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AN APPROXIMATION FOR THE TESTING OF PRIVATE PASSENGER LIABILITY TERRITORIAL RATE LEVELS USING STATEWIDE DISTRIBUTION OF CLASSIFICATION DATA

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A previous paper[1] by Philipp K. Stern presented an excellent description of basic ratemaking procedures for Automobile Liability insurance. To utilize this procedure, it is necessary to have territorial exposures by classification. Independent companies writing a large volume of private passenger liability business could use this method to test their private passenger liability territorial rate levels as they would probably have a sufficient volume of data in the necessary detail. Many small independent companies, however, would not have a sufficient volume of their own data and probably would not have a readily available source of data in the detail required by the procedure described in Mr. Stern's paper. A method is needed by statisticians and others responsible for rate levels of small independent companies so they may more easily determine the adequacy of their rate levels.

The purpose of this paper is to explore the possibility of developing a method of testing private passenger liability territorial rate levels by substituting the statewide distribution of classification data for the actual distribution by rating territory. Such a method should be useful to small independent companies and could be used by company actuaries as a basis for estimating the adequacy of their rate levels.

DATA USED IN STUDY

The annual compilation of Automobile experience prepared by the National Association of Independent Insurers provided readily available data for such a study.

[1] Current Rate Making Procedures for Automobile Liability Insurance, *PCAS* XLIII, p. 112.

The NAII calls for Automobile private passenger liability experience require data to be reported by coverage and classification statewide and by coverage and territory for all classifications combined in all states except Louisiana, New Jersey, New York, North Carolina, Texas and Virginia. Private passenger data for these six states are reported by coverage and classification for each territory.

In order to determine the effect of substituting a statewide distribution for the actual territory distribution, statewide and territorial rate level changes were developed for the states of Lousiana, New Jersey, North Carolina and Virginia. The indicated rate level changes for each state were determined both on the basis of a statewide distribution of classification data and classification data by territory. Indicated rate level changes were also determined for the states of Alabama, Arkansas, Florida, Illinois, Ohio and Washington on the basis of each state's distribution of classification data statewide.

It was decided to use only calendar/accident year[2] data and to test the results. The NAII experience data prior to 1958 was compiled on a policy year basis so that calendar/accident year experience was only available for the years 1958, 1959, 1960 and 1961. 1961 rate levels would ordinarily be developed in 1960 from experience data for the years 1957, 1958 and 1959 as this three-year period would be available for review in 1960. As calendar/accident year 1961[3] was to be used for testing the rate levels, the experience data to develop the rate levels was limited to calendar/accident years 1958[4] and 1959.[4] The three-year period 1958, 1959 and 1960 would have been used if calendar/accident year 1962 had been available to test the rate levels. It is suggested that if the statewide distribution method is used, a three-year period should be considered as the longer period should provide a more stable base.

DEVELOPMENT OF EARNED PREMIUM AT PRESENT RATES

Earned premium at present rate level is required in order to determine both the statewide rate level changes and the territorial rate level changes. To compute the earned premium, rates for basic limits are required. The National Bureau of Casualty Underwriters rates were used as they were readily available. However, an independent company's rates or another rating bureau's rates could have been used. The developed rates

[2] Exposures and premium compiled on a calendar year basis. Incurred losses, number of incurred losses and allocated adjustment expense compiled by year of accident.

[3] Incurred losses valued as of March 31, 1962.

[4] Incurred losses valued as of March 31, 1960.

and loss ratios for 1961 would have been substantially the same regardless of the basic limits rates used, provided the rate class differentials were the same. If a different set of basic limits rates had been used, they would have produced different rate level changes by state and territory, however, the application of these rate level changes to the rate schedule utilized should produce approximately the same revised rates as the method actually used. The earned premium was calculated by multiplying N.B.C.U. private passenger car basic limits rates in effect in December of 1960 by the 1958 and 1959 earned car year exposures within each territory for each private passenger classification based on calendar/accident year 1959 distribution by class in each territory. The December 1960 rates were used on the assumption that 1958 and 1959 data would not be available until late in the fourth quarter of 1960.

