This paper will make only brief reference to

the expense portion of the rate and the expense experience, in connection with the expense loading in manual rates.

Loss Experience

Loss experience is the aggregate of transactions recorded by classification and territory on the company books of (1) the measure of the insured hazard, (2) the premium charged for the insurance coverage, and (3) the payments of indemnity amounts that eventually are made under the insurance contract.

1. The measure of the insured hazard, or the *exposure,* gives a numerical value to the insured object: the exposure of a private passenger automobile used by the owner in the ordinary way is *one car;* but if the private passenger car is owned by a concern that is engaged in renting it to others, the measure of the hazard may be expressed in miles driven, or in rental receipts. For the various types of risks, the exposure base is selected in such manner that it most accurately measures the hazard to which the object is exposed. The commonly used types of exposure bases for automobile liability insurance are:

Exposure	Recorded as
Per car	Car months
Mileage	Number of miles
Receipts	Dollars
Payroll	Dollars

2. The recorded written premium is the premium charged for the policy. The definition of written premium in the Automobile Statistical Plan is self-explanatory.
3. There will be claims for indemnification under the insurance contracts; amounts the company eventually will pay are called *losses.* Some losses are paid almost instantly upon the presentation of the claim, others after a moderate delay while the circumstances of the loss or the extent of the damage or injury are investigated; some claims may require extensive investigation or court litigation, with the result that it will not be known for an extended period of time whether there is liability on part of the insuring company to make any payment, and if so, how large the payment will be. Thus, there are *paid losses* entered on the company records, and *outstanding losses,* the latter reflecting a reserve based on the company's estimate of the ultimate cost of settling a specific claim. In connection

with claims under litigation, substantial amounts are often spent by the company in defense of its insured against whom the claim is made. Certain expenses incurred in connection with claims in suit, as defined in the Automobile Statistical Plan, are susceptible to the same statistical treatment as losses, i.e., they can be assigned to the particular class and territory applicable to the risk. They are called *allocated loss adjustment expenses;* in most of the statistical summaries described here, they are combined with the losses.

In addition to recording loss amounts, the company enters a count of claimants on whose behalf a loss payment is made or a loss reserve is established.

Each company may develop its own set of codes needed for the recording of its experience in a form suitable for the company's internal operations and requirements. Each company is obligated, however, to record its experience at least in such detail as is required by the Commissioner of Insurance in each state in which the company operates. It must follow an accepted set of rules so that the experience, after it is summarized, is meaningful and susceptible to interpretation.

The loss experience used in the ratemaking procedures described in this paper is that gathered by the National Bureau of Casualty Underwriters and the Mutual Insurance Rating Bureau.

Experience reports are received by each Bureau from its member companies for all states, from subscriber companies for the states in which they receive rating service from the Bureau, and from other companies that have elected a Bureau as their statistical agent.

Such reports are prepared in accordance with the statistical plan and periodic instructions issued by the Bureaus to the reporting companies.

The Automobile Statistical Plan

Since January 1, 1963 there is in use the Automobile Statistical Plan that applies to automobile liability and automobile physical damage insurance.[2] The Plan is jointly developed by the Mutual Insurance Rating Bureau, National Automobile Underwriters Association and National Bureau of Casualty Underwriters, and is published and distributed by the latter organization to companies affiliated with either of the three. (Prior

[2] The Plan applies in all states other than Massachusetts. In that state, a different plan is published by the Massachusetts Automobile Accident Prevention and Rating Bureau applicable to automobile bodily injury liability; the codes in that plan are also used for automobile property damage liability insurance by the Bureaus.

to that date, each of the three organizations published its own plan.) The Plan, after the required approval by the regulating authority in each state, becomes an official Statistical Plan.

Statements in this context will be directed only at the provision in the Plan pertaining to automobile liability insurance.

The Plan is designed to develop private passenger and commercial car experience on an accident year basis and the experience for other automobile classifications on a policy year basis. Experience developed on an accident year basis provides a comparison of the incurred losses on accidents that occur in a given 12 months period with the exposures and premiums earned during the same period. The policy year basis of experience consolidation provides a comparison of the incurred losses that occurred on all policies having an effective date in a given calendar year, with the earned exposures and earned premiums on such policies. The concepts of accident year and policy year statistics will be more fully explained in the presentation of experience consolidation in a subsequent section.

The accident year basis of consolidating experience was adopted first for private passenger experience beginning with accident year 1954 and extended to commercial cars with the consolidation of data for accident year 1959. It has not been adopted for the other classifications, which remain on a policy year basis mainly because the need of dealing with interim policy audits by special procedures would counteract any benefits that might be obtained from the adoption of the accident year basis.

The Plan contains instructions as to the maximum detail by which experience is to be recorded. There are two basic characteristics of detail of experience: classification and territory.

With respect to classification detail, the statistical plan provides, with only minor exceptions, for separate codes for every manual[3] classification for which separate rates are established. For example, if there are 9 private passenger manual classifications for which rates are published, the statistical plan provides for as many statistical codes, viz: classes 111, 112, 113, 115, 121, 123, 125, 127 and 130.

The manual rates are modified for a specific private passenger car by manual rules that provide for multi-car discount, compact-car discount, and driver training credit. These elements are reflected in the codes by

[3] Automobile Casualty Manual and Special-Package Automobile Policy Manual of N.B.C.U. and M.I.R.B. respectively.

the addition of a fourth coding digit to indicate whether any of these modifications or combinations thereof was applied. A fifth coding digit is added to indicate the application of the Safe Driver Insurance Plan or other merit rating plan and the resulting rate modification.

For commercial cars, separate codes apply by rate class and size type, corresponding to the rating criteria in the manual. Separate codes are shown for the various types of public automobiles, the divisions for garage liability, and various miscellaneous classifications and special types of coverages.

Occasionally, the plan may require statistical detail greater than the detail reflected in the rating system, if such detail is required for analytical studies. For example, the statistical plan required for some years the coding and reporting of experience on garages by industry classifications (Dealers, Service Stations, etc.) before a rate distinction was made between these classifications in the Automobile Casualty Manual. Such differentiation was introduced based on the data thus obtained.

Other detail required for analytical studies is sometimes obtained from special calls for experience or from sampling studies.

With respect to territory detail, the plan provides, again with minor exceptions, that all business be recorded by the applicable territory codes. The rate territory code numbers are shown, with the definitions of territories, in the Automobile Casualty Manual and the Special-Package Automobile Policy Manual. (The manuals are arranged so that separate rate schedules are shown for each territory for which separate statistics are to be obtained, even if two or more territories are assigned the same rates.)

As noted above, statistical plans require the approval of the rate supervisory authorities in the various states. After the approval of an original plan, each subsequent change in the plan also requires approval. Changes in the rating system have to be reflected in the statistical plan in order to maintain the correspondence between the detail of the rating system and the detail for its statistical support.

Reports of Experience

Each year, all companies that are due to report their experience receive from the Bureau a set of instructions setting forth the detail in which the data are to be filed; these instructions are referred to as a *Call for Experience*. The content of the Call is developed by the appropriate committees of the Bureau, pursuant to a statistical program that was submitted to and approved by the rate supervisory authority in each state. Therefore,

the Call is an official document issued by the Bureau on behalf of the Insurance Commissioners, as well as for the Bureau's ratemaking purposes; compliance with the requirements of the official Call is mandatory. Some of the requirements of the Call go beyond the detail required by the states, compliance with which is a matter of the relationship of the Bureau with its members and subscribers.

Under a typical official Call for automobile liability insurance the following reports are required, separately for bodily injury and property damage:[4] (See Appendix A for recent changes)

Written exposures and written premiums

Private passenger non-fleet

Summary reports by class and territory, for each calender quarter – filed quarterly, or transaction report (options available).

All other classifications

Transaction reports – filed quarterly.

Losses and number of claims

Paid losses with paid allocated loss adjustment expenses and number of paid claims – monthly transaction reports.

Outstanding losses and number of outstanding claims with reserves for allocated loss adjustment expenses. Transaction reports twice a year with losses valued as of March 31 and September 30 respectively (the latter is limited to private passenger cars). Loss reports are also required for medical payments coverage.

Individual reports of excess losses

Such reports are filed in conjunction with the reports of outstanding losses.

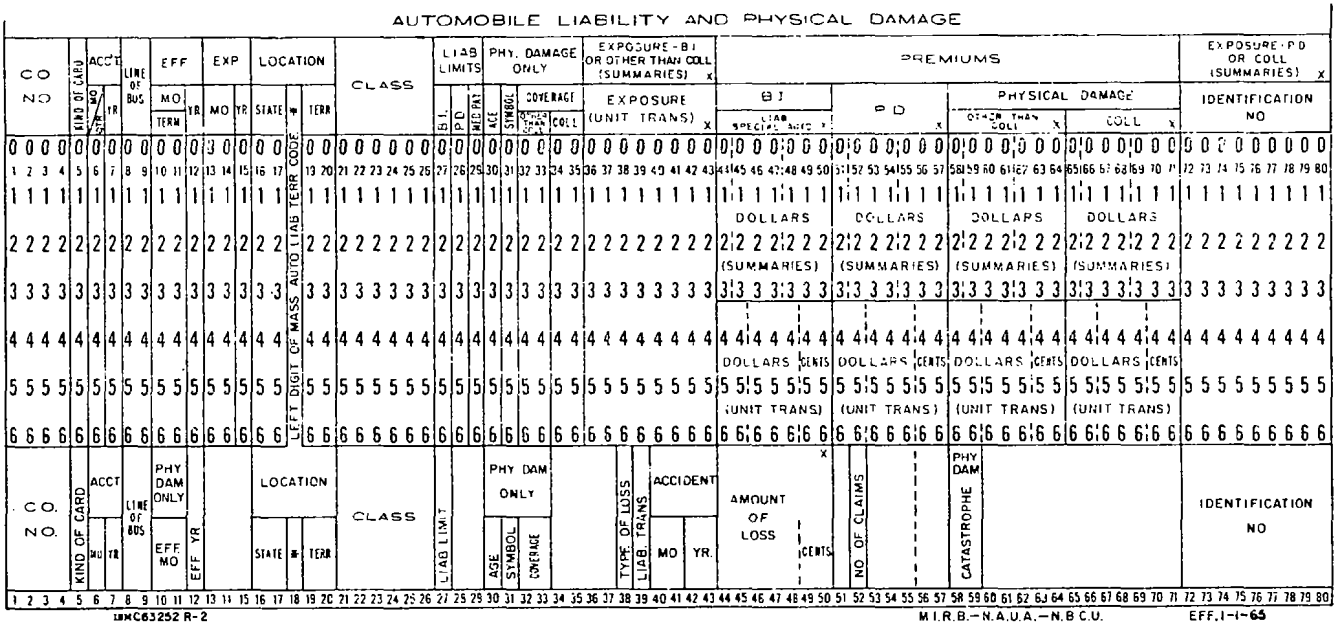
Almost all companies file these reports in the form of punch cards; except for the exposure and premium reports for private passenger cars, these punch cards are duplicates of information recorded by the company as each transaction is made. Because of the large volume of private passenger business, options are available to companies for reporting in form of summaries or transactions.[5]

Exhibit 1 shows a facsimile of the punch card used for reporting automobile liability experience to the National Bureau and Mutual Bureau

[4] For the sake of clarity, some procedural detail is omitted.

[5] When the transaction method of reporting on punch cards was first adopted in 1953, it was considered the most economic method of reporting; with the increasing use of electronic computers, reporting on tape takes its place as an alternative medium.

FACSIMILIE OF PUNCH CARD
FOR
REPORTING AUTOMOBILE INSURANCE EXPERIENCE



NOTE: Upper headings apply to exposures and premiums. Lower headings apply to losses and number of claims.

and physical damage experience to the National Automobile Underwriters Association.

These reports are filed with the Bureau by the companies at dates fairly evenly spread throughout the year. Written exposures and written premiums are reported for each quarter 60 days after the end of the quarter. Paid losses and paid allocated loss adjustment expenses are reported monthly, 45 days after the end of the month, and outstanding losses with outstanding allocated loss adjustment expenses are filed on May 15 and October 15, with excess loss reports following within one month. (In future references, the term "losses" will be used as losses including allocated loss adjustment expenses, unless otherwise stated.) These are the building blocks from which the Bureau prepares summary tabulations which are discussed next.

As noted previously, the reported data are used to produce accident year experience for some classification groups, and policy year experience for the other classifications. These summaries are generally in detail by class within territory, separately for bodily injury and property damage liability. These two types of summarizations will be dealt with separately.

Accident Year Experience Summaries

This basis of summarization is applied to private passenger car non-fleet and commercial car fleet and non-fleet experience.[6]

The accident year experience, after consolidation, will consist of the exposures earned and premiums earned during a 12 month period, and the incurred losses and number of claims resulting from accidents that occurred during the same period.

The earned exposures and premiums have to be calculated from the reported written exposures and written premiums. It was noted above that written exposures for private passenger cars are reported by the companies, summarized by class and territory, for each quarter year. A quarter year in this context is described as an *accounting quarter,* which means that it includes all written exposure and written premium transactions entered on

[6] An explanation, at this point, of the terms *fleet* and *non-fleet* is in order. The Automobile Statistical Plan states that a vehicle is part of a fleet if the policy covering it is written under a fleet plan; all other cars are non-fleet. That is not a good definition, but it is generally understood. The Automobile Casualty Manuals of the Bureaus contain a manual rule (Rule 9, General Rules Section) that describes the Fleet Plan. From this rule, characteristics of a fleet can be identified, sufficient for assigning a risk to the fleet category for statistical purposes:

There are at least 5 cars insured under the policy at its inception date. The policy contains a provision for the automatic coverage of all automobiles owned or leased by the insured during the policy term. The final exposure and premium is determined by audit after expiration of the policy.

the company records during that quarter. Such transactions are the writings on new and renewal business, full or partial cancellations on business previously recorded and corrections of existing entries, regardless of the effective date of the transaction. Since private passenger policies are written for a term of one year as well as for terms less than one year (three, four, six months, etc.) separate summaries are filed by the companies by term of policy.

