MERIT RATING IN PRIVATE PASSENGER AUTOMOBILE LIABILITY INSURANCE AND THE CALIFORNIA DRIVER RECORD STUDY

BY

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For a great many years individual automobile risk merit rating has existed in various parts of the world. A workable system has been in use in the British Isles for many years. Messrs. Bohlinger and Morrill report that in England a policyholder is entitled to a "no claim rebate" if he makes no claim under the policy. "If no claim is made for a single policy year, the reduction is 10% upon renewal; if no claim is made for two years consecutively, the reduction is 15% and if no claim is made for three consecutive years, 20%."[1]

They report that New York State used a merit rating plan in 1929. This was shortly abandoned because of defects in administration and abuses in its application which defeated the purpose for which it was intended.

No-claim bonus plans have a great mass appeal and have found common acceptance in some European countries as well.

In 1938 a safe driver reward plan came into being in many states. In New York State, however, a safe driver reward plan which rewarded accident free drivers was not adopted. Instead a preferred risk rating plan which penalized drivers with accident records was used. Both of these plans were abandoned during the war when gasoline rationing came into being. They were not resurrected after the war. New York State, however, reverted to the preferred risk rating plan during the early 1950's.

During the early 1950's the Canadian merit rating plan was adopted for use in Canada. This plan affords a rate benefit according to the length of time that the risk has been accident free. (Five[2] years produces the maximum credit.)

[1] Page 35 of "Insurance Supervision and Practices in England". Report by Deputy Superintendents Alfred J. Bohlinger and Thomas C. Morrill to Robert E. Dineen, Superintendent of Insurance, State of New York Insurance Department, 1948.

[2] Originally three years produced the maximum credit. Effective September 1, 1959, however, a new class with rates 20% less than 1A was established under the name of "Class 1A Select" and defined as follows:

a. Pleasure and
b. Applicant 25 years of age and over and
c. No accident involving the applicant or the automobile or any automobile for which it has been substituted for the past 5 years and
d. No proof of financial responsibility required and
e. Rating information statement form on file with insured which states
   1. Permit to drive held for past 5 years.

Footnote 2 Continued Next Page

There is a general belief on the part of those insurance companies engaged in the utilization of such plans that merit rating is a sound, effective tool for adjusting the premium commensurate with the hazard according to individual risk.

Part of the uneasy feeling in the United States with respect to merit rating rests on credibility considerations. The argument runs something as follows:

With an expected accident frequency of less than 10% per year, the fact that an individual is involved in an accident in a particular year is considered fortuitous and ought not to be given special consideration for the purpose of adjusting the rate charged to that risk.

The proponents of the use of the preferred risk rating plan approach use the notion that an individual should be considered innocent of extra hazard potential until proven guilty via his actual past accident record. The risk which has been accident free pays the slightly less than average rate which most individuals in his class pay. When he shows via his past accident record that he qualifies, then a surcharge is imposed. The magnitude of this surcharge depends upon the caliber of his record.

More recently, individual insurance companies have adopted what is known as the California type plan. This is a plan which was promulgated by the National Bureau of Casualty Underwriters for application in California and more recently in other states as well. It rests upon the previous accident and driving record of drivers in the state. It came into being in answer to the need for recognition of the driving performance of individuals. The cornerstone of this plan is a statistical research effort made by the State of California. It is well to describe the findings of that study in some detail.

The State of California, Department of Motor Vehicles, Division of Driver's Licenses under the direction of Chief Fred P. Williams, recently concluded a driver record study as part of a long range research program directed toward evaluation and appraisal of the state's various programs directed toward public safety on the highways. A sample of 94,935 individuals (1.3% of all drivers) was selected for study and evaluation.

The study was based entirely upon the records of the Department of Motor Vehicles. Despite the lack of total records under existing procedures (failure to report accidents or failure to completely record abstracts of convictions for traffic violations), the results of this study are meaningful. Although it is generally believed that professional driving groups such as chauffeurs, salesmen, etc. tend to accumulate more convictions and accidents than the average driver, the Depart-

Footnote 2 Continued

2. No male driver under 25.
3. Automobile not used for driving to and from work.
4. Average and anticipated mileage not exceeding 10,000 per annum.
5. Not more than two drivers per automobile in the household.

ment's study does not attempt to evaluate this factor of road exposure.

In summarizing the findings of this study the Department indicates that a definite relationship exists between the number of abstracts (records of convictions for traffic violations) in a driver's record and the number of accidents he is likely to have. Analysis of the data shows a consistent tendency toward an increase in the number of accidents with an increase in the number of abstracts. For example, on the average, those individuals with no abstracts in the record had an average frequency of accident involvement of 8.6% while those with five or more abstracts had a frequency of 55.31%. The average frequency of accident involvement for all drivers in the study was 16.31%. Thus it is seen those with 5 or more abstracts had an accident involvement frequency 239% more than the grand average.[3] There is a clear and definite increase of the average accident involvement according to the number of abstracts. The relationship is almost linear as the figures in Exhibit I indicate.