RATE LEVEL CHANGES

To develop the statewide rate level changes for each of the ten states used in the study, factors were used to include unallocated loss adjustment expenses, to adjust losses to reflect changes in average paid claim costs subsequent to the experience period and to reflect the development of the incurred losses to 63 months for bodily injury and 39 months for property damage. The factors used in this study have been utilized in past rate revisions. However, their accuracy is not important for the purpose of this study as the prime interest at this time is to determine the degree of relationship between rates determined on the basis of the actual class distribution by territory and rates developed by substituting a statewide class distribution for the actual territory distribution by class. The losses used to determine the territorial rate level changes were adjusted to include the unallocated loss adjustment expenses using factors of 1.10 for bodily injury and 1.16 for property damage. The incurred losses including all adjustment expenses used to compute statewide rate level changes were developed to 63 months for bodily injury and 39 months for property damage by application of the following development factors:

Calendar/Accident Year	Bodily Injury	Property Damage
1958	.974	.989
1959	1.006	.962

The calendar/accident year weights, expected loss and loss adjustment ratios, loss trend factors and limits used for each state are as follows:

State	Calendar/ Accident Year Weight 1958	1959	Expected Loss and Loss Adjustment Ratio	Loss Trend Factor B. I.	P. D.	Limits
Alabama	.15	.85	.645	1.051	1.104	5/10/5
Arkansas	.15	.85	.630	1.035	1.053	10/20/5
Florida	—	1.00	.630	1.072	1.020	10/20/5
Illinois	—	1.00	.655	1.029	1.040	10/20/5
Louisiana	.15	.85	.651	1.076	1.045	5/10/5
New Jersey	—	1.00	.636	1.014	1.065	10/20/5
North Carolina	.15	.85	.650	1.119	1.110	5/10/5
Ohio	—	1.00	.625	1.040	1.028	10/20/5
Virginia	.15	.85	.646	1.036	1.087	10/20/5
Washington	—	1.00	.655	1.107	1.054	10/20/5

The various calculations necessary for developing Louisiana statewide and territorial rate levels using classification data by territory are set forth in Exhibits I and II.

Exhibit I shows the development of the following statewide bodily injury and property damage rate level changes:

Bodily Injury	+ 9.1%
Property Damage	— 13.5
Total	— 0.1%

DEVELOPMENT OF 1961 RATES

Exhibit II shows the development of the bodily injury rate level changes by territory. The indicated 1A bodily injury and property damage[5] rates were used to determine rates for the other private passenger classifications by application of the following differentials:

[5] Property damage rates were developed using the procedure shown in Exhibit II for bodily injury.

Differentials to Class 1A

Class	Rural and Small City Territories	Large City Territories
1A	1.00	1.00
1B	1.00	1.10
1C	1.45	1.45
2A	1.90	1.90
2C	3.60	3.10
3	1.50	1.50
1AF	.70	.70
2AF	1.33	1.33
2CF	2.52	2.17

The differentials for Classes 1A, 1AF, 1B, 1C and 3 were reduced 20% to reflect the discount for "two or more cars". The differentials were also reduced 10% to reflect the discount for compact cars.[6] All rates were rounded to the nearest dollar except for those states subject to the discount.

Louisiana Statewide Distribution by Class
1959 Calendar/Accident year

Class	Earned Car Years	Percentage
1A	42,811	32.8
1B	53,680	41.1
1C	6,272	4.8
2A	9,702	7.4
2C	1,087	.8
3	4,376	3.3
1AF	10,834	8.3
2AF	1,656	1.3
2CF	270	.2
Total	130,688	100.0

1A rates were also developed for Louisiana using the same procedure except that calendar/accident year 1959 statewide classification distribu-

[6] The compact car discount is not applicable in Louisiana and North Carolina.

tion percentages shown were multiplied by the total 1958 and 1959 earned car year exposure to determine the earned car year exposure by classification within each territory. The assumed earned car year exposures by class and territory were then multiplied by the December 1960 N.B.C.U. basic limits rates to develop earned premium at present rates. The indicated statewide rate level changes for Louisiana on the basis of the statewide distribution by class were as follows:

Bodily Injury	+ 9.4%
Property Damage	— 13.2
Total	+ 0.2%

The effect of using the statewide distribution by class is reflected by an increase of 0.3% for bodily injury and property damage combined.