For commercial cars, the transaction reports received from the companies are summarized by the Bureau into accounting quarter summaries by class and territory.

These written exposure and written premium summarizations, private passenger and commercial – each by class and territory, are now converted into *earned* data.

The concept of *earned* exposure and premium may be explained by the following example: A policy is issued covering one private passenger car, for a premium of $108, with an effective date of July 1, 1963, for a term of one year expiring June 30, 1964. A transaction entry will be made, recording 12 car months of written exposure and $108 of written premium, effective date 7/1/63, term 1 year. On July 31, the company will have provided coverage for 1/12 of the term; it will have earned 1/12 of the annual premium, or $9; the fact that the exposure for one car has been in effect for 1/12 of the policy term is expressed as 1 car month earned. Two months after the effective date, $18 and 2 car months will have been earned, $27 and 3 car months after 3 months, etc. As of December 31, one-half will have been earned: $54 of the written premium and 6 car months of exposure, during the year 1963. The remainder will be earned during the following year, 1964. The remaining $54 of written premium and 6 car months of exposure will be fully earned as of June 30, 1964, the expiration date of the policy.

For the purpose of the Bureau calculations of earned exposures and premiums, it was decided to work from quarterly written data with the assumption that the writings are evenly distributed within each quarter. Barring unusual circumstances, this assumption is reasonable for the degree of accuracy desired.

Thus, all writings during the first quarter of the year are assumed to have an average effective date of February 15. What will be their contributions to earnings as of the end of the year? Contributions will be made at the rate of ¼ during the 4th, 3rd and 2nd quarters, but only ⅛ during the first quarter in view of the assumption that the policies have

been in effect only for one-half of that quarter. The remaining ⅛ of the first quarter writings will be earned during the following year. Similarly, the second quarter writings will contribute ⅛ + ¼ + ¼ to the earnings of the current year and ¼ + ⅛ to the earnings of the following year.

The earnings in each year, therefore, contain contributions from the writings during the 4 quarters of the preceding year and from the writings during the 4 quarters of the current year.[7]

Exhibit 2 illustrates the above method of earnings calculations.

Incurred losses for an accident year consist of the losses paid and the losses reserved pertaining to the accidents that occurred during that year. The number of claims are defined in the same way.

In the transaction reports of paid losses filed by the companies each month, loss payments are reported, as they are made, on accidents that occurred in the past. For example, the transactions for the month of January, 1963 may include amounts paid on several accidents that occurred during that month plus those on accidents that occurred during December, 1962, November, 1962 etc., going back any number of months and years. Similarly, the reports of outstanding losses include loss reserves on accidents of relatively new vintage as well as on accidents that may have occurred two, three or more years ago.

All these transaction reports are sorted by the year of accident for the purpose of summarizing accident year incurred losses.

If we take all losses on 1963 accidents that were paid from January to December 1963 and add to these paid losses all reserves established on 1963 accidents not yet settled on December 31 of that year, we would have the incurred losses on accident year 1963 as they are known on December 31, 1963. This type of summary, however, would be quite incomplete. Reports on many accidents that occurred toward the end of the year may not yet have reached the central recording office in the company organization, reports of payments made may still be in the internal reporting channels and information on the severity of recent accidents may be too spotty for a reliable estimate of their expected loss cost.

For these reasons, the cut-off date is moved forward to March 31 of the following year. During these additional three months, much of the lacking information is received on accidents of recent occurrence, and the loss data on accidents of the entire year achieve greater maturity. By

[7] This applies to business written for a term of 1 year. Appropriate modifications have to be made for business written for terms of less than 1 year, such as terms of 3, 4 or 6 months.

CALCULATION OF EARNED PREMIUMS

Exhibit 2

FROM PREMIUMS WRITTEN BY QUARTERS - POLICIES WRITTEN FOR AN ANNUAL TERM

Calendar Year Quarter of Writing	Premium Written	PREMIUMS EARNED FROM QUARTERS OF WRITING									
		EARNED DURING YEAR N					EARNED DURING YEAR N+1				
		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	Total
Year N											
1st Quarter	$10,000	$1,250	$2,500	$2,500	$2,500	$8,750	$1,250				$1,250
2nd Quarter	11,000		1,375	2,750	2,750	6,875	2,750	$1,375			4,125
3rd Quarter	9,000			1,125	2,250	3,375	2,250	2,250	$1,125		5,625
4th Quarter	10,000				1,250	1,250	2,500	2,500	2,500	$1,250	8,750
Total	40,000	1,250	3,875	6,375	8,750	20,250	8,750	6,125	3,625	1,250	19,750
Year N+1											
1st Quarter	10,000						1,250	2,500	2,500	2,500	8,750
2nd Quarter	11,000							1,375	2,750	2,750	6,875
3rd Quarter	9,000								1,125	2,250	3,375
4th Quarter	10,000									1,250	1,250
Total	40,000						1,250	3,875	6,375	8,750	20,250

Factors applied to premiums written during Calendar Year Quarter M to calculate premiums earned:

Earned During Quarter	Factor
M	.125
M+1	.250
M+2	.250
M+3	.250
Current Year	.875
M+4	.125
Total	1.000

Summary	
Premium Earned During Year N	
From Year N Writing	$20,250
Premium Earned During Year N+1	
From Year N Writing	19,750
From Year N+1 Writing	20,250
Total	40,000

moving the valuation date to March 31 following, accident year 1963 now includes all loss payments on 1963 accidents made from January 1, 1963 to March 31, 1964 and reserves valued as of the same date on all such accidents not yet settled as of March 31, 1964. For accident year incurred losses so developed the terms *accident year 1963 as of March 31, 1964* or *accident year 1963 as of 15 months* are used.

The losses included as outstanding in this summary will change as time goes on. Some of them will be paid during the following 12 months at the same amount as reserved, some at smaller or larger amounts while some cases may be closed without payment. Some will still be unsettled as of the later date, but the estimate of their ultimate cost may have changed. These changed values are reflected in a new summarization of the 1963 incurred losses, 12 months later, as of March 31, 1965, or, as of 27 months. This new summarization consists of all losses paid from January 1, 1963 to March 31, 1965 plus losses outstanding as of March 31, 1965 on all 1963 accidents. This process is repeated once more to produce the same accident year as of 39 months for bodily injury.[8]

The difference between the incurred losses from one valuation date to the next is called *loss development;* it is usually expressed as a ratio of the amounts at the later date to those at the earlier date, and this ratio is used as a *loss development factor* in ratemaking, which will be explained later.

All that has been said above in reference to losses equally applies to the method used to summarize the reported number of claims for an accident year as of 15, 27 and 39 months.

We have dealt with the incurred losses in total, i.e. the sum of all losses regardless of the size of each individual loss. A separation of these losses into two parts is needed, each to be used in a different phase of the ratemaking process.

Rates published in the Automobile Casualty Manual set the price for coverage at certain basic limits of liability. The basic limit is the lowest limit for which rates are published. For automobile property damage liability insurance, the basic limit is $5,000. For bodily injury liability insurance, the basic limit in some states is $5,000 per claimant subject to a maximum of $10,000 for all claimants in a single accident, and in other

[8] The process is repeated further to 51 months and to 63 months but these summaries are made on a broader basis, statewide or countrywide for groups of classifications, rather than in the full detail by class and territory.

states the limit is $10,000 per claimant subject to a maximum of $20,000 per accident.[9]

Coverage at limits higher than the basic limits is provided at charges in addition to those resulting from the application of the manual rates. The charges for such higher limits are found in the Increased Limits Tables in the Automobile Casualty Manual.

Generally, rates for the standard limits coverage are based on experience that excludes the effect on premiums and losses of coverage provided for limits above basic. Experience on the portion of coverage provided above basic limits is used in the determination of the Increased Limits Tables. The technique of obtaining premium at basic limits is explained later; it is necessary, however, to separate the losses into *basic limits losses* and *excess losses* at the point of experience consolidation.

Of the many thousands of accidents for which paid and outstanding loss transaction reports are filed annually, relatively few involve payments or reserves larger than the basic limit. Companies are required to earmark for a special report every accident with an incurred loss exceeding the basic limit (excluding allocated loss adjustment expenses – such expenses incurred by the company are in addition to the policy limit).

At reporting time, an Individual Report of Excess Losses is filed on each such accident. The Bureau determines from these reports the excess portion for the accident, for bodily injury and for property damage liability separately, For medical payments coverage, a simplified method is used to determine the excess portion.

The excess portions are incorporated in the data which enter into the experience summary.

So far we have defined an accident year as covering a 12 month period with the inference that this period is from January 1 to December 31 of that year. That is the usual understanding when the term *accident year* is used. Any other 12 months period could, of course, be selected, so long as reporting procedures adequately provide for it. The Bureaus use a modification of the accident year concept in consolidating private passenger experience: 12 months periods beginning July 1 and ending June 30 of the following year. This type of consolidation is called *fiscal-accident year experience.*

[9] These limits correspond to the minimum coverage required by the Financial Responsibility Laws in effect in each state.

For practical reasons, the Bureaus work with sub-summarizations of private passenger experience by semi-annual periods of earned exposures and earned premiums and paid losses. Either accident year or fiscal-accident year data can be produced by combining 2 semi-annual sub-summaries (first plus second half, or second half plus first half of the following year) with the appropriate paid losses; outstanding losses as of March 31 are included for the accident year summaries and, as of September 30, for the fiscal-accident year.

Experience compiled on a fiscal-accident year basis is, by six months, more recent than the last prior compiled experience on the accident year basis. The Bureaus compile private passenger experience for about 15 states on a fiscal-accident year basis, while the experience for all other states is compiled on the accident year basis. This procedure allows for some staggering of the workload in summarization as well as rate review and rate filings, without increasing the lag between the time of review of experience and the experience period. This method is used only for private passenger cars because of the relatively greater importance of this portion of the business.

Policy Year Experience Summaries

For classifications other than private passenger non-fleet and commercial fleet and non-fleet, experience is compiled on a policy year basis. Prior to the adoption of the accident year basis of consolidation, all automobile liability insurance experience was compiled on a policy year basis. For reasons of practicality, the policy year method was retained for private passenger fleets, garages, public automobiles, and numerous miscellaneous classifications.

A policy year experience summary uses the same building blocks as does an accident year summary, only the arrangement of the components differs.

Experience might be compiled for policy years as of 15, 27, 39 months, etc., as is the accident year experience. In the area in which at present the policy year basis is used, however, it is the practice not to compile experience as of 15 months; for these classification groups, policy year data are only compiled as of 27 and as of 39 months in classification detail, and loss development to 51 months and to 63 months is obtained through the summarization of losses by broad groups of classifications.

We may, therefore, direct our attention now to the method of compiling experience for a policy year as of 27 months, and its development to a

39 months basis.[10] By the definition previously given, the policy year experience compares earned exposures and earned premiums on all policies written with effective dates during a calendar year with the losses incurred on the same policies. Policies written to be effective January 1 remain in effect during the entire year and expire December 31; they are fully earned as of December 31. Policies with later effective dates continue to be in effect beyond December 31, with the policies effective on the last day of the year remaining in effect until the end of the following year. On the latter, only one day of the one year exposure and the corresponding fraction of the premiums are earned during the year of the effective date; the remainder is earned during the following year. Thus, 24 months after the first day of the policy year all policies are expired and the written exposures and written premiums are fully earned.[11]

For many of the classifications for which experience at present is compiled on the policy year basis, the exposures and premiums are subject to final determination upon policy expiration based upon an audit of the risk's records, such as classifications for which the experience is measured in payroll, miles or earnings. For example, for an automobile policy covering the premises and operations of a garage, the exposure is the total payroll of the garage employees for the year. At the inception date, only an estimate can be made of the number of mechanics and their salary for the ensuing year, the number of salesmen, etc. These quantities are finally determined from the payroll record of the insured after the policy has expired. As these audits are performed, the final audited exposures and premiums are entered into the statistical records of the company and from there they flow to the statistical agent with the quarterly exposure and premium transaction reports.[12]

In order to allow sufficient time for the inclusion of the audit results, the Bureau includes an additional three months in the exposure and premium policy year summarization; consequently, policy year experience is

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[10] Although of no immediate import on current ratemaking, the concept of experience for a policy year as of 15 months should not be disregarded. Appendix B contains a brief discussion of this subject.

[11] Automobile liability policies are generally not written for a term of more than one year. Some companies write *open-end* policies, providing that the policy remains in effect, unless cancelled by the insured or by the company, upon payment of the renewal premium. For statistical purposes, such policies are treated as policies written for a definite term and have to be reported accordingly to the statistical agent.

[12] The results of audits are usually addditions to or subtractions from previously filed reports of the estimated exposures and premiums.

"as of 27 months" with respect to exposures and premium for all classifications subject to the policy year method of consolidation.

The summarization of the policy year incurred losses differs from that of accident year losses only in the time element. The paid loss and outstanding loss transaction reports include in the identifying information the effective year of the policy under which the loss arose. All loss transactions on policies with the same effective year make up the incurred losses for that policy year. Incurred losses for a completed policy year are valued as of March 31 of the second following year for the first summarization (as of 27 months), e.g. policy year 1963 as of March 31, 1965. A subsequent summarization produces losses valued 12 months later, or as of 39 months.

Excess loss reports are related to the total incurred losses on the same basis as explained earlier for the accident year.

The end product of the operations explained in this section is an ordered tabulation of the experience; an example of a tabulation of accident year experience, in the form usually prepared by the Mutual Insurance Rating Bureau, is attached as Exhibit 3.

Before concluding this discussion on experience summaries, a few remarks are in order to demonstrate what is done by the Bureau to attain the greatest possible degree of accuracy in the consolidated experience.

As noted previously, companies report their data on punch cards and/or tabulations, at various times throughout the year. In the Mutual Bureau alone, more than ten million punch cards are received each year from the companies.

