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AUTO B.I. LIABILITY RATES — USE OF 10/20 EXPERIENCE IN THE ESTABLISHMENT OF TERRITORIAL RELATIVITIES

BY

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THE CURRENT SITUATION

Since the passage of the Safety Responsibility Law in New York State, an ever increasing proportion of the motorists have purchased 10/20 limits of coverage. Now, with the advent of compulsory insurance, 10/20 is a universal minimum.

In spite of this, the Automobile Liability Manual sets 5/10 as the basic limits and, what is as important, quotes rates for 5/10 coverage, a virtual fiction under the present circumstances.

THE PROBLEM OF RATEMAKING

In recognition of the fact that 5/10 rates are no longer true "basic" rates for New York, for the past two private passenger rate revisions, 10/20 experience has been used in establishing the over-all rate level. The problem dealt with in this study is, as indicated by the title, the determination of the possible consequences involved in using 10/20 experience in setting up territorial relativities. The question raised is whether significant distortions are likely to occur if this experience is used at the territorial level.

TWO TYPES OF EFFECTS PRODUCED

We may begin by observing that the results obtained through the use of 10/20 experience may differ from those derived from 5/10 experience in two ways. In the first place, one territory may actually be subject to more excess limits claims than the average. This may be due to road conditions, claim consciousness or any of the causes to which high claim cost is usually attributed. The use of 10/20 experience would increase the rates for this territory in relation to the others not subject to such claims in the same degree. This would seem to inject a desirable refinement into the ratemaking process. It would, to an even greater extent than is the case today, distribute equitably among the territories the cost of doing business.

The second possible source of difference between the two bases would be that due to chance fluctuations. Since excess limits claims are of an infrequent or "catastrophic" nature, it might be argued that the predictability of their occurrence or non-occurrence would not warrant the assignment of a high degree of credibility to this experience. In other words, it would seem on the surface that on the basis of this experience one might attribute to a territory certain characteristics which do not truly pertain to that territory, but which have appeared by chance.

In order to decide whether or not the benefits of using this excess limits experience outweigh the disadvantages, it is necessary to determine the magnitude of the distortions which are likely to be produced by these chance occurrences.

ASSUMPTIONS

In order to evaluate the distortions which may occur in the system under study, certain *reasonable* assumptions must be made concerning the frequency and effect of excess limits claims. The bases for these assumptions will be analyzed at a subsequent stage under the heading "Basis of Assumptions."

1. In view of the magnitude of the exposures and the small probability of occurrence of an excess limits claim, the distribution employed will be taken from a table of Poisson Probabilities. The notation to be used is

$$P_m\ (X) = \text{Probability of X claims occurring given that the mean is m.}$$

2. The probability of occurrence of an excess limits claim (over 5/10) is, on the average, 3% of the probability of occurrence of a claim (without regard to size).

3. The amount to be included in the 10/20 experience will be the first $10,000 of each claim irrespective of any accident limit. Moreover, the amount presently included in the 5/10 experience is the first $5,000 of each claim regardless of any accident limit. Each excess limits claim (over 5/10) will produce an additional $4,500 at 10/20 limits.

OBJECT OF CALCULATIONS

The calculations performed are designed to determine the range within which the formula pure premium can be expected to fall 90% of the time if 10/20 experience is used. Under either rating system, the 5/10 indications are considered correct. That is, whether we use 5/10 or 10/20 experience, the 5/10 pure premium will be the same. The only difference is that instead of a flat loading for the increment between 5/10 and 10/20, the actual experience will be used.

THE "AVERAGE" TERRITORY

Referring to the table appended to this survey, we note the following information:

a)	Number of Territories (combination equals 1 territory)	= 35
b)	Total number of claims (3 years)	= 160M
c)	Total exposure (3 years)	= 4,545M
d)	Average Pure Premium (10/20)	$35

From these figures, we derive the following:

e)	Average number of claims per territory	4,500
f)	Average exposure per territory	130M
g)	Average number of excess limits claims per territory (see assumption 2)	135

At this point, we can begin our calculations. We are interested in the range in which the pure premium can be expected to fall 90% of the time if 10/20 experience is used. The number of claims in this range is determined by solving for k in the following equation:

$$\sum_{135-k}^{135+k} P_{135}(X) = .90$$

$$k \sim 20$$

This means that 90% of the time, the effect on the pure premium will be

$$\pm \frac{20\ (\$4{,}500)}{130M} = \pm \$.75^*$$

That is, if the "true" pure premium is $35.00, the formula pure premium based on 10/20 will be somewhere in the interval $35.00 ± $.75 in 90 per cent of the cases.

A natural question presents itself now. The observer may ask wherein the benefit lies of using a value somewhere between $34.25 and $35.75, when under our present setup we use the exact value $35.00. The answer is this. $35.00 is a perfect answer if, and only if, the territory in question has an excess limits claim frequency which is exactly average. This is so because when we use a flat loading for the increment between 5/10 and 10/20, we are assuming that all territories are the same (or average). What happens, however, in the case where the territory has a "true" excess limits claim frequency different from the average? In this case, we would still be using $35.00 as our 10/20 pure premium (under the existing system). Yet, since this figure is based on an assumption of *average* experience between 5/10 and 10/20, it is manifestly incorrect.