TESTING OF RATES

The rates developed on both bases were used to determine the earned premium for calendar/accident year 1961. The premium was calculated by multiplying the rates by the earned exposures for each classification within each territory. The 1961 calendar/accident year basic limits incurred losses were adjusted to include unallocated loss adjustment expenses by use of the factor of 1.10 for bodily injury and 1.16 for property damage. The adjusted basic limits losses for calendar/accident year 1961 were then divided by the earned premium to obtain territorial loss ratios on the basis of both sets of rates. The loss ratios were as follows:

Louisiana – Calendar/Accident Year 1961

Territory	Loss and Loss Adjustment Ratio			
	Bodily Injury		Property Damage	
	(a)ø	(b)ø	(a)ø	(b)ø
(01) Jefferson, Orleans, Plaquemines and St. Bernard Parishes	.625	.625	.671	.671
(02) East Baton Rouge and West Baton Rouge Parishes	.632	.616	.631	.601
(03) Bossier, Caddo and De Soto Parishes	.781	.781	.786	.786
(04) Ouachita Parish	.745	.745	.830	.830
(05) Calcasieu Parish	.881	.881	.590	.590
(06) Lafayette Parish	.549	.549	.560	.560
(07) Rapides Parish	.563	.563	.672	.672
(08) Remainder of State	.599	.620	.699	.699
Entire State	.643	.648	.682	.678

(a)ø – Loss ratios computed using earned premiums developed from the actual territorial classification distribution.

(b)ø – Loss ratios computed using earned premiums developed from the statewide classification distribution.

Inspection will indicate a high degree of correlation. Using the standard correlation coefficient formula, the coefficients for Louisiana are as follows:

Bodily Injury	.9964
Property Damage	.9988

The rates developed for the states of New Jersey, North Carolina and Virginia on both a statewide and territorial distribution basis were tested using the same procedure as was used for Louisiana. The correlation coefficients were calculated from the loss ratios developed on both distributions and are as follows:

	Bodily Injury	Property Damage
New Jersey	.9939	.9693
North Carolina	.9999	.9999
Virginia	1.0000	.9726

COMPARISON OF 1961 RATIOS DEVELOPED FROM THE STATEWIDE DISTRIBUTION METHOD AND N.B.C.U. RATES

The procedure used for developing Louisiana rates from the statewide distribution and testing the rates using 1961 calendar/accident year losses was followed to the extent possible in determining the rates and 1961 loss ratios for the states of Alabama, Arkansas, Florida, Illinois, Ohio and Washington. Territory rate levels were developed using calendar/accident years 1958 and 1959 except for the states of Illinois and Ohio. The territory rate levels for these two states were determined on the basis of calendar/accident year 1959 only as Automobile experience for Illinois and Ohio was not collected by the NAII until 1959. The 1959 calendar/accident year statewide distribution by class for each state was used to determine the class distribution by territory. To test the rates developed from calendar/accident years 1958 and 1959, it was necessary to use the 1961 calendar/accident year statewide distribution to determine the assumed car year exposure by class for each territory for 1961 as the distribution by class within each territory was not available for these six states. The 1961 assumed car year exposures were multiplied by the rates developed from calendar/accident years 1958 and 1959 to determine the earned premium. The 1961 calendar/accident year basic limits incurred losses were adjusted to include unallocated loss adjustment expense and were then divided by the earned premium to obtain loss ratios. N.B.C.U. rates in effect in 1961 or revised in 1961 in these six states were used to determine the earned premium by territory and were compared to the earned premium based on rates calculated using NAII data for calendar/accident years 1958 and 1959. The loss ratios on both bases are as follows:

Calendar/Accident Year 1961

Loss and Loss Adjustment Ratio

State	Expected	Bodily Injury (a)ø	Bodily Injury (b)ø	Property Damage (a)ø	Property Damage (b)ø
Alabama	.645	.572	.497	.620	.479
Arkansas	.630	.643	.604	.582	.523
Florida	.630	.632	.624	.575	.521
Illinois	.655	.619	.837	.661	.597
Ohio	.625	.626	.481	.682	.510
Washington	.655	.653	.525	.668	.527

(a)ø – Loss ratios computed using 1961 earned premiums developed from rates based on the statewide distribution in the NAII compilations.