All these fragments are combined by the Bureau to produce the summaries. From the time of recording of each piece of information in the company offices to the last step in the Bureau, the data are processed many times by people and machines; without predetermined safeguards, errors would enter and remain in the system.

One of the most effective safeguards is the requirement of balancing totals which are carried through the system from the beginning to the end. Other means of testing the accuracy of the reported data are comparisons of averages produced by the data with known averages, tests for distributions and comparisons with prior reports. A very large effort in man hours and machine hours, involving substantial expense, is required in this activity.

When the data are finally summarized, tabulations of the experience are filed with the rate regulating authority in each state. The data are now

SPECIMEN OF EXPERIENCE TABULATION

Exhibit 3

AUTOMOBILE LIABILITY INSURANCE

CALL YEAR / LINE	COMPANY CODE	COVER	ITEM	TERRITORY STATE	TERRITORY TERR.	CLASS	ACCIDENT YEAR	EARNED EXPOSURE (CAR YEARS)	EARNED PREMIUM	LOSSES INCURRED * LIABILITY	LOSSES INCURRED * MEDICAL	NO. OF CLAIMS INCURRED LIABILITY	NO. OF CLAIMS INCURRED MEDICAL	EXCESS LOSSES (EXCESS PORTION) LIABILITY	EXCESS LOSSES (EXCESS PORTION) MEDICAL
41	x	1	01	xx	yy	1110	1963	534	26223	5225	2018	13	15		
41	x	1	01	xx	yy	1111	196	6026	332997	166488	34835	143	180	42000	4182
41	x	1	01	xx	yy	1112	196	3403	144761	63936	9846	71	61	13000	187
41	x	1	02	xx	yy	1113	196	500	21030	9859	6166	7	14	543	1205
41	x	1	01	xx	yy	1120	196	786	39401	11567	4524	17	38		
41	x	1	01	xx	yy	1121	196	7042	405660	152783	33568	225	220	2000	1236
41	x	1	01	xx	yy	1122	196	3091	153014	21082	13781	39	68		2850
41	x	1	01	xx	yy	1123	196	469	22781	4180	6719	6	44		1580
41	x	1	01	xx	yy	1130	196	43	2275	41165	5546	5	8	30000	2000
41	x	1	01	xx	yy	1131	196	316	20636	13420	1028	17	10		
41	x	1	01	xx	yy	1132	196	153	9494	4350	336	3	3		
41	x	1	01	xx	yy	1133	196	37	2128		300		2		
41	x	1	01	xx	yy	1150	196	17	442		471		1		
41	x	1	01	xx	yy	1151	196	341	9489	25718	5165	16	15	1500	146
41	x	1	01	xx	yy	1152	196	365	9179	150	971	1	9		
41	x	1	02	xx	yy	1153	196	16	384		110				
41	x	1	01	xx	yy	1210	196	441	10369	1471	1482	2	12		
41	x	1	01	xx	yy	1211	196	1030	90694	24336	3001	54	34		
41	x	1	01	xx	yy	1214	196	26	1833						
41	x	1	01	xx	yy	1218	196	54	4523						
41	x	1	02	xx	yy	1230	196	46	5464	3321	111	4	4		
41	x	1	01	xx	yy	1231	196	393	52279	35086	5827	23	21		226
41	x	1	01	xx	yy	1234	196	65	6865	3410		8			
41	x	1	01	xx	yy	1238	196	63	8448	6666		8			
42	x	1	01	xx	yy	1250	196	2	110						
41	x	1	01	xx	yy	1251	196	36	1673						
41	x	1	01	xx	yy	1254	196	2	171						
					Total		1963	27,496	1,796,467	803,966	176,129	829	954	107,296	17,619

Explanatory Notes for Identifying Information:
Call Year - 4, i.e. 1964
Line - 1, Automobile Liability
Company Code - not used here
Coverage - 1, stands for bodily injury liability
Item -01, code to identify major classification group private passenger
State & Territory - the appropriate codes would be shown
Class Code
1110 Class 111 (1A) Single Car Risk, cars with compact car discount
1111 Class 111 (1A) Single Car Risk, standard size
1112 Class 111 (1A) Two-or-More Car Risk with multi-car discount, Cars without compact car discount
1113 Class 111 (1A) " " " " " " Cars with compact car discount
112X Class 112 (1B)
Etc.

* Losses incurred are the total limits losses and they include allocated loss adjustment expenses.

ready to be used for rate review by these authorities, and for ratemaking by the rating organization.

PRELIMINARY RATEMAKING CALCULATIONS

Certain calculations will be explained in this section which are preliminary to the actual analysis of the experience. Dealing mainly with the mechanics of the calculations in this section will allow a more straightforward presentation of the ratemaking formula in the following chapter.

Earned Premiums At Manual Rates

The premiums at present manual rates are calculated by multiplying the earned exposures by the basic limit present (at time of rate review) manual rates. Taking the data from Exhibit 3, as example, which shows accident year 1963 experience for private passenger cars, we find the exposures shown below:

	Territory xxyy	Bodily Injury Liability	
(1)	(2)	(3)	(4)
Class Code	Earned Number of Cars	Present Manual Rate	Premiums at Present Manual Rates (2) x (3)
1110	534	$ 90	$ 48,060
1111	6,026	100	602,600
1112	3,403	80	272,240
1113	500	72	36,000
Total	27,496	$119.36	$3,281,923

Class Code 1111 stands for Rate Class 11, a car subject to the manual rate without any modification. This rate is shown on a rate page of the Automobile Casualty Manual. Code 1110 denotes a Class 11 car qualifying for the 10% compact car discount. Code 1112 applies to a Class 11 car that is part of a multi-car risk and obtains the 20% multi-car discount. A car under Class 1113 receives both of these discounts ($.80 \times .90 = .72$), a compact car subject to the multi-car discount. The average rate of $119.36 is obtained by dividing the total premium at present manual rates by the total earned number of cars.

This calculation is repeated for each class within each territory, separately for bodily injury and for property damage.

We could now prepare a new tabulation, containing the same data as the example on Exhibit 3 to which has been added on each line the earned premium at present manual rates. It should be noted that such new tabulation will show two kinds of premiums:

The Earned Premium – more fully described as the Total Limits or Collected Earned Premium

The Earned Premium at Present Basic Limits Manual Rates – often called the Collectible Earned Premium

It would be repetitious to expand the discussion of the differences between these two kinds of premiums. The above explanation of the premium at present basic limits manual rates and the earlier reference to the Automobile Statistical Plan for a complete definition of the premium reported by the companies should suffice.

Loss Adjustment Expenses

The incurred allocated loss adjustment expenses are combined with the incurred losses in the summarization of the experience by class and territory. It has been found desirable by the Bureaus to include, in ratemaking statistics, also the unallocated loss adjustment expenses with these losses. By exhibiting the combined loss and loss adjustment expense amounts, there is shown more clearly how much of the premium dollar is expended by the companies directly on behalf of the insured, by the terms of the insuring agreement.

The unallocated loss adjustment expenses are not reported by the companies under the calls for classified experience, since they cannot be segregated in comparable detail. Total loss adjustment expenses incurred are reported by the companies in the Insurance Expense Exhibit, countrywide by line of insurance. The Bureaus require their companies to report annually, as supplemental information, allocated and unallocated loss adjustment expenses separately, countrywide, and separately for automobile bodily injury and property damage liability. From these data, a loading factor is calculated which is applied to the reported losses and allocated loss adjustment expenses, converting them to losses including all loss adjustment expenses. The factors used at present, as determined from stock company experience by the National Bureau of Casualty Underwriters, are 1.10 for automobile bodily injury liability and 1.16 for automobile property damage liability.

Loss Development Factor

The incurred losses for each accident year include paid losses and outstanding losses. The latter are loss reserves on open cases. The loss reserves represent the best estimates by the companies of the ultimate cost of all open cases, based on all available information as of the reporting date of the outstanding losses. There are, however, differences between these estimates and the actual ultimate cost. The incurred losses, under the Bureau program, are summarized for a number of subsequent valuation dates for each year to a point where they can be considered, for all practical purposes, as having reached the ultimate value. The observed development of the incurred losses on older years is used to adjust the incurred losses of the more recent years to an estimated ultimate value. For bodily injury liability insurance, incurred losses for each year are valued five consecutive times, carrying the development from 15 months to 63 months. For property damage liability, the development is carried to 39 months, from three successive valuations. The difference in the aging required for bodily injury incurred losses as compared with property damage losses is based on the recognition that a greater portion of the former remains in the category of open cases for a longer period.

These development data are obtained from basic limits losses up to 39 months for bodily injury and to 27 months for property damage. For the development beyond these valuations, total limits losses are used.

Exhibit 4 shows the calculation of loss development factors of the type generally used in the present ratemaking procedures. For most states, such factors are based on countrywide data, although in some states with a substantial volume, loss development factors based on the state's own experience are used.

The loss development factor is the ratio of the incurred losses as of the later valuation date to the incurred losses as of the earlier valuation date of the same accident year. For each development period, there are available such ratios for a number of years, and the average of the ratios is used as the loss development factor. On Exhibit 4, the bodily injury loss development from 15 months to 27 months is based on accident years 1958, 1959 and 1960; in the absence of strong counter-indications, the average of the factors, in this case 1.081, is used as the factor to develop losses from 15 months to 27 months. Loss development factors for the other periods are obtained in the same manner. The products of the factors will combine the loss development for longer periods, such as the 1.064 factor to develop losses from 15 months to 63 months.

Exhibit 4

AUTOMOBILE LIABILITY INSURANCE - PRIVATE PASSENGER CARS

CALCULATIONS OF LOSS DEVELOPMENT FACTORS

BODILY INJURY*

Accident Year	10/20 Limits Incurred Losses As Of: 15 Months	27 Months	39 Months	Loss Development Factors: 15 to 27	27 to 39	15 to 39
1958	$118,364,408	$126,058,939	$126,063,887	1.065	1.000	
1959	180,893,383	196,976,013	196,043,747	1.089	.995	
1960	218,239,683	237,427,687	xxx	1.088	xxx	
Average:				1.081	.998	1.079

Accident Year	Total Limits Incurred Losses As Of: 39 Months	51 Months	63 Months	Loss Development Factors: 39 to 51	51 to 63	39 to 63
1956	$ 55,402,103	$ 54,583,271	$ 54,175,414	.985	.993	
1957	128,338,912	127,565,779	127,105,218	.994	.996	
1958	138,327,181	137,516,031	xxx	.994	xxx	
Average:				.991	.995	.986

Loss Development From 15 to 63 Months = 1.079 x .986 = 1.064
27 to 63 Months = .998 x .986 = .984
39 to 63 Months = .986

PROPERTY DAMAGE**

Accident Year	Basic Limits Incurred Losses As Of: 15 Months	27 Months	Total Limits Incurred Losses As Of: 27 Months	39 Months	Loss Development Factors: 15 to 27	27 to 39	15 to 39
1957	$161,559,911	$159,015,151	$159,151,125	$157,762,253	.984	.991	
1958	167,908,153	164,272,502	164,345,870	163,422,273	.978	.994	
1959	171,712,658	168,545,452	168,658,986	167,442,062	.982	.993	
1960	176,582,043	174,791,491	174,886,985	xxx	.990	xxx	
Average:					.984	.993	.977

15 to 39 Months = .984 x .993 = .977
27 to 39 Months = .993

Incurred Losses include allocated loss adjustment expenses.
* All states where bodily injury losses up to 10/20 are used for manual rates.
** Countrywide.

Three such cumulative factors are developed for bodily injury, one each to develop losses from 15 months, 27 months and 39 months respectively, to an ultimate basis. Two factors are needed for property damage. Thus, these factors develop the experience from the point at which the development of the classified experience ends.

Loss development factors for commercial cars accident year experience are obtained in the same manner.

For classifications summarized on a policy year basis, loss development from 27 months to later dates is measured similarly. Appendix B discusses the use of pure premium ratios for the development of the incomplete policy year to a complete policy year basis. Such pure premium ratios are used also for the development of policy year losses valued as of 27 months to a later date for classification groups for which exposures and premiums as well as losses are subject to changes beyond 27 months.

Expected Loss Ratio

The portion of the premium dollar available for the payment of losses and all loss adjustment expenses is the Expected Loss and Loss Adjustment Ratio. Its complement is the portion required for expenses and a provision for underwriting profit and contingencies. The expense ratios can be obtained from the Insurance Expense Exhibit, which shows separate amounts for the various categories of expense.

It is customary to include in the expense items a budgetary provision as Production Cost Allowance, which is generally not based on the past experience from the Insurance Expense Exhibit. At present, the production cost allowance for automobile liability insurance is generally 20% for the major classification groups (private passenger cars, commercial cars and garages) with some departures upward and downward in some areas.

The expense item Taxes is provided for at present by an average allowance of 3.0% to cover state local insurance taxes, licenses and fees, payroll taxes and a variety of miscellaneous taxes, but not including Federal Income taxes. Appropriate departures by state where tax requirements depart from the average are reflected in the expense provision on a state basis.

The provision for the expense item Inspection and Bureau is 1% for private passenger cars and commercial cars, with larger amounts for the other automobile insurance categories, to cover dues, assessments, fees

and charges for the various boards and bureaus, statistical and service organizations and other affiliations of companies.

Miscellaneous expenses not specifically assignable to any of the above categories fall into the expense item General Administration. The present provision for this item is 5.5%.

Added to the above items of expense is a provision in the expense loading for underwriting profit and contingencies. This amounts to 5% at present, with exceptions in a few states. It is evident that this 5% of premium is not available as underwriting profit if the losses or expenses are greater than expected; any funds obtained from this theoretical profit provision in the rates becomes a contingency cushion against adverse loss or expense experience. Conversely, better than expected loss and expense experience adds to profit, until rates are adjusted.

The standard expense and loss ratios for private passenger and commercial cars determined by the National Bureau of Casualty Underwriters from the expense experience of its member companies are set forth below. The Mutual Insurance Rating Bureau, in its ratemaking calculations, uses the same expected loss and loss adjustment ratio as that used by the National Bureau.