*To the nearest 25 cents.

What would happen if 10/20 experience were used to establish our rates? We shall now examine the cases where the excess limits claim frequency is half the average or twice the average.

EXCESS LIMITS CLAIM FREQUENCY OF HALF THE AVERAGE

Suppose a territory were average in every respect except that its inherent excess limits claim frequency were .015 times its total claim frequency. This means that it would tend to produce 68 excess limits claims. The number actually produced would not be 68 in most cases; but 90 per cent of the time, it would be in the range 68 $\pm$ k where k is defined by the following equation:

$$\sum_{68-k}^{68+k} P_{68}(X_i) = .90$$

$$k \sim 13$$

In about 90 per cent of the cases, the pure premium would fall in the area $\pm$ \$.50 around the "true" value. In this situation, the "true" value would be \$32.75. This figure is arrived at as follows:

(1) Ratio of 10/20 pure premium to 5/10 pure premium indicated by latest experience (fully developed) = 1.155

(2) Excess limits pure premium (average)
\$35.00 — (\$35.00 $\div$ 1.155) = 4.70

(3) Excess limits pure premium based on frequency of half the average = 2.35

(4) 10/20 pure premium
(\$35.00 $\div$ 1.155) + 2.35 (rounded) = 32.75

Therefore, the pure premium would fall in the interval \$32.75 $\pm$ \$.50 in 90 per cent of the cases. It should be borne in mind that if 5/10 experience were used, the pure premium would be \$35.00. This is considerably outside the range shown above.

EXCESS LIMITS CLAIM FREQUENCY OF TWICE THE AVERAGE

The case where the inherent frequency is double the average will clearly indicate a greater spread of probable pure premium values. This is so because in the Poisson-Type distribution the variance equals the mean. Here our true number of excess limits claims is 270. The range is determined by solving for k in

$$\sum_{270-k}^{270+k} P_{270}(X_i) = .90$$

There are no Poisson tables available for m=270. However, where m is large, the Normal Curve provides an exceedingly close approximation. A table of Normal Curve Areas reveals that 90 per cent of the cases fall within a range of 1.65, about the mean. Therefore,

$$k \sim 1.65\,\sigma \sim 27$$

In this instance, in 90 per cent of the cases the pure premium will lie within $1.00 of the mean. Proceeding as in the previous section, we find that the pure premium will lie in the interval $39.75 ± $1.00. Here again it should be kept in mind that the present methods will provide a pure premium of $35.00.

AN EXTREME CASE

A bit of thought will reveal that there are certain types of territories where the 90% range of pure premium is apt to be wider than in most other cases. I have selected one of these for illustrative purposes. It is Monticello, which has a high claim frequency and very little exposure. A table is appended which shows the 90% range for each New York territory (or combination) based on an average excess limits claim frequency.

MONTICELLO

a)	Number of claims (3 years)	= 875
b)	Total exposure (3 years)	= 15M
c)	Pure Premium	= $57
d)	Credibility	= 80%
e)	Number of excess limits claims (see assumption 2)	= 26

The number of claims in the 90% range is k in the following equation:

$$\sum_{26-k}^{26+k} P_{26}(X_i) = .90$$

when k = 8 we have

$$\sum_{18}^{34} P_{26}(X_i) = .91$$

That is, in 91 per cent of the cases, the formula pure premium will lie in the interval $57.00 ± $2.00. This, it will be recalled, is based upon the assumption that Monticello has average excess limits potential. The appended table will reveal that this is the extreme case for New York State. The remaining territories are confined, for the most part, to fluctuations of $1.00 or less. Moreover, these table entries

describe the error only when a territory has average excess limits potential. When a territory is not "average" in this respect, the use of 10/20 experience tends to produce a superior result since the pure premium range centers about the "true" value.

BASES OF ASSUMPTIONS

1. The use of a Poisson Distribution to describe the occurrence of Auto Bodily Injury Claims has substantial precedent. The principal feature which enables one to employ this approximation in the case of Auto Bodily Injury Claims—a very small probability of occurrence—is present to an even greater extent in the case of excess limits claims.

2. The 1950 call for Size of Claim Data revealed the following Auto Bodily Injury Liability claim distribution for calendar year 1949 (Private Passenger Cars).

	New York	*Countrywide excl. New York*
Total # claims paid	59,076	145,374
# Excess limits claims	637	1,802
Ratio	.01	.01

This proportion (.01) has undoubtedly risen somewhat with the increasing average claim cost. The latter item has gone up by more than 20 per cent since the time of the call. The use of 3 per cent appears conservative.

3. Insurance Department records indicate that according to a preliminary survey made in 1952, the additional cost resulting from considering the first $10,000 per claim rather than the first $5,000 was about $3,500 per claim. Since the average claim cost has increased since that time, $4,500 seems a more likely figure today.