(b)ø – Loss ratios computed using 1961 N.B.C.U. rates.

The loss ratios computed for each of the six states using 1961 earned premium based on the statewide distribution of NAII experience varied less from the expected loss ratio than those computed from premium on the basis of 1961 N.B.C.U. rates. No criticism of N.B.C.U. rates is implied as they were developed from and for a different book of business. However, independent companies using N.B.C.U. rates may be interested in making similar comparisons.

COMPUTATION OF STATEWIDE DISTRIBUTION BY CLASS

Incidental to determining the percentage of earned cars by territory for those six states, additional computations were necessary as some independent companies do not use the Louisiana classification system in these states. In addition to the nine classifications used in the state of Louisiana, independent companies also wrote the following classes:

1, 1F, 1B and 1C combined, 1BF, 2, 2B and 2BF[7]

The exposures for class 1 were allocated to 1A, 1B and 1C in the same ratio as 1A, 1B and 1C bear to the total of these three classes. 1F and 1BF were added to 1AF. 1B and 1C combined were allocated to 1B and 1C in the same ratio as these two classes bear to their total. Classification 2 was allocated to 2A and 2C in the same manner as 1B and 1C combined. Exposures for 2B were added to 2A and 2BF to 2AF. All classifications were thus combined on a nine classification basis and the percentages were computed for each class. The exposures for code 1900 "other class plan filed" were not used as it was assumed that this classification would follow the same percentage distribution as the nine classifications.

ANALYSIS OF VARIATIONS BY CLASS DUE TO SUBSTITUTION OF STATEWIDE DISTRIBUTION

The results obtained in the states of Louisiana, New Jersey, North Carolina and Virginia show that while the territory loss ratios vary from the expected loss ratio, only slight variations are observed between the loss ratios computed from rates determined on a statewide distribution by class and those computed on the basis of the territory distribution.

At the start of the study, it was believed that use of a statewide distribution would cause sufficient distortion to require the use of a correction factor. An analysis of farm, non-farm, single, multiple and compact car

[7] Automobile Statistical Plan — All Coverages, published by the National Association of Independent Insurers.

classes was made to determine the variation between the statewide distribution and the territory distribution by class. However, there was not a sufficient variation by class to cause a severe distortion. The greatest variation was noted in the farm class 1AF. The Louisiana statewide percentage distribution of class 1AF for calendar/accident year 1959 was 8.3%. Territory 01, 1AF exposure for the same year was 0.6% while territory 08, was 19.1%. The use of the statewide distribution assumes that 8.3% of the earned cars in each territory were class 1AF. The following table indicates the effect of assuming the distribution of class 1AF is 8.3% in both territories 01 and 08:

Louisiana – Calendar/Accident Year 1959

Coverage	Territory	Class 1AF Distribution		Developed 1A Rates based on Distribution		1961 Loss Ratio based on Distribution	
		Actual	Assumed	Actual	Assumed	Actual	Assumed
B. I.	01	0.6%	8.3%	$31	$31	.625	.625
	08	19.1	8.3	31	30	.599	.620
P. D.	01	0.6	8.3	18	18	.671	.671
	08	19.1	8.3	15	15	.699	.699

The amount of error due to the variations in classifications by territory does not seem to justify the use of a correction factor.

APPLICATION OF STATEWIDE DISTRIBUTION METHOD

A statistician who desires to test his company's rate levels and does not have sufficient data or, as often happens, is assigned the task of determining rate levels for a state that his company is planning to enter for the first time could use the statewide distribution method.

Assuming private passenger territorial rate levels were needed for a particular state in January 1963, the 1962 NAII compilation of Automobile experience could be utilized to determine:

1. The total earned car year exposures, basic limits incurred losses and number of incurred claims for calendar/accident years 1959, 1960 and 1961 by territory.
2. The 1961 statewide percentage distribution of earned car year exposures by class.