Standard Loss and Expense Items
Private Passenger and Commercial Cars

Production Cost Allowance	20.0%
General Administration	5.5
Inspection and Bureau	1.0
Taxes, Licenses & Fees	3.0
Underwriting Profit & Contingencies	5.0
Sub-Total	34.5
Expected Losses and Loss Adjustment Expenses	65.5
Total	100.0

Credibility

Credibility factors are used in ratemaking to express in numerical values the credence given to the experience. Full credibility is expressed as 1.00, with values below 1.00 assigned to the various intervals of less than full credibility. The criterion upon which credibility is based is volume of experience. For liability insurance, the number of claims has been used for many years for this purpose. For the automobile line of insurance, full credibility is assigned to a volume producing 1084 claims or more during

the experience period. The following table is used for the assignment of credibilities:

Number of Claims	Credibility	Number of Claims	Credibility
0-10	0	390-530	.60
11-42	.10	531-693	.70
43-97	.20	694-877	.80
98-172	.30	878-1083	.90
173-270	.40	1084 and over	1.00
271-389	.50		

This table is used in conjunction with the normal ratemaking data. A different table is used for credibilities assigned to paid losses used in trend factor calculations.[13]

Where a body of experience does not meet the standard of full credibility, some other element has to be found to fill the deficiency. This other element is given the complement of the credibility assigned to the particular body of experience. These two elements are averaged by the respective credibility weights to arrive at a value that is accepted as the true value. We may average an experience loss ratio of .60 with an expected loss ratio of .50; if the former is given .70 credibility, the weighted average would be determined as follows: Experience Loss Ratio $\times$ Credibility + Expected Loss Ratio $\times$ (1.00 $-$ Credibility) or

$$.60 \times .70 + .50 \times (1.00 - .70) = .57$$

Thus, while the experience loss ratio regardless of credibility indicates an increase of 20% ($.60 \div 50 = 1.20$ or $+ 20\%$) we give it credence only to the extent of .70, which produces an indicated increase of 14%. In this case, we are giving weight partly to the experience indication and partly to the status quo, that is, present rates or present rate level.

Experience Exhibits

The first summary of experience (Exhibit 3) is a tabulation listing the data, usually in numerical order by class, within territory, separately for each year. For use in ratemaking, further summarizations are required, the form of which varies depending upon the purpose each such summarization serves. For example, if it is desired to compare the experience for the various territories within a state, experience for all classes com-

[13] A full discussion of this subject is contained in L. H. Longley-Cook, "An Introduction to Credibility Theory"— *PCAS XLIX*.

bined within a major classification group may be used by year or for a number of years combined. For another type of review, many territories and the experience of several years may be combined in order to exhibit a larger volume of data in a finer breakdown by classification.

Exhibit 5 presents an example of private passenger experience by territory. It offers an opportunity to introduce frequently used terms not previously presented.

Experience pure premium is the average incurred basic limits loss cost per unit of earned exposures, or for a convenient multiple of units of exposures (commonly called *pure premium*):

$$\text{Pure premium} = \frac{\text{Incurred basic limits losses}}{\text{Earned exposures}}$$

The pure premium is usually expressed in dollars and cents, e.g., $38.41 per private passenger car on the first line of Exhibit 5. For exposure bases with a low loss cost per unit the pure premium may be expressed in mills, such as $.545 per $1,000 of exposure.

Average incurred claim cost is obtained in the following manner:

$$\text{Average incurred claim cost} = \frac{\text{Incurred basic limits losses}}{\text{Number of incurred claims}}$$

Incurred claim frequency is the number of incurred claims per unit of earned exposure or a convenient multiple of units of exposures:

$$\text{Incurred claim frequency} = \frac{\text{Number of incurred claims}}{\text{Earned exposure}}$$

On Exhibit 5, the incurred claim frequency is expressed per 100 earned car years.

It can be seen from the three fractions above that the product of average claim cost and claim frequency is equal to the pure premium.

Incurred loss ratio is the portion of the earned premium set aside for losses (paid and reserves) expressed as:

$$\text{Incurred loss ratio} = \frac{\text{Incurred losses}}{\text{Earned premium}}$$

Pure premiums and average incurred claim costs are usually based on basic limits incurred losses, i.e., incurred losses excluding the excess portion. Loss ratios have to include incurred losses on a basis compatible with the premiums used. In the automobile liability insurance experience reported under the Bureau reporting procedure, the earned premium is the total premium charged for the policy; it includes, in addition to the charge

EXHIBIT 5

AUTOMOBILE LIABILITY INSURANCE EXPERIENCE

ACCIDENT YEARS 1960 - 1962

PRIVATE PASSENGER CARS-ALL CLASSES COMBINED-BY STATISTICAL TERRITORY

BODILY INJURY

Territory CODE	Accident YEAR	EARNED EXPOSURE	EARNED PREMIUM	LIABILITY INCURRED LOSSES BASIC LIMITS *	LIABILITY INCURRED LOSSES EXCESS	LIABILITY NUMBER OF INCURRED CLAIMS	MEDICAL PAYMENTS INCURRED LOSSES	TOTAL LIMITS LOSS RATIO	AVERAGE CLAIM COST	CLAIM FREQUENCY	PURE PREMIUM	
11	60	19,371	967,489	744,019	54,899	755	90,076	.92	985	3.9	38.41	
11	61	87,030	4,352,881	2,718,941	188,580	2,871	335,978	.75	947	3.3	31.24	
11	62	98,506	3,704,034	2,865,292	79,524	2,936	384,403	.90	976	3.0	29.09	
	TOTAL	204,907	9,024,404	6,328,252	323,003	6,562	810,457	.83	964	3.2	30.88	
12	60	3,612	174,998	52,562		95	12,192	.37	553	2.6	14.55	
12	61	19,199	924,312	392,812	21,275	470	69,091	.52	936	2.4	20.46	
12	62	23,192	808,762	557,752	26,980	619	87,157	.83	901	2.7	24.05	
	TOTAL	46,003	1,908,072	1,003,126	48,255	1,184	168,440	.64	847	2.6	21.81	
13	60	1,846	91,347	81,079	45,645	68	8,990	1.49	1,192	3.7	43.92	
13	61	9,327	441,007	206,667		231	45,965	.57	895	2.5	22.16	
13	62	11,188	397,630	240,415	13,490	290	30,711	.72	829	2.6	21.49	
	TOTAL	22,361	929,984	528,161	59,135	589	85,666	.72	897	2.6	23.62	
14	60	7,234	342,304	199,174	4,296	230	33,501	.69	866	3.2	27.53	
14	61	31,711	1,500,193	826,839	21,522	927	98,434	.63	892	2.9	26.07	
14	62	39,347	1,355,679	1,150,229	67,443	1,204	141,583	1.00	955	3.1	29.23	
	TOTAL	78,292	3,198,176	2,176,242	93,261	2,361	273,518	.80	922	3.0	27.80	
15	60	3,635	170,077	129,051		120	14,491	.84	1,075	3.3	35.50	
15	61	18,837	878,655	567,693	64,488	527	67,047	.80	1,077	2.8	30.14	
15	62	30,161	1,050,007	858,962	102,308	765	110,780	1.02	1,123	2.5	28.48	
	TOTAL	52,633	2,098,739	1,555,706	166,796	1,412	192,318	.91	1,102	2.7	29.56	
16	60	130,423	6,831,378	3,070,391	157,717	3,516	387,730	.53	873	2.7	23.54	
16	61	26,439	1,306,658	463,973	21,820	482	71,780	.43	963	1.8	17.55	
16	62	4,494	155,724	146,218		120	18,809	1.06	1,218	2.7	32.54	
	TOTAL	161,356	8,293,760	3,680,582	179,537	4,118	478,319	.52	894	2.6	22.81	
17	60	23,743	996,942	404,539	128,761	461	65,476	.60	878	1.9	17.04	
17	61	21,667	749,796	359,725	92,626	452	57,177	.68	796	2.1	16.60	
17	62	21,717	590,841	368,002	16,775	438	52,223	.74	840	2.0	16.95	
	TOTAL	67,127	2,337,579	1,132,266	238,162	1,351	174,876	.66	838	2.0	16.87	
18	60	18,594	1,341,290	489,798	2,398	509	94,262	.44	962	2.7	26.34	
18	61	17,749	1,077,756	648,726	23,399	524	84,127	.70	1,238	3.0	36.55	
18	62	18,259	953,148	554,831	75,406	530	89,840	.76	1,047	2.9	30.39	
	TOTAL	54,602	3,372,194	1,693,355	101,203	1,563	268,229	.61	1,083	2.9	31.01	

* 10/20

for basic coverage, charges for increased limits, and the bodily injury liability premium includes charges of medical payments insurance when such coverage is provided. This earned premium has to be compared with the losses corresponding to the coverage it represents. The losses have to be the total limits losses (basic limits losses plus excess losses), and the medical payments losses have to be added to the bodily injury losses. On Exhibit 5, the bodily injury loss ratio on the first line is shown as:

$$.92 = \frac{\$744{,}019 + \$54{,}899 + \$90{,}076}{\$967{,}489}$$

If premiums at basic limits manual rates are used, the resulting loss ratio will reflect only the basic limits liability incurred losses.

The underlying pure premium is the portion of the rate that is available for losses and all loss adjustment expenses. The rate is the premium charged per unit, e.g., the rate for a private passenger car for a given class in a given territory is $100. If the expected loss and loss adjustment ratio is .655, the amount in that rate available for losses is $65.50; that is the underlying pure premium. It can be directly compared with the experience pure premiums. Usually, such comparison is based on broader averages. A comparison may be made of the experience pure premium in a territory for all private passenger classes combined with the pure premium underlying the average rate in the territory. The calculation of the average rate is shown in a prior section in conjunction with the calculation of premiums at manual rates.

Classification Differentials

As will be seen later, the ratemaking formula for the major classification groups first establishes a statewide indicated rate level change, then distributes the change by territory, and finally produces rates for each class in each territory. This last step utilizes percentage relationships between the classes, generally known as classification differentials.

Because of the relatively large number of classifications within the major classification groups, experience for each class in each territory or even on a statewide basis is not sufficiently stable for a rating system that is designed for countrywide application. A stable system of differentials is obtained by the use of classification experience on a very broad basis.

It must be noted at this point that it has become customary, in any such broad experience summarization, to segregate the data between New York and countrywide excluding New York. Although these two com-

ponents of the total experience very often produce similar results, recognition has to be given to conditions characteristic of New York experience that require its separate review. There are other states that, for a variety of reasons, may not fit into the countrywide pattern and that are treated separately.

The experience is arranged by classification for each year, or a combination of years, of a selected experience period, and by coverage. The raw experience is then used to calculate, for each class, incurred claim frequencies, average claim costs, loss ratios and pure premiums. Realizing that the experience for each class may be different from the other classes by chance alone, the class developing the largest volume of experience is selected as the *base class* against which the other classes are measured. Within the major classification groups, the base classes best meeting the criterion of stability are: Class 11 (1A) for private passenger cars, Class 5CA for commercial cars, and the industry classification Franchised Dealers for garages – hazard 1.

By use of the following simulated data, it may now be demonstrated how classification relativity may be measured:

Private Passenger Class	Pure Premium	Loss Ratio	Indices* Based On Pure Premium	Indices* Based On Loss Ratio
11	$ 33.12	.722	1.000	1.000
12	38.06	.770	1.149	1.066
13	39.29	.603	1.186	.835
21	62.22	.746	1.879	1.033
23	121.78	.800	3.677	1.108
30	46.42	.770	1.402	1.066

* Ratio of each class to Class 11

The pure premium indices above measure the relationship of the loss cost per car for each class to the base class. Consequently, they also indicate how the rate for each class should relate to the rate for the base class, if it is accepted that the expense portion of the rate is obtained by a uniform expense loading. Thus, the rate for Class 12 should be 114.9% of that for Class 11, that for Class 13, 118.6% of the Class 11 rate, etc. However, pure premiums obtained from a consolidation of widely divergent bodies of experience must be used with great caution since they may contain distortions. The above model may contain in Class 11 a proportionally larger share of experience coming from low loss cost territories than is contained in the experience for Class 12. Consequently, a part of the indicated rate differential is purely due to distribution; this distortion due to dis-

tribution would have to be corrected for, prior to accepting pure premium indices as true indications of classification relativities.

The loss ratio indices have an entirely different meaning. It will be recalled that the unqualified term *loss ratio* for automobile liability insurance is the ratio of the total limits incurred losses to the earned premiums resulting from the actual premiums charged during the experience period. The experience used in the model already reflects the fact that the different rate classes were charged different rates, reflecting a system of differentials in effect during the experience period. Let it be assumed that Class 12 rates were 110% of the Class 11 rates. If Class 12 developed losses 10% higher than Class 11, both classes should produce the identical loss ratios. If Class 12 does not produce the same loss ratio as Class 11, the existing 1.10 differential should be changed. The loss ratio index indicates the magnitude of the indicated change; in the above example, the index for Class 12 is 1.066, or the differential for Class 12 should be increased by 6.6%. As in the case of the pure premiums, caution is necessary in using this type of loss ratio for classification relativity. The inclusion of increased limits premiums and excess losses introduces an element usually not included in the determination of manual rates. Bodily injury liability loss ratios also reflect medical payments premiums and losses, which may not necessarily produce the same relativity of a rate class to the base as does the liability experience. There are, however, many advantages in favor of using *collected loss ratios*. These loss ratios can be obtained with relative ease directly from the experience; unlike pure premiums, they are less likely to be distorted by the influence of divergent distributions, since the premiums reflect the different rate and loss levels of the component territories; and finally, loss ratios based on the actual experience have an air of reality, reflecting the over-all underwriting record for each class.

Average incurred claim costs and frequencies may be similarly interpreted. (It should be borne in mind that the product of the two reproduces the pure premium.)

All of these quantities, properly used, have their place in the interpretation of experience.