An approximate check exists on the combination of assumptions 2 and 3. As stated earlier, the 10/20 pure premium has been about 1.155 times the 5/10 pure premium for recent years. Since the average 10/20 pure premium has been about $35.00, the increment is seen to be about $4.70.

If we take an excess limits claim frequency of .03, we derive the following:

Number of claims = 160,000*

Number of excess limits claims
.03 × 160,000 = 4,800

The effect of these claims on the pure premium is*

$$\frac{4{,}800 \times \$4{,}500}{4{,}545{,}000} = \$4.75$$

* See page 3—the "Average" Territory.

This demonstrates that these two assumptions, in combination, are reasonable. An error in one of these assumptions tends to be offset by a compensating error in the other and the effect on the argument is negligible.

CONCLUSIONS

The results of employing 10/20 experience rather than 5/10 are that, in general, rather than using a fixed loading as an estimate of the excess limits loss potential for all territories, which is correct for the strictly average territory and incorrect for all others, we use a quantity which differs by territory. This quantity tends to be correct for each territory but in any event is within a narrow band of values centered about the "true" value in a considerable majority of the cases. I have indicated in this paper the range of values within which the formula pure premium can be expected to fall 90 per cent of the time

In summary, it appears that the present system of relying on the 5/10 experience is based on one of two assumptions:

a) Territories are all alike as respects excess limits claim potential.
b) Differences in excess limits claim potential are not susceptible of measurement.

It is my opinion that the first assumption is incorrect. The second assumption has, up to this time, caused ratemakers to tread cautiously in using excess limits experience. I trust that the preceding exposition may enable them to pursue more exact rates with somewhat less trepidation.

TABLE A

Territory	*Exposure 1952-1954 (000)*	*Number of Claims 1952-1954*	*Credibility (Based on # claims)*	*Range of Formula Pure Prem. Deviation (prob = .90)*	*Formula Pure Prem. 10/20*	*Deviation as a % of Formula pp*
Monticello	15	875	.8	$2.00	$57	4%
Queens	58	3,385	1.0	1.25	53	2
Saratoga Springs	18	784	.8	1.50	48	3
Queens Sub.	562	30,047	1.0	.50	47	1
Albany	107	4,512	1.0	.75	..	..
Troy	42	1,865	1.0	1.25	..	..
Sub-Total	149	6,377	1.0	.75	44	2
Glens Falls	23	856	.8	1.25	40	3
Schenectady	92	3,271	1.0	.75	40	2
Gloversville	21	765	.8	1.25	40	3
Nassau	550	22,663	1.0	.25	39	1
Utica	53	2,152	1.0	1.00	..	..
Rome	18	652	.7	1.25	..	..
Sub-Total	71	2,804	1.0	1.00	38	3
Suffolk	209	6,863	1.0	.50	38	1
Buffalo	341	12,935	1.0	.50	37	1
Amsterdam	16	585	.7	1.50	41	4
Rensselaer Co.	20	670	.7	1.00	37	3
Putnam Co.	18	573	.7	1.00	37	3
Oswego	20	798	.8	1.50	36	4
Syracuse	134	5,082	1.0	75	34	2
Fort Plain & Herkimer	33	1,022	.9	1.00	34	3
N.Y.C. Suburban	314	10,411	1.0	.50	33	2
Rochester	233	7,319	1.0	.50	32	2
Ossining	64	1,711	1.0	.75	31	2
Buffalo Sub. & N. F. Sub.	71	2,066	1.0	.75	..	..
Niagara Falls	78	2,198	1.0	.75	..	..
Sub-Total	149	4,264	1.0	.50	30	2
Kingston	45	1,383	1.0	1.00	..	..
Newburgh	32	878	.9	1.00	..	..
Sub-Total	77	2,261	1.0	.75	30	3
Staten Island	61	2,019	1.0	1.00	29	3
Elmira	33	856	.8	.75	31	2
Syracuse Sub.	33	937	.9	1.00	29	3
Northern Counties	216	5,753	1.0	.50	29	2
Catskill & Col. Co.	44	1,043	.9	.75	28	3
Dutchess Co. Rem.	37	953	.9	1.00	..	..
Poughkeepsie	40	1,033	.9	1.00	..	..
Sub-Total	77	1,986	1.0	.75	28	3
Rockland County	47	1,338	1.0	1.00	28	4
Terr. 54	72	1,821	1.0	.75	..	..
Genesee	24	634	.7	1.00	..	..
Rochester Sub.	11	269	.4	.75	..	..
Sub-Total	107	2,724	1.0	.75	27	3
Middletown	51	1,410	1.0	1.00	26	4
Central Cos.	227	5,589	1.0	.50	..	..
Terr. 57	90	2,208	1.0	.75	..	..
Auburn	21	542	.7	1.00	..	..
Cortland-Ithaca	33	861	.8	.75	..	..
Binghamton	76	1,554	1.0	.75	..	..
Sub-Total	447	10,754	1.0	.25	25	1
Watertown	22	567	.7	.75	25	3
Western Cos.	189	4,007	1.0	.50	..	..
Jamestown	31	679	.7	.75	..	..
Sub-Total	220	4,686	1.0	.50	23	2
Total	4,545	160,394				