The total 1959, 1960 and 1961 earned car year exposures for each rating territory could then be distributed by class on the basis of the 1961 state-

wide percentage distribution. The next step would be to multiply, (1) the company's rates in effect for the state at that time, (2) another company's rates, or (3) a bureau's rates, by the assumed earned cars for each class within each territory to determine earned premium at present rate level for each rating territory and the entire state, separately for bodily injury and property damage. The basic limits incurred losses could then be adjusted to include all unallocated loss expenses by use of a factor determined from the company's own data or the use of 1.10 for bodily injury and 1.16 for property damage currently used in rate revisions by the rating bureaus. The basic data would then be available to determine the statewide rate level changes in the same manner as they were calculated for Louisiana in Exhibit I. The accident year weights may be determined as follows:

1. If the earned premium at present rate level for the latest year for bodily injury and property damage combined, exceeds $20,000,000, apply a weight of 1.00 to the latest year.
2. If the earned premium as computed in (1) is less than $20,000,000 and exceeds $5,000,000, use a weight of .85 applicable to the latest year and a weight of .15 applicable to the prior year.
3. If the earned premium computed in (1) is less than $5,000,000, then use a weight of .70 for the latest year and a weight of .30 for the prior year.

After determining the accident year weights, the incurred losses are developed to 63 months for bodily injury and 39 months for property damage. A loss development factor may be determined from an analysis of the company's loss developments, or the NAII compilation could be used to determine the development of incurred losses from 15 to 27 months. A development to 27 months is not entirely satisfactory but a further development is not readily available. The loss and loss adjustment ratio at present rates is then computed. This ratio may be adjusted to reflect subsequent changes in average paid claim cost and a not unreasonable factor could be developed from the company's quarterly average paid claim cost by the method of least squares. If the company data is not available, NAII average paid claim cost data on an annual basis could be used. The loss and loss adjustment ratio at present rates adjusted to reflect the changes in average paid claim costs should then be divided by the expected loss and loss adjustment ratio to determine the indicated rate level change. The expected loss and loss adjustment ratio could be determined by subtracting the company's provision for expenses in their rates from 1.000. The number of claims for the calendar/accident years used in determining the

earned premium at present rates would be used to determine the amount of credibility[8] applicable to the rate level change. After the computation of the statewide rate level changes, the statistician would then compute the territorial rate level changes.

CONCLUSION

The results of this study would seem to indicate territory rate levels could be approximated by the substitution of a statewide distribution of classification data for the territorial distribution, and the statewide distribution method affords independent companies a reasonable basis for checking and comparing rate levels.

[8] Current Rate Making Procedures for Automobile Liability Insurance, *PCAS* XLIII, p. 131.

EXHIBIT I

LOUISIANA
AUTOMOBILE LIABILITY INSURANCE — PRIVATE PASSENGER CARS

Development of Statewide Rate Level Changes†

(1) Coverage	(2) Calendar/ Accident Year	(3) 5/10/5 Limits Earned Premium at Present Rates (a)	(4) 5/10/5 Limits Incurred Losses (b)	(5) Number of Claims	(6) Loss & Loss Adjustment Ratio at Present Rates (4) ÷ (3)	(7) Calendar/ Accident Year Weights
B. I.	1958	$ 3,953,836	$ 2,570,427	2,763	.650	15%
	1959	4,070,745	2,696,312	2,840	.662	85
P. D.	1958	2,696,566	1,528,828	9,181	.567	15
	1959	2,792,999	1,492,154	9,271	.534	85

(8) Coverage	(9) Weighted Loss & Loss Adjustment Ratio at Present Rates Sum of (6) x (7)	(10) Factor to Adjust Losses for 24 months of Subsequent Change in Claim Costs	(11) Experience Loss & Loss Adjustment Ratio (9) x (10)	(12) Expected Loss & Loss Adjustment Ratio	(13) Credibility (based on number of claims)	(14) Indicated Rate Level Change $\left[\frac{(11)}{(12)} - 1.0\right]$ x (13)
B. I.	.660	1.076	.710	.651	1.00	+ 9.1%
P. D.	.539	1.045	.563	.651	1.00	− 13.5
Total						− 0.1

† The calendar/accident year earned cars used to develop the earned premium, incurred losses and number of incurred claims were obtained from data compiled by the National Association of Independent Insurers.

(a) N.B.C.U. rates used to compute earned premium at present rates.