A different measure of classification relativities, at present most readily accepted, but requiring quite elaborate calculations, is obtained by determining, for each class, the loss ratio the class would produce if the premiums were calculated at the rates in effect for the base class; loss ratios are calculated for each private passenger class at the rates for Class 11. After placing the loss ratios for each class on the level of the base class,

indices can be calculated for each class that indicate the relativity to the base required for each class.

When all these calculations are completed, classification differentials are determined by a process of selection rather than by a formula approach. Such selection takes into account what can be gleaned from claim frequency, average claim cost, pure premium and collected loss ratio relationships, as well as the indices obtained from loss ratios at base class rates.

The classification differentials reflected in the present Bureau rating system are set forth in a later section, with additional comments appropriate for each of the major classification groups.

Trend Factors

Considerable time elapses before the latest available experience is reflected in the rates. The last portion of the experience for the latest accident year is reported by the companies approximately six months after the close of that year; several additional months are required for the processing of the data in the Bureau, which includes the summarization of the experience, preparation of rate review exhibits for the Bureau rating committees, review by the committees and the preparation of a rate filing. A means of reducing this time gap is the use in the ratemaking formula of trend factors based upon data that can be obtained for a more recent period.

The reports of paid losses and number of paid claims, filed currently by the companies under the established reporting procedure, provide a ready source of such later information. The Bureaus compile these data for each calendar year quarter from which average paid claim costs are calculated for each state. These data provide a record of the changes that have occurred in average claim costs, for a period subsequent to the experience period that is reflected in the classified experience.

They are used for the calculation of trend factors which are then superimposed upon the classified experience used for rate level determination.

Average paid claim cost data are compiled separately for private passenger cars and for all automobile classifications combined. The former are applied to private passenger experience, while the latter are used for the other classification groups. The influence of large loss payments, presumably involving excess losses, is reduced by excluding from each reported bodily injury loss payment the amount above $5,000; thus, the bodily injury average paid claim cost data are on an approximate basic

limits basis. The influence of seasonal fluctuations is eliminated by calculating average paid claim costs for 12 month periods ended with successive quarters, i.e., 12 months ended March 31, June 30, etc.

At present, a three year period is used for the calculation of the average change in average paid claim costs. This three year period provides twelve values, one for each quarter-ended twelve month period. These data are fitted to a straight line by the use of the least squares method. From the values of average paid claim costs on this *line of best fit,* the average annual change in paid claim costs is determined. Multiples of the annual dollar change are used to determine the expected average paid claim cost at a date subsequent to the last period for which actual data are available.

A comparison of the extended value with the value of the last point of the straight line indicates the expected percentage increase or decrease in average paid claim costs. This percentage change is converted into a trend factor which is applied to the accident year or policy year loss experience.

The selection of the point of time to which the straight line is extended depends upon the experience period reflected by the latest available accident year or policy year experience. If, for example, the statewide rate level is to be based upon the latest accident year, the experience reflects the average loss level prevailing during the third quarter of that accident year. In that case, a trend factor reflecting eighteen months of subsequent change in average paid claim costs would adjust the loss level to approximately the date at which it might be expected that revised rates based upon such experience would be introduced. A longer period of subsequent change in average paid claim costs would be required if the rate level were to be determined on the basis of the mean of the latest two accident years, since such mean would reflect the average loss level prevailing at a time further removed from the time the experience is utilized.

Exhibit 6 illustrates the calculation of the average paid claim cost trend factor.

THE MAKING OF RATES

Before rates can be promulgated, a filing has to be submitted to the rate regulatory authority in the state affected, and, in most states, approval of the rates has to be obtained from that authority. The rate filing consists of a memorandum which explains the various steps in the development of the rate revision, supporting statistics and an exhibit of proposed rates.

Exhibit 6
Sheet 1

AUTOMOBILE LIABILITY INSURANCE - TREND FACTORS

BASED ON AVERAGE PAID CLAIM COSTS

Sheet 2 of this exhibit presents an example for trend factor calculation. The line of best fit average paid claim costs are calculated as follows:

BODILY INJURY

Year Ended	x *	Average Paid Claim Cost Actual (y)	x^2	xy	Line of Best Fit
3/31/60	-11	$ 624	121	$-6,864	$600.00
6/30/60	- 9	602	81	-5,418	609.56
9/30/60	- 7	603	49	-4,221	619.12
12/31/60	- 5	620	25	-3,100	628.68
3/31/61	- 3	624	9	-1,872	638.24
6/30/61	- 1	661	1	- 661	647.80
9/30/61	+ 1	669	1	+ 669	657.36
12/31/61	+ 3	672	9	+2,016	666.92
3/31/62	+ 5	678	25	+3,390	676.48
6/30/62	+ 7	670	49	+4,690	686.04
9/30/62	+ 9	690	81	+6,210	695.60
12/31/62	+11	718	121	+7,898	705.16
		7,831	572	+2,737	

Derivation of Line of Best Fit

Mean of $y = \bar{y} = \frac{\Sigma y}{12} = \frac{\$7,831}{12} = \$652.58$

Semi-quarterly increment $(z) = \frac{\Sigma xy}{\Sigma x^2} = \frac{\$+2737}{572} = \$+4.78$

Value for line of best fit $= \bar{y} + (x)(z)$

Example (3/31/60) $652.58 + (-11) ($4.78) = $652.58 - $52.58 = $600.00

* Number of semi-quarterly periods counted from the midpoint of the experience period 8/15/61.

The same calculations are made from countrywide data. The trend factor is the credibility-weighted average of the factor indicated by the state's experience and by the countrywide experience. A credibility table is used by .05 intervals, giving full credibility on the basis of the paid losses for the latest calendar year of $7.5 million for bodily injury and $1.0 million for property damage.

Exhibit 6
Sheet 2

STATE XX

AUTOMOBILE LIABILITY - PRIVATE PASSENGER CARS
Development of Factors to Adjust Accident Year
Data for Subsequent Change in Claim Costs
(Based on Calendar Year Average Paid Claim Cost Data)

(1) Year Ended	(2) Paid Losses*	(3) Number of Paid Claims	Average Paid Claim Cost (4) Actual (2)÷(3)	(5) Line of Best Fit	(6) Paid Losses*	(7) Number of Paid Claims	Average Paid Claim Cost (8) Actual (6)÷(7)	(9) Line of Best Fit
		Bodily Injury				Property Damage		
3/31/60	$6,021,489	9,649	$624	$600.00	$5,946,354	48,385	$123	$125.14
6/30/60	5,975,009	9,933	602	609.56	6,072,887	48,469	125	126.22
9/30/60	6,099,300	10,122	603	619.12	6,249,715	49,047	127	127.30
12/31/60	6,399,391	10,315	620	628.68	6,364,625	49,350	129	128.38
3/31/61	6,782,022	10,872	624	638.24	6,484,178	49,629	131	129.46
6/30/61	7,196,524	10,884	661	647.80	6,368,658	48,382	132	130.54
9/30/61	7,342,247	10,971	669	657.36	6,305,692	47,862	132	131.62
12/31/61	7,528,739	11,204	672	666.92	6,259,689	46,099	136	132.70
3/31/62	7,717,863	11,380	678	676.48	6,411,388	48,109	133	133.78
6/30/62	7,759,403	11,580	670	686.04	6,746,592	49,829	135	134.86
9/30/62	8,066,606	11,690	690	695.60	6,891,570	50,627	136	135.94
12/31/62	8,356,618	11,641	718	705.16	6,996,132	52,032	134	137.02

	Bodily Injury	Property Damage
(10) Average annual dollar change in paid claim costs based upon line of best fit		
a) State	$+38.24	$ + 4.32
b) Countrywide	+11.84	+ 3.92
(11) Average dollar change in paid claim costs in 18 month period (Line 10 times 1.50)		
a) State	$+57.36	$ + 6.48
b) Countrywide	+17.76	+ 5.88
(12) Average change in paid claim costs in 18 month period expressed as percent		
a) State #	+ 8.1%	+ 4.7%
b) Countrywide	+ 2.3	+ 4.1
(13) State credibility	1.00	1.00
(14) Indicated factor $1.0 + [(12a) \times (13)] + [(12b) \times [1.0 - (13)]]$	1.081	1.047

\# B.I. $57.36 ÷ $705.16
P.D. $ 6.48 ÷ $137.02

* Excluding all loss adjustment expenses.

It is submitted with a letter of transmittal which usually specifies the proposed effective date of the revised rates.

In the following discussion, examples will be used in the form of exhibits usually found in such rate filings. The major steps in the development of the rate revision are:

Determination of statewide rate level
Development of rate level changes by territory
Calculation of classification rates

Generally, rate programs for any given year and group of classifications reflect a pattern which is followed in all states. The pattern established for determination of the statewide rate levels in any given cycle of rate revisions, the method used for the development of territory rate level changes, the evaluation of the experience through the use of credibility tables, and the various other elements of the ratemaking process have the objective of producing consistency in the interpretation of experience.

The aggregate of these procedures is a ratemaking formula that should produce rates that are adequate, not excessive and not unfairly discriminatory. The ratemaker, as well as the rate regulatory official, finds comfort in the formula approach; with each state, territory and class treated alike as the formula works, unfair discrimination has no place in manual ratemaking. There are differences of opinion on the propriety of the present ratemaking formula in meeting the requirement that rates be adequate and not excessive. It is not the purpose of this paper to expand on this discussion. The formula is presented as one that does produce adequate and non-excessive rates, as is stated in the rate filings by the rating bureaus.

The use of a formula does not mean that automobile liability insurance ratemaking should or has become a mechanical process. The ratemaker and the reviewer of rates have to be willing and able to depart from the formula by superimposing upon it such modifications as special circumstances require to give due consideration to all relevant factors, in addition to past experience, as mandated by the rating laws.

Statewide Rate Level

As was noted before, past experience is taken as an indication of the required premium level for the immediate future during which the rates are to apply. It is necessary to select the experience period which is most likely to meet this expectation. While responsiveness of the experience is desirable, it is also necessary to select a base that has stability in order to avoid large fluctuations in the rates from year to year. For some states,

the volume of experience for the latest year is large enough to meet both requirements. In others, a balance has to be found between stability and responsiveness by giving weight to the latest two years for statewide rate level determination. Thus, there is in use a schedule (based upon the combined bodily injury and property damage liability premium at manual rates for the latest year) according to which weight is given in any state to the experience for the latest two years. Corresponding to these weights, varying multiples of the average change in average paid claim costs are used to adjust the accident year or policy experience to current level.

These schedules are shown below:

Premium Volume (Premium at Manual Rates)	Weight		Trend Factor Annual Change Multiples
	Prior Year	Latest Year	
	Private Passenger Cars		
Under $5,000,000	30%	70%	2.00
$5,000,000 or more, but less than $20,000,000	15%	85%	1.75
$20,000,000 and over	0	100%	1.50
	Commercial Cars		
Under $1,000,000	50%	50%	2.25
$1,000,000 or more, but less than $7,500,000	30%	70%	2.00
$7,500,000 or more, but less than $30,000,000	15%	85%	1.75
$30,000,000 and over	0	100%	1.50
	Garages		
All sizes	30%	70%	2.75

A typical rate level calculation is shown in Exhibit 7, demonstrating the development of proposed statewide rate level changes for private passenger cars. While in this example the statewide premium volume is large enough to warrant basing the rate level on the experience for the latest year, the experience for the preceding year is also shown for comparison purposes. This is a state in which standard coverage requires 10/20/5 limits; this is, therefore, the lowest limit at which rates are published in this state. Consequently, premiums and losses used in ratemaking are at these limits.

Exhibit 7

AUTOMOBILE LIABILITY INSURANCE - PRIVATE PASSENGER NON-FLEET

Development of Statewide Rate Level Changes

(1) Coverage	(2) Accident Year	(3) 10/20/5 Limits Earned Premium at Present Collectible Rates ∮	(4) 10/20/5 Limits Incurred Losses *	(5) Number of Claims	(6) Loss & Loss Adjustment Ratio at Present Rates (4) ÷ (3)	(7) Accident Year Weights	(8) Weighted Loss & Loss Adjustment Ratio at Present Rates
B.I.	1961	$ 15,010,758	$10,506,865	10,679	.700	0%	.694
	1962	15,150,080	10,510,586	11,114	.694	100	
P.D.	1961	10,082,544	7,045,698	43,934	.699	0%	.688
	1962	10,185,639	7,010,762	44,464	.688	100	

(9) Coverage	(10) Factor to Adjust Losses for Subsequent Change of Average Paid Claim Costs	(11) Rate Level Loss Ratio (8) x (10)	(12) Expected Loss & Loss Adjustment Ratio	(13) Credibility	(14) Indicated Rate Level Change $\left(\frac{11}{12} - 1.0\right)$ x (13)
B.I.	1.041	.722	.657	1.00	+ 9.9%
P.D.	1.000	.688	.657	1.00	+ 4.7
Total					+ 7.8

* Including all loss adjustment expenses. Factors of 1.10 for B.I. and 1.16 for P.D. were applied to losses and allocated loss adjustment expenses to include unallocated loss adjustment expenses. The accident year incurred losses have been developed to 63 months for bodily injury and 39 months for property damage by application of the following loss development factors:

Accident Year	B.I.	P.D.
1961	.984	.993
1962	1.064	.977

∮ The earned premium at present collectible rates takes into account the manual rates and rules modifying private passenger rates.

Data are shown separately by year and separately for bodily injury and property damage liability, as identified in Columns 1 and 2. Column 3 shows the premium that would be collected under the rate structure in effect at time of rate review for all units insured during the experience period. Reference is made to the earlier section (p. 160) explaining the calculation of premiums at manual rates. From that earlier example it is noted that the premium at present rates not only reflects the rates that are printed in the Manuals but also the rules that are superimposed upon the rates in the rating of a private passenger car, reflecting, where applicable, rate reductions given to compact cars, multi-car risks, driver training credit for youthful operators, and the application of the Safe Driver Insurance Plan.

Column 4 shows the incurred losses for the two accident years at basic limits and developed by loss development factors as explained in the footnote. The calculation of the loss development factors was previously explained and is set forth in Exhibit 4.

Columns 5, 6 and 7 are self-explanatory.

Column 8 is a simple calculation of weighted averages:

$$\begin{array}{ll} \text{B.I} & .700 \times 0 + .694 \times 1.00 = .694 \\ \text{P.D.} & .699 \times 0 + .688 \times 1.00 = .688 \end{array}$$

The factors shown in Column 10 are determined as previously explained. However, the factors developed on Exhibit 6, Sheet 2 were modified in the rate filing, recognizing other relevant underwriting information. Column 11 is described as the rate level loss ratio. It reflects the premium resulting from the rates in effect at time of rate review and the losses incurred during the experience period adjusted for any changes that have occurred in claim costs since the average date reflected by the accident year losses. Thus, if past loss experience will repeat itself, the present rates will produce the loss ratios shown in Column 11 for the immediate future. If the rate level loss ratios are higher than the percentage of the premium dollar available for losses, rates have to be increased; if lower, a decrease is in order. The expected loss and loss adjustment ratio is shown in Column 12. The indicated percent change in rate level is determined by the division shown in Column 14:

$$\text{Indicated rate level change} = \frac{\text{Rate level loss ratio}}{\text{Expected loss ratio}} - 1.00$$

If the statewide experience is given less than full credibility, the credibility

factor is applied to the result of the above calculation. (See Credibility Table, Page 166)

Exhibit 7 thus shows that the overall statewide premium level for private passenger cars should be increased by 9.9% for bodily injury and by 4.7% for property damage liability insurance.

The change indicated for the loss portion of the rates, therefore, affects the total premium which provides for the necessary losses and expenses.

It is in order to comment briefly on this inter-relationship of loss and expense requirements. By far the largest part of the expense portion, by its nature, is a percentage function of the total premium. The production cost item reflects an allowance for commission and brokerage and for other acquisition costs. Compensation to producers, for the companies operating through the agency system, is generally determined, as percentage of the total premium, by the contractual relationship between the companies and the producers. Taxes, likewise, are a percent of total premium. Dividends to policy holders, although not a contractual obligation of the company, are paid as a percentage of premium. This leaves only the expense items General Administration and Inspection and Bureau for which a percentage relationship to the loss level is not obvious. To a great extent, these expenses, subject to inflationary influences, have risen with the loss level during the past 20 years. However, these expense requirements are reviewed independently, based on the Insurance Expense Exhibit. If the dollars required for these expense items related to the total premium dollars produce ratios lower than provided for in the expense loading, the percentage expense provision is reduced; or it is increased in the contrary case.

Exhibit 7 demonstrates the rate level calculation for private passenger cars, based upon the experience on private passenger cars that are not insured under a fleet plan (non-fleet). The resulting rates are used for both fleet and non-fleet private passenger cars. The ratemaking procedure does not provide for the inclusion of private passenger fleet experience in the ratemaking data.

The statewide rate level is determined by the same procedure for commercial cars and for garages with some differences, as noted below.

For commercial cars, fleet and non-fleet experience is used in ratemaking. In the calculation of premiums at manual rates, recognition is

given to the *graded premium reduction* for fleet risks based upon number of cars in each fleet. (See Automobile Casualty Manual Rule 9.) In order to reflect this rate modification, periodic samples are obtained by the Bureaus of the distribution of exposures by size of fleet. From these distributions, an average reduction factor is obtained which is applied to the fleet premiums at manual rates, usually on a statewide basis. The experience period used for statewide rate level on commercial cars varies in accordance with the table of weights shown earlier in this section.

Garage experience is compiled on a policy year basis, utilizing the two latest complete policy years as of 27 and 39 months respectively for statewide rate level. Since this policy year experience reflects an average loss level further removed in time from the loss level at the time of rate review, a longer period is reflected in the trend factor than is used on the accident year data for private passenger and commercial cars.

The calculation of premiums at manual rates for garages contain some departures from the previously described methods. Garages may be insured on two bases under the Automobile Casualty Manual: Hazard 1 coverage applies to the premises and operations including owned and rented automobiles, as well as automobiles in the custody or control of the insured. Hazard 2 coverage does not include such automobiles.

The manual defines three rate classes for Hazard 1 and one class for Hazard 2 with exposures measured by payroll and, in addition, a minimum premium for each of the two divisions, on a per location basis. The Automobile Statistical Plan does not contain separate classifications corresponding to the payroll classes (a), (b) and (c) for Hazard 1. Through periodic Special Calls, data are obtained by the Bureaus that provide distributions of exposures by payroll class and by size of payroll, which are used in the premium at manual rate calculations. While these samples provide adequate information on the exposure distribution by rate class and size of risk, loss statistics are not available in comparable detail. No satisfactory method has yet been found by which accidents can be reliably related to the payroll class of a garage risk. Therefore, the relationship between the rates for payroll classes (a), (b) and (c) has to be based on judgment.

The above sets forth the calculation of the statewide rate level change by use of the loss ratio (at manual rates) method. Another method used is that based on pure premiums. In that case, the experience pure premium is compared with the underlying pure premium. Algebraically, both meth-

ods involve the use of the same quantities and produce the same results. This can be demonstrated as follows:

Formulae for calculation of indicated rate level change I:

Loss Ratio Method

$$I = \frac{\text{Statewide loss ratio at manual rates}}{\text{Expected loss ratio}} \tag{1}$$

Pure Premium Method

$$I = \frac{\text{Statewide experience pure premium}}{\text{Underlying pure premium}} \tag{2}$$

The statewide loss ratio at manual rates is determined as:

$$\frac{\text{Statewide sum of losses}}{\text{Statewide sum of premiums at manual rates}}, \text{ or}$$

$$\frac{\sum l}{\sum er} \tag{3}$$

where e are the exposures for each class within each territory
r are the manual rates corresponding to the exposures
l are the losses

The statewide underlying pure premium is determined as:

Statewide average rate $\times$ Expected loss ratio, or

$$\frac{E \cdot \sum er}{\sum e} \tag{4}$$

where E is the expected loss ratio, e and r as defined above.

The statewide experience pure premium is determined as:

$$\frac{\text{Statewide losses}}{\text{Statewide exposures,}} \quad \text{or}$$

$$\frac{\sum l}{\sum e} \tag{5}$$

Substituting in Formula (2) the identities from (5) and (4), we find

$$I = \frac{\sum l}{\sum e} \div \frac{E \cdot \sum er}{\sum e} \tag{6}$$

$$= \frac{\sum l}{\sum e} \times \frac{\sum e}{E \cdot \sum er}$$

$$= \frac{\sum l}{E \cdot \sum er}$$

Substituting in Formula (1), we find

$$I = \frac{\sum l}{E \cdot \sum er} \tag{7}$$

which is identical with formula (6)

Depending upon circumstances, the ratemaker will use either the loss ratio or the pure premium method. The latter has advantages since the calculation of the underlying pure premium is usually based upon the exposure distribution for the latest year, which saves work in calculating the premium at present rates. Provided no significant change in distribution occurred during the years of the experience period, the underlying pure premium can be compared with the experience pure premium of several years. Fewer clerical operations are involved in averaging pure premiums for two or more years or coverages than in working with loss ratios. The pure premium method was more widely used before the advent of fast calculating machines. At present, the Bureaus generally use the loss ratio method for the major subdivisions of private passenger, commercial cars and garages, while many of the other classifications are reviewed on a pure premium basis.

The two methods described above are used where premiums at manual rates can be calculated. There are situations where data are not available in the required detail for such calculation or where the effort to accomplish this would be disproportionate. Under such circumstances, the rate review is based on total limits loss ratios, i.e., loss ratios based on the total collected earned premiums and the total incurred losses, with such adjustments as are appropriate. Examples for this type of rate review are in a later section of this paper.

Territory Rate Level

The statewide rate level change is next distributed among the territories within the state, in accordance with each territory's contribution to the statewide experience. The territory experience is reviewed on the basis of a longer experience period than is used for statewide rate level. This provides a broader base which reduces the influence of any chance fluctuations in the experience due to the relatively smaller volume on a territory basis. For private passenger cars, three years of territory experience are used at present. For commercial cars and garages, which develop a considerably smaller volume, the latest five years of territory experience are used.

Each state is divided into a number of territories ranging from two

territories for small states such as New Mexico to about 70 territories for the state of New York. The territory subdivisions are established by the Bureaus on the basis of surveys and underwriting judgment that take into account characteristics bearing on the loss-producing potential, such as population density, intensity and flow of motor vehicle traffic, frequency and severity of accidents, etc. The existing territory structure is periodically reviewed by the rating organizations and changes are made where required. As was noted before, experience is recorded and reported separately for each of these territories.

The basic approach to the development of rate level changes for each territory within a state is by a formula which is explained by reference to Exhibit 8. Frequently, two or more territories may be combined for the development of a single rate schedule where the experience does not warrant differentiation. It may require one or more test runs of the data, before Exhibit 8 can be produced in its final form.

After decisions have been made on the desired territory combinations, certain basic data are posted on Exhibit 8 from source material for each territory, as identified in Column 1.

The data shown in Columns 2 and 4 are obtained from the territory experience exhibit (Exhibit 5). Column 2 shows the number of earned exposures for the latest year as an indicator of volume in each territory and also for use in weighting of certain data, as will be shown later. Column 4 shows the experience pure premiums for the experience period.

The average manual rate shown in Column 3 is based on the exposures for each class in each territory and the corresponding rates, as explained on page 160. Column 5 shows the loss and loss adjustment ratio at manual rates. It could be obtained from the premiums at manual rates and the incurred losses for each territory. In this exhibit, it is obtained by dividing the experience pure premium by the average rate. From the prior proof regarding the pure premium and the loss ratio methods it can be seen that the same results would be obtained either way.

Column 6 shows the credibility given to the experience in each territory. The credibility is determined from the number of incurred claims shown on Exhibit 5 and the table of credibility factors shown earlier in this paper. The statewide totals are obtained by addition for column 2, as weighted averages for columns 3 and 4, using column 2 as weights, and by the same calculation as for the territory entries for column 5.

AUTOMOBILE LIABILITY INSURANCE - PRIVATE PASSENGER CARS

Development of Rate Level Changes by Territory

Bodily Injury - 10/20 Limits

(1) Territory	(2) Accident Year 1962 Earned Number of Cars	(3) Present Average Rate	(4) Accident Years 1960 - 1962 Pure Premium (Incl. All Loss Adj.)	(5) Loss & Loss Adj. Ratio at Present Rates (4) ÷ (3)	(6) Credibility	(7) Formula Loss & Loss Adjustment Ratio at Present Rates	(8) Col. (7) as Ratio to Statewide Average	(9) Territorial Rate Level Change (8) x Statewide Rate Level Factor/-1.0	(10) Average of Present Differentials to Rate Class 1A	(11) Proposed Class 1A Rate
11,12,13 & 16 Combined	137,380	$ 38.65	$ 26.55	.687	1.00	.687	1.027	+12.9%	1.137	$ 38
14,15 & 84 Combined	72,463	36.95	26.06	.705	1.00	.705	1.054	+15.8	1.119	38
17	21,717	25.31	16.87	.667	1.00	.667	.997	+ 9.6	1.150	24
18	18,259	44.09	31.01	.632	1.00	.632	.945	+ 3.9	1.142	45
19	10,894	32.44	22.41	.691	.80	.687	1.027	+12.9	1.119	33
21	21,676	31.67	20.53	.648	1.00	.648	.969	+ 6.5	1.131	30
22	12,111	32.60	26.36	.809	.90	.795	1.188	+30.6	1.124	38
23	39,974	26.98	17.29	.641	1.00	.641	.958	+ 5.3	1.124	25
24	23,790	33.86	22.19	.655	1.00	.655	.979	+ 7.6	1.092	33
25	29,427	25.84	14.63	.566	1.00	.566	.846	- 7.0	1.123	21
26	11,206	31.73	18.62	.587	.70				1.094	
27	3,894	33.00	21.56	.653	.30				1.087	
28	40,767	31.51	19.86	.630	1.00				1.087	
Sub-Total of 26,27,28	55,867	31.66	19.73	.623	1.00	.623	.931	+ 2.3	1.092	30
Total	443,558	34.45	23.06	.669		.669				

NOTE: Territory combinations 11,12,13 and 16, and 14,15 and 84 respectively represent areas in which boundaries were re-defined during the experience period. They have to be used in combination until experience for the separate parts becomes available.

Column 7 is called the Formula Loss and Loss Adjustment Ratio at Present Rates. It is calculated as the weighted average of the territory loss ratio in column 5 and the statewide loss ratio in column 5, giving weight to the territory loss ratio to the extent of the credibility given to the territory, with the complement of that credibility given to the statewide loss ratio. This calculation can be expressed by the following formula:

$$\text{Col. (7)} = \text{Col. (5)} \times \text{Col. (6)} + \text{Col. (5) Statewide Total} \times [1.0 - \text{Col. (6)}]$$

The formula loss ratio in column 7 provides the basic indicator for the share of the statewide rate level change that will eventually be assigned to each territory. A review of the formula and Exhibit 8 shows that, for a territory with full credibility, the loss ratio in column 5 becomes the formula loss ratio in column 7. For territories that have less than full credibility, the territory's own experience is recognized to the extent of the territory's credibility. The inclusion of the statewide average experience in the formula tends to keep fluctuations within narrower limits for territories in which their experience might produce chance fluctuations because of limited volume.

In the example presented in Exhibit 8, three territories (26, 27, 28) were combined for the development of the formula loss ratio in column 7. The sub-totals for columns 2, 3, 4 and 5 were obtained in the same manner as set forth above for the statewide totals; the credibility in column 6 is based on the number of claims for the territory combination. The formula loss ratio in column 7 for this combination was calculated from the sub-total entries in the preceding columns; thus, a territory combination is used as if it were a single territory.