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

Calendar/Accident Year	Bodily Injury	Property Damage
1958	.974	.989
1959	1.006	.962

EXHIBIT II
Sheet 1

LOUISIANA
AUTOMOBILE LIABILITY INSURANCE — PRIVATE PASSENGER CARS

Development of Bodily Injury Rate Level Changes by Territory†

(1) Territory	(2) Calendar/ Accident Years 1958-1959 Earned Number of Cars	(3) 5/10 Present Average Rate	(4) 5/10 Limits Pure Premium (Incl. All Loss Adj.) for Calendar/ Accident Years 1958 & 1959	(5) Loss & Loss Adjustment Ratio at Present Rates for Calendar/ Accident Years 1958 & 1959	(6) Credibility 1958 and 1959	(7) Formula Loss & Loss Adjustment Ratio at Present Rates [(5) x (6)] + [1.0 − (6)] x .663	(8) Col. (7) as Ratio to Statewide Average	(9) Indicated Territorial Rate Level Changes [(8) x 1.091] − 1.0	(10) Average of Present Differentials to Rate Class 1A	(11) Indicated Class 1A Rate (3) x [1.0 + (9)] ÷ (10)
(01) Jefferson, Orleans, Plaquemines and St. Bernard Parishes	55,774	$ 29.37	$ 21.35	.727	1.00	.727	1.108	+ 20.9	1.163	$ 31
(02) East Baton Rouge and West Baton Rouge Parishes	30,741	38.47	26.22	.682	.80	.678	1.034	+ 12.8	1.169	37
(03) Bossier, Caddo and DeSoto Parishes	27,508	24.19	15.86	.656	.60	.659	1.005	+ 9.6	1.153	23
(04) Ouachita Parish	10,740	23.71	17.40	.734	.40	.691	1.053	+ 14.9	1.128	24
(05) Calcasieu Parish	17,986	29.74	15.88	.534	.50	.599	.913	− 0.4	1.178	25
(06) Lafayette Parish	9,151	33.83	24.10	.712	.40	.683	1.041	+ 13.6	1.089	35
(07) Rapides Parish	11,837	23.37	25.10	1.074	.40	.827	1.261	+ 37.6	1.116	29
(08) Remainder of State	93,158	33.95	20.35	.599	1.00	.599	.913	− 0.4	1.093	31
Entire State	256,895	31.24	20.71	.663		.656				

†The calendar/accident year earned cars, incurred losses and number of incurred claims were obtained from data compiled by the National Association of Independent Insurers.

EXHIBIT II
Sheet 2

NOTES PERTAINING TO DEVELOPMENT OF LOUISIANA
BODILY INJURY RATE LEVEL CHANGES BY TERRITORY

Column (3) Average of present rates based on calendar/accident year 1959 distribution by classification in each territory.

Column (4) This column although not essential is included in rate exhibits to show the pure premium.

Column (5) Basic limits incurred losses for calendar/accident years 1958 and 1959 adjusted to include unallocated expenses, divided by the earned premium at present rates for calendar/accident years 1958 and 1959.

Column (6) Credibility[9] – based on number of claims.

Column (7) The formula for calculating this ratio by territory is shown. The ratio for the entire state (.656) is computed as follows:

$$\frac{\text{Sum of Column (2)} \times \text{Column (3)} \times \text{Column (7) for each territory}}{\text{Column (2)} \times \text{Column (3) for entire state}}$$

Please note that if this ratio differs from the loss ratio for the entire state in Column (5) by more than one point, an adjustment should be made in the formula for computing Column (7) by including a factor determined by dividing the actual incurred losses (adjusted to include unallocated expense) by the formula expected losses.

Column (8) Column (7) as a ratio to entire state ratio (.656).

Column (9) Statewide rate level change (Exhibit I – Column 14) applied to each territory.

Column (10) The average of present differentials[10] is computed by multiplying the exposures for each class in each territory by the applicable differential to rate class 1A. The sum of the exposures so extended is divided by the total exposures for each territory.

Column (11) Indicated class 1A rate.

[9] Current Rate Making Procedures for Automobile Liability Insurance, *PCAS* XLIII, p. 112.

[10] Use of a statewide distribution of class data will require only two computations—one for rural and one for large city territories, assuming the company uses the same differentials to rate class 1A.