The statewide average for column 7 is calculated from the territory entries in column 7 using as weights the products of (2) and (3). This average is not necessarily the same as the statewide average in column 5, as it happens to be in this example.

In column 8, the quantities shown in column 7 are expressed as ratios to the statewide average. For example, for the first territory entry, the index of 1.027 is obtained by dividing .687 for the territory by the statewide average of .669. Column 8 indicates the percentage departure of the loss ratio of each territory from the statewide average. These indices in column 8, translated into percentage changes, show the indicated change in rate level for each territory, prior to any change in the statewide rate level. (The indices in column 8 average to 1.000 using columns 2 and 3 as weights.) Thus, if it were desired to adjust only the territory rate levels

without a change in the statewide premium level, rates would have to be increased 2.7% in territory 19, decreased by 3.1% in territory 21, etc.

Column 9 combines the rate level change indicated for the territory with the previously determined statewide rate level change. In Exhibit 7, it was determined that the statewide bodily injury rate level changes shall be an increase of 9.9%. Consequently, the factor used in column 9 is 1.099.

If there were only one rate in each territory, the precent changes in column 9 applied to that rate would produce the revised rate. Since, however, the territory rate level changes will affect more than one class within each of the major classification groups, additional steps are required before the revised rates can be determined. We shall return to Exhibit 8 for the additional calculations in the succeeding chapter after dealing with classification relativities.

Rates for the Major Classification Groups

Within the major classification groups of private passenger cars and commercial cars, rates for the various classes are related to each other by percentages, referred to as *classification differentials.* The method of determining these differentials has been explained in a prior section. The following tables set forth the differentials reflected in the rates in most states:

PRIVATE PASSENGER CARS

Table of Differentials to Class 1A Rates

TABLE I—STANDARD

Class	Large Cities	Small Cities
111 (1A)	1.00	1.00
112 (1B)	1.10	1.00
113 (1C)	1.45	1.45
115 (1AF)	.70	.70
121 (2A)	1.90	1.90
123 (2C)	3.10	3.60
125 (2AF)	1.33	1.33
127 (2CF)	2.17	2.52
130 (3)	1.50	1.50

COMMERCIAL CARS

Table of Differentials to Class 5CA Rates

Class	Major Cities	All Other
3CA	1.65	1.95
3CB	2.65	3.15
4CA	1.25	1.30
4CB	1.90	2.05
5CA	1.00	1.00
5CB	1.50	1.70
6	.55	.60
7CA	1.45	1.55
7CB	2.15	2.35
8CA	.80	.80
8CB	1.50	1.35
9	.47	.51

For private passenger cars, the table of differentials is expanded to reflect manual rules that modify the rates shown in the manual, viz., the 10% reduction for compact cars, the reduction for multi-cars which is generally 20%, and the reduction of 10% granted to youthful drivers who have completed a driver education course. The rates printed in the manual are the rates prior to these modifications. Thus, a manual rate of $100 for Class 1A would be $90 if the car is a compact car; it would be $80 if there are two standard size cars insured for the same household; the rate for one of these two cars would be $72 if it were a compact car, etc. These modifications superimposed on the rate class differentials produce differentials that reflect all possible combinations.

From the above table it is noted that different sets of differentials apply for large cities compared with other areas. For private passenger cars, territories are defined as large city territories if the territory includes a city with a population of 40,000 or more. This distinction presumably recognizes different driving patterns in the use of the automobile in driving to and from work. While it was based on underwriting judgment when the 6 Class Plan for private passenger cars was first introduced, subsequent experience gave support to this type of territory identification. For commercial cars, large cities are the cities with a population of 500,000 or more.

The base classes to which the differentials are applied are Class 1A for private passenger and Class 5CA for commercial cars. These base rates are developed from the average rate that can be determined for each territory after the territory rate level change has been established. On Exhibit 8, column 9, the percent change for each territory is shown. This percent change, applied to the average rate in column 3, produces the revised average rate. The Class 1A rate is found by dividing the revised average rate by the average differential. The latter is the average of the applicable differentials, each weighted by the corresponding exposure in the territory. This calculation is designed to reproduce in each territory, as closely as possible, the indicated premium level, taking into account the distribution of business by the various classes for the latest year. If there is no change in the existing rate class differentials, the average differential is more directly obtained by dividing the average rate by the Class 1A rate in effect at time of rate review. The extension of differentials by exposures is necessary if, in conjunction with a rate level change, differentials between classes are also revised. In that case, column 10 would show the average of the proposed differentials.[14] This exact calculation is necessary in such case so that the revised rates with the new differentials will in the aggregate reproduce the indicated average rate.

Rates for the other classes within the classification group are obtained by multiplying the revised base rate by the applicable differentials, i.e., the Class 1A rate times the private passenger differentials and the Class 5CA rate by the commercial car differentials. All manual rates for private passenger and commercial cars are rounded to the nearest dollar.

For garages, the rate level change developed for the territory is applied to the existing rates for Classes (a) (b) and (c) for Hazard 1 and the single class for Hazard 2. These rates are shown in dollars and cents in

[14] When differentials are changed, reductions for some classes and increases for others are not necessarily in balance. The average of the proposed differentials compared with the average of the existing differentials indicates the *off-balance* of the new system. Example for calculation of average differential:

Class (1)	Exposure Distribution (2)	Differentials (3)	Product (2) × (3) (4)
A	.35	1.00	.350
B	.20	.90	.180
C	.30	1.50	.450
D	15	2.25	.338
Total	1.00		1.318

1.318 is the average of the differentials in Col. (3)

the manual. The garage minimum premiums are adjusted by the same percentages as the rates, subject to certain limitations.

Rates for Other Classifications

The Automobile Casualty Manual contains rates for many other types of risks in addition to the major classifications discussed in the preceding section. Some of these rates are shown on the rate pages while the premium charges for other classes are set forth in the rules in the various sections of the Automobile Casualty Manual.

For some of these classifications, experience is compiled in detail by class and territory and is reviewed on the basis of loss ratios at manual rates or pure premiums and underlying pure premiums, such as rates for taxicabs. For most of these miscellaneous classifications, however, the experience is relatively sparse and it is compiled only on a statewide basis. Consequently, premiums at manual rates cannot be computed; use is made of total limits loss ratios which are sometimes adjusted to present rate level by average factors that reflect the premium level changes from the time reflected in the experience period to the time of rate review.

For most of these classifications, the hazard of any one class can be related to that of a class within the major classification groups. For example, motorcycles are likely to be used for pleasure or in going to and from work, similar to the use of private passenger cars. This similarity in use suggests a relationship in rates. The percentage relation is obtained by comparing total limits loss ratios for the same experience period for such related classes. If rates for motorcycles are 75% of the private passenger rate and they produce approximately the same loss ratio as do private passenger cars, it can be concluded that the 25% difference in premium properly recognizes a corresponding difference in loss level. If the loss ratios differ significantly, a change in the percentage relationship of rates is indicated.

These relationships are reviewed periodically, but not as frequently as the rates for the major classification groups. Between reviews, the premium charges for the related classes will change with the rates for the classes to which they are related.

Assigned Risk Experience and Rates

Risks that do not meet the ordinary underwriting standards are distributed among the companies on the basis of each company's participation in the total automobile liability business. This distribution of risks is performed by the Automobile Assigned Risk Plan, an instrumentality

maintained in each state by all companies writing automobile liability insurance. Over many years, assigned risks have produced, in the aggregate, extremely adverse loss experience, while the number of such risks continues to increase. Approximately 90% of the premiums developed from assigned risks come from private passenger cars. The adequacy of rates charged such risks and the effect of this portion of the atuomobile liability insurance market on the total experience is of particular concern.

The Assigned Risk Plan in every state contains a section dealing with the rates that the company shall apply to risks assigned to it. Initially, this section stated in all states that the company shall apply the rates produced by its own rating system, combined with a provision for additional charges that apply to a risk that has had a record of accidents, or of convictions for violation of the motor vehicle laws. The additional charges varied with the number of accidents and severity of law violations. This provision still applies in several states.

In recent years, a different method of rate treatment has been introduced in a number of states. Under this method, private passenger rates for assigned risks are developed from the assigned risk experience of all companies and these rates are filed by the Bureaus on behalf of their companies and individually by each of the non-Bureau companies. (For classifications other than private passenger, the procedure described in the preceding paragraph is generally in force.) These rates are further subject to additional percentage charges for risks that, during a stated experience period prior to issuance of the policy, have had accidents or have been convicted for motor vehicle law violations. These rates for assigned risks are determined by the ratemaking method described in this paper; because they are based on their own experience, they tend to be more nearly self-supporting than the rates charged assigned risks in states where this method is not used. Unfortunately, assigned risk rates are more nearly self-supporting in states in which the assigned risk premium is relatively small. They have remained inadequate in many states, among them the states accounting for most of the assigned risk premium volume.

In order to maintain an over-all adequate rate level, the private passenger assigned risk experience in most states is combined with the private passenger experience not written through the Assigned Risk Plan (such business is frequently referred to as *voluntary business* to distinguish it from the assigned risk business). In this combination, the premium at present manual rates for voluntary business is determined as explained earlier; that for the assigned risk portion reflects the rates and the addi-

tional charges applicable to assigned risks. Also, the expected loss and loss adjustment ratios for voluntary and assigned risks[15] are weighted to produce an average expected loss and loss adjustment ratio to be applied to the total experience. By this procedure, any deficiency[16] in the assigned risk rate level is reflected in the experience used for making manual rates that apply to voluntary risks.

A full explanation of this matter as it affects rates would require a complete exposition of the statistical treatment of assigned risk experience and the variations from state to state. The latter depend upon the degree of adequacy obtained in the assigned risk rates and the readiness of the rate supervisory authorities to approve, for all assigned risks, rates that are higher than those applied to voluntary business. On the latter point, some raise the question of unfair discrimination that may result if assigned risks without accident or conviction records, even though in the aggregate they produce adverse experience, were required to pay higher rates than similar risks accepted in the voluntary market.

Package Automobile Policies

The marketing of a combination of automobile insurance coverages for an *indivisible premium*, in use in the property insurance field since the early fifties, was adopted in 1959 for Bureau companies with the development of the Special Automobile Policy for private passenger cars by the National Bureau of Casualty Underwriters and the National Automobile Underwriters Association and a similar Package Automobile Policy by the Mutual Insurance Rating Bureau.[17] Provision was made in the Automobile Statistical Plan for the separate recording and reporting of experience developed under these policies.

The package policies of the National Bureau and the Mutual Bureau consist of two parts: Part I, paralleling the coverages provided in the Auto-

[15] The difference lies in the production cost allowance which is lower for assigned risk business than for voluntary business.

[16] We need not concern ourselves with the possibility of redundancy; if assigned risks should develop experience better than average, competition among the companies would soon absorb such risks in the voluntary market.

[17] The above announcement by NBCU was accompanied by the introduction of a refinement in the private passenger classification system based on the accident and traffic law violation record of the individual insured, the Safe Driver Insurance Plan. Both innovations occurred at a time when the relationship of the member and subscriber companies to their respective rating organizations experienced a change in the direction of lesser rigidity and greater recognition of the need for experimentation in the classification of risks, pricing systems, and marketing methods. Several of the Bureau companies developed their own form of package policies and introduced different types of merit rating plans for private passenger cars.

mobile Casualty Manual, and Part II, those in the Physical Damage Manual. Part I provides coverage for bodily injury liability, property damage liability, medical expense and insurance for bodily injury caused by uninsured motorists on a combined basis for a single premium charge. This section will deal with ratemaking for Part I.

For a better understanding of the pricing formula which was used to develop a single premium for this combination of coverages, note should be taken of some of the differences between the coverages included in the Special Automobile Policy (S.A.P.) and the corresponding coverages provided in the Automobile Casualty Manual for the Family Automobile Policy (F.A.P.):

Liability Limits: The basic limits under the Family Automobile Policy are \$5,000/\$10,000 or \$10,000/\$20,000 for bodily injury (depending upon the minimum requirements of the financial responsibility laws in each state) and \$5,000 for property damage liability. These limits provide larger maximum amounts for bodily injury than for property damage liability, and higher amounts in the case of bodily injury or death to two or more persons than if only one claimant is involved in one accident. The insured has a choice of a variety of other limit combinations.

The Special Automobile Policy provides coverage at a single liability limit, so that the same maximum amount is available for indemnification whether an accident involves one or more injured persons, or whether it involves only bodily injury, only property damage, or both. In a 5/10/5 state, the lowest available single limit is \$15,000; in a 10/20/5 state, \$25,000. A limited number of higher single limits is available.

Medical Expense Coverage: An insured covered under the Family Automobile Policy may, if he wishes, purchase medical payments insurance at a selected limit in conjunction with the coverage. Available data indicate that about 75% of private passenger cars insured for bodily injury under this policy also carry medical payments insurance. The Special Automobile Policy includes a minimum of \$1,000 medical expense coverage. The medical coverages under the two policies, however, are not identical. Under the Family Automobile Policy, medical payments insurance is a separate and distinct coverage. Under the Special Automobile Policy, the medical expense provisions specify that, as a condition of payment, the injured person is required to execute a covenant not to sue any person insured under the liability

coverage of the policy, or the insurance company that issued the policy, for the medical expense. The possibility of duplication of payment under the liability and medical expense coverages is thereby eliminated. In addition, medical expense coverage does not apply under the package policy if the expenses are paid or are payable under other forms of insurance affording benefits for medical expenses.

Uninsured Motorist Coverage: At the time of introduction of the Special Automobile Policy, uninsured motorist coverage was available on an optional basis under the Family Automobile Policy in most states.[18] Under the Special Automobile Policy, every insured receives this coverage.

The effects of these differences were given recognition in the design of the formula by which the original rates for the Special Automobile Policy were calculated. In addition, the formula reflected anticipated expense savings in the marketing of automobile insurance and in the processing of the accounting and statistical records.

The component parts of the single premium charge for the lowest available limit were based on the charges for the corresponding coverages in the Automobile Casualty Manual, with certain modifications, as set forth below:

Liability Coverages: The manual 10/20 bodily injury rate is adjusted \$25,000 limit. To reflect the increment from 10/20/5 coverage to to 25/25[19] limits and the manual \$5,000 property damage rate to the \$25,000 single limit coverage, the applicable factor in the Automobile Casualty Manual for bodily injury was used and a selected factor (lower than the manual factor) for property damage, both discounted in accordance with a table shown further below.

Medical Expense Coverage: One half of the medical payments charge applicable under the Automobile Casualty Manual.

Uninsured Motorist Coverage: One half of the uninsured motorist rate applicable under the Automobile Casualty Manual.

The sum of the charges so determined was further reduced by a packaging discount factor; in most states, this discount amounted to 10%. Since

[18] Since that time, laws have been passed or regulations have been issued in many states that require that every automobile liability policy contain this coverage, unless rejected by the insured. Under the Family Policy and the Package Policy, uninsured motorist insurance provides bodily injury coverage at limits corresponding to the limit requirements of the Financial Responsibility Law. (In a few states a limited property damage coverage is also included.)

[19] 5/10 and 15/15 respectively for a \$15,000 single limit.

rates in the Automobile Casualty Manual are for annual coverage, while the package policy rates are published for a semi-annual term, the result has to be multiplied by .50; the product is rounded to the nearest whole dollar.

The discounts applied to the manual increased limits factors are obtained from the following table:

B.I. Rate Percent of B.I. & P.D. Combined Rate		Discount for Single Limit	
		$15,000	$25,000
At Least	But Less Than		
—	15%	.025	.020
15%	20	.035	.025
20	25	.040	.030
25	30	.045	.035
30	35	.050	.040
35	40	.055	.040
40	60	.060	.040
60	65	.055	.040
65	70	.050	.040
70	75	.045	.035
75	80	.040	.030
80	85	.035	.025
85	—	.025	.020

The above discounts were selected by judgment. Assuming that an insured purchases a single limit at least as high as the per accident bodily injury limit he had heretofore available under his split limit coverage, the package policy provides more coverage than was granted under the policy written on a split limit. For example, an insured who carried 20/40/5 coverage is likely to purchase a $50,000 single limit policy. While the company liability also increases with the granting of the higher single limit coverage, it is expected that loss distributions will not change materially. Therefore, if past experience shows that the aggregate premium charged for coverage for the various limit combinations on a split limit basis was adequate to cover excess losses, the premium for the broader single limit coverage can be reduced. The actual selection of the discount factors was made by relating premium charges for various split limit com-

binations within each bracket of single limit coverage to the single limit charge obtained by a straight application of the increased limits table.

The following example illustrates the calculations of a single limit package policy rate:

Given:

Manual B.I. rate = \$60 (10/20 limit)
Manual P.D. rate = \$40 (\$5,000 limit)
Manual Medical rate = \$9.00
Manual U.M. rate = \$3.00

\$25,000/25,000 increased limits B.I. factor = 1.12
\$25,000 increased limits P.D. factor = 1.08

Applicable single limits discount factor = .96
Packaging discount factor = .90

Single limit \$25,000 rate =
(Liability portion + ½ Medical rate + ½ U.M. rate) × .90 × .50

Liability portion =
(\$60 × 1.12 × .96) + (\$40 × 1.08 × .96) = \$105.98

Single limit \$25,000 rate = (\$105.98 + \$4.50 + \$1.50) × .45 = \$50.39
rounded to \$50

Higher limits are available for the following combinations:

Bodily Injury and Property Damage Liability—Single Limit	Medical Expense Limit
\$ 50,000	\$2,000
100,000	3,000
200,000	4,000
300,000	5,000

The rates for the higher limit combinations are obtained by applying increased limits factors of 1.10, 1.20, 1.25, 1.30, respectively to the \$25,000 rate.

The Special Automobile Policy of NBCU and NAUA and the Package Automobile Policy of MIRB were introduced gradually on a state by state basis. Eventually, the differences in coverages provided in the Mutual Bureau and National Bureau policies in respect to the liability part were

reconciled, and the new product is called the Special Package Automobile Form.

Subsequent to the introduction of this policy and the pertinent rates, there were, of course, changes in most states in some or all of the Automobile Casualty Manual rates for the coverages that are combined in the Special Package Policy. As is always the case with innovations in insurance, be it classifications, territories, coverages or combinations thereof, considerable time elapses before data become available from which the judgment used in rate determination may be reviewed and any indicated corrective action may be taken. In the meantime, additional judgment must be used in updating the rates.

The Special Package Automobile Policy poses a particular problem because of the difference in the marketing approach adopted by the various companies within the rating organizations. Some companies have adopted the package as their vehicle for marketing all or most of their private passenger business, while others use it selectively. The ratemaking practices during the five years since the introduction of this policy have tended to widen the gap between the premium charged for the package of coverages and the premium that would be due if these coverages were purchased separately under the rules of the Automobile Casualty Manual. It is not uncommon to find that this difference amounts to 25% to 30% under present manual rate schedules. This widening of the difference was brought about by the practice of changing rates for the package not directly in formula relationship to the change in rates for the separate components; rather, selected changes were frequently applied which reflected less than the average increase in the component rates.

Studies now in progress will help to determine whether the private passenger rate level in any state should be based on the average combined experience developed under the Family and Package Policies, or whether each should determine its own level. Closely connected with this question is that of the expense requirement in the rates for either type of policy. So far, the loss and expense experience developed under package automobile policies has not formally been used in ratemaking for private passenger cars; presumably, whatever information is available in this respect is reflected in the judgment used to adjust the private passenger rate levels. The time may be close, in view of the volume developed from automobile package policies, when this experience will receive formal recognition in the ratemaking procedure.

APPENDIX A

NEW PRIVATE PASSENGER CLASSIFICATION AND RATING SYSTEM—STATISTICS

Effective January 1, 1965, a revised private passenger classification and rating system was introduced, with a refinement in the classifications that will require a new approach to the summarization of experience. The new system was developed by the National Automobile Underwriters Association and the National Bureau of Casualty Underwriters; it was adopted also by the Mutual Insurance Rating Bureau for optional use by its members and subscribers.[20]

The greatest expansion in statistical and rating detail under the new system affects the youthful driver classifications which include male drivers under 25 years of age, as heretofore, and to which are newly added female unmarried drivers under 21 years of age, and the unmarried male owners or principal operators of an automobile, ages 25 to 29. For the youthful operators, rates will vary by year of age, personal status (male or female, single or married), and qualification for driver training credit, and the use of automobile criteria will newly apply. In addition, rate differences recognizing compact car and multi-car credits will apply, as will the sub-classification system under the Safe Driver Insurance Plan or other plans serving the same purpose. There are 4900 distinct rating classes possible in any rate territory for these youthful driver categories (assuming 5 subdivisions under the Safe Driver Insurance Plan). For the remaining adult driver population, the new system has added, as separate categories, the over-65 age group, and females, ages 30 to 64, who are the sole drivers of the automobile. Three hundred separate statistical entities are produced by the system for the adult drivers.

In order to accommodate this classification system, it was necessary to go from a 5 digit to a 6 digit code for private passenger cars. It is apparent that it would be impractical to continue the system of summarizing private passenger experience in complete detail by class and territory. Tabulations of experience in the full detail of the new classification system would be unmanageable by their mere length, the cost of producing them would be prohibitive by present data processing standards, and most of the detail would be too sparse to be of use in analysis and ratemaking.

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[20] While the new system applies to automobile liability and automobile medical payments insurance as well as to automobile physical damage insurance, the following comments are directed only at the kinds of insurance under the jurisdiction of NBCU and MIRB.

Consequently, the rating organizations have changed the requirements for the reporting of experience by the companies under the Official Call, and have made tentative plans for a new approach to summarization of that experience for use in rate review and ratemaking, and for filing of such experience with the rate regulatory authorities.

In the area of reporting, the new system encourages the filing of experience by the companies in complete detail without any summarization. Losses (paid and outstanding, with allocated loss adjustment expenses) have been filed for some time by the companies in the form of transaction reports on punch cards; there will be no change in this respect. For the reporting of exposures and premiums, heretofore reported in summaries by class and territory for each accounting quarter, changes in the direction of transaction reports were made. The National Bureau will accept exposure and premium transaction reports on punch cards (or magnetic tape) on all private passenger business. The Mutual Bureau, at this time, will accept such transaction reports on the youthful driver classifications, continuing the summarized form for the other private passenger classes.

In addition to these reporting methods, there is available to the companies a method of reporting exposures and premiums in summarized form on a *limited key* basis, i.e., summarized experience by accounting quarter by selected digits of the 6 digit code. Some of the classification detail is lost in this type of summary. That detail will be obtained from companies using this reporting method by periodic supplementary reports of exposure and premium samples.

The utilization of this experience will be based partly upon data summarized by territory in some of the classification detail, possibly the detail of the limited key referred to above, and partly upon the use of samplings of distributional data for the remaining elements of the classification system. The use of magnetic tape for storage of this vast amount of detail and the use of electronic computers for its processing and analysis is imperative.

A program of this type requires approval and acceptance by rate regulatory authorities, since it also affects the type of information they will receive from the organizations acting as their official statistical agents. To the extent that companies not affiliated with the National Bureau of Casualty Underwriters or the Mutual Insurance Rating Bureau will use the new private passenger classification system, official statistical agents other than these two rating organizations will presumably be affected by the new demands for rate review statistics. It must be recalled that the

rating laws provide that companies shall file their loss experience in a form reasonably adapted to and not inconsistent with the rating systems in use.

Eventually, a reasonable summarization program will evolve; it might be expected that the ratemaking procedure will continue to follow the present pattern. Data will be available to calculate premiums at manual rates, partly from summaries of the total experience and partly from the sampling distributions of exposures, for the determination of statewide and territory rate levels. Losses can be correspondingly summarized. Reasonable assumptions will have to be made and techniques will have to be developed for the review of classification experience. In this connection, it should be noted that the new private passenger classification system is compatible with, and its experience can be reduced to, the statistical detail of the private passenger class plan generally in use prior to January 1, 1965 and to be continued in use in some areas.

APPENDIX B

THE INCOMPLETE POLICY YEAR

A policy year, by definition, extends over a period of two calendar years; policies written during the 12 months period of the policy year remain in effect beyond December 31, with the policies written on the last day not expiring until December 31 of the following year. On the average (assuming an even distribution of writing throughout the year), one half of the written premiums are earned during the year of writing; correspondingly, one half of the exposures are earned, i.e., on the average, the insured objects have been exposed to the loss producing hazards for one half of the full annual duration of coverage.

If we want to review the experience on all policies written during 1963, as of December 31, 1963, we could construct the experience with the above assumption as follows: the total incurred losses for policy year 1963 consist of all loss payments from January 1 to December 31, 1963 plus the reserves[21] from all accidents covered by the policies written during 1963. These losses are compared with one half of the premiums earned during 1963 from policies written during 1963. Such experience is called experience of an *incomplete policy year.* Twelve months later, as of

[21] Reserves for outstanding losses are usually valued as of three months later; in this case, as of March 31, 1964. Also, the paid and outstanding losses include amounts on accidents that occurred prior to the cut-off date but were recorded between January 1, 1964 and March 31, 1964.

December 31, 1964, the written premiums will be fully earned, all accidents that are covered by these policies will have occurred; the earned premiums and incurred losses as of that date would present a *complete policy year.*

A more accurate approximation, however, is required if experience for an incomplete policy year is to be used for ratemaking, as was the case prior to the adoption of the accident year method.

The experience for an incomplete year (as of 12 months) was adjusted to a complete basis by applying to it modification factors obtained from the observed development of prior years. This development was measured by use of pure premiums of prior policy years at their successive valuations.

Since the pure premium is a function of exposures and incurred losses, development factors based on pure premiums combine in one step a measure of the development of both. The following illustrates the calculations of such pure premium ratios:

BODILY INJURY LIABILITY

	Number of Written Car Years		Basic Limits Incurred Losses*	
(1) Policy Year	(2) As Of 12 Months	(3) As Of 24 Months	(4) As Of 12 Months*	(5) As Of 24 Months*
1962	2,079,685	2,085,145	$35,369,982	$65,568,694
1963	2,177,435	2,168,448	39,145,075	72,632,151

	Pure Premiums		
(6) Policy Year	(7) 12 Months (4) ÷ (2)	(8) 24 Months (5) ÷ (3)	(9) Ratio Of Pure Premiums (7) ÷ (8)
1962	17.01	31.45	.541
1963	17.98	33.49	.537
Mean			.539

*Valued as of 15 months and 27 months respectively.

The pure premium ratios used to be called *earned factors;* in order not to mistake them, in this discussion, for the earned premium and exposure fractions used in connection with accident year data, we shall refer to them as *pure premium development factors.*

In the above example, it will be noted that the written exposures, car years in this case, do not change materially during the second half of the policy year. This second half is the run-off of the exposures written during the first half; any changes after December 31 can only be changes on existing policies, such as cancellations, additions of coverage, changes in class or territory, and any new business effective December 31 of the policy year or just prior to that date but recorded after that date.

The average (or mean) of the pure premium development factors of two or three prior years is used to adjust the written exposures and written premiums for the most recent policy year, which is available only as of 12 months, to an earned basis as of 12 months. For example, if the written exposures for the next year, 1964, are 2,201,853, the application of a .539 factor produces 1,186,799 of earned exposures for policy year 1964. If the incurred losses as of December 31, 1964 are $42,560,606, a pure premium of $35.86 for 1964 would result.

The incomplete policy year losses are subject to further adjustment for loss development beyond the 27 months level to which the earned factor adjusts them. Comments on the loss development of policy year experience may be found in the section dealing with this subject.

It is noted that the application of earned factors to the incomplete policy year experience results in a volume approximately one half of what it will be eventually on a complete policy year basis. This has to be taken into account when use is to be made of several policy years, one including an incomplete year, on a weighted basis.