Although there are many ways in which information might be summarized with respect to age, sex or type of license (chauffeur's or operator's) the study, in the main, concentrates upon the relationship of abstracts of conviction of traffic violation and accident involvement. This most recent study verifies and enlarges the results of a previous study made in April 1954. Very little difference is noted in the distribution of the record of accidents between the two studies and some difference is noted in the distribution of abstracts. It may be that the enforcement levels changed between 1954 and 1958 resulting in an increase in the proportion of drivers having abstracts of driving violations and convictions. The accident record improved slightly.

The detail of the methodology used indicates that the differentiating factors taken from each driver's record were as follows:

1. The driver's license number prefix
2. Type of license (operator or chauffeur)
3. Sex
4. Age
5. Quantity of "failure to appear" notices attached to the record

This information was taken off for the three year period ending in 1958. Following that, the quantity of accidents, abstracts and double count abstracts for each of three years individually was entered and, in addition, the total quantity of abstracts for the full three year period was entered according to the total quantity of accidents. Briefly the records show better performance by women than men. 91.78% of female drivers had no accident records whereas 82.65% of male drivers had clear records. As to abstracts, 75.75% of women drivers had no abstracts compared to 48.5% of male drivers with none.

[3] But see footnote 6 for a slight modification of this figure.

Over 60% of operators had no abstracts while only 36.1% of chauffeurs had similarily clean records. With regard to accidents, 87% of the operators had no accidents while 77% of the chauffeurs showed no accidents. Additionally, drivers who hold both operator's or chauffeur's licenses had a poorer performance as indicated by abstracts than those holding chauffeur's licenses only. Almost 70% of those in the "both" category had one or more abstracts in record.

The study indicates a clear trend toward improving driving performance with increase in age. For example, male drivers in the 22 year old bracket showed only 22.9% were free of convictions whereas 56 year old men showed 59.23% in the no abstract category. This tendency appears to be true for other age groups as well.

In keeping with traditional notions that the probability of accident involvement is fairly small the data was reviewed in the light of Poisson theory. Surprisingly enough the application of a Chi-Square test showed that the Poisson distribution did not fit the California data too well. The author found after some experimentation that the data virtually fell into place when a negative binomial distribution[4] was substituted for the Poisson. This led to a reconsideration of the nature of the underlying data. When the expectation varies from trial to trial as appears to be the case with accident records in this state, then the negative binomial distribution gives results superior to the Poisson distribution.[5] Exhibit II shows the data, by number of abstracts together with the mean frequency, the variance and the ratio of the variance to the mean frequency.[6]

What is the importance of the finding of a distribution which fits the California data? It enables us to do several things:

1. To the extent that abstract records are an accurate linear magnifier of potential accident involvement, such abstract records can be used for individual risk rate adjustment.

2. Inferences as to parameters other than the mean claim frequency may be made (e.g. the California study shows the variance is 1.18 times the mean accident frequency for all abstracts and 1.11 times for 0 abstracts). Tables of expected distributions can be formed.

3. The average claim frequency in a territory, together with an

[4] The author's discovery is developed mathematically in *Some Considerations on Automobile Rating Systems Utilizing Individual Driving Records* by L. Dropkin.

[5] It may be shown that when the expectation from trial to trial is made constant the negative binomial distribution degenerates into the Poisson distribution.

[6] It occurred to the author that some individuals in the 0 abstract category may continue to renew their license although they are not actually drivers and therefore cannot be involved in accidents. Inquiry of the California Department of Motor Vehicles brought forth the reply that there is no known estimate of what proportion of the total such individuals are. Exhibit III indicates the effect of assuming 0%, 5% and 10% of license holders belong in this category. Both the mean and variance tend to increase but the ratio decreases. On a 5% assumption basis those with five or more abstracts would have an average accident involvement frequency 222% higher than the grand average.

estimate of the variance can be used to develop an assumed risk distribution based on the negative binomial distribution. The effect of the application of specific charges can then be predicted.

4. A company which utilizes a merit rating program could then make reasonable predictions of its expected distribution of business in each category and may attempt to measure the success of its individual risk rating program against theoretical expected distributions.

5. Improvements in rules, definitions, underwriting, etc. may be indicated by 4. The mean frequency and variance for each sub-group of the class should be in the same relative rank as the respective rates. Further, the ratio of variance to mean frequency may be used as one test of the homogeneity of the sub-group definition. Such ratio for each of the sub-groups should be less than that of the class as a whole.

Suppose a company determined to use abstracts as a measure of accident potential for ratemaking purposes. Further, suppose the plan which it developed were to be applied to a class and territory where the accident frequency was 10%. In line with Exhibit I, the selected mean accident frequency for risks with no abstracts would be .53 of 10% or 5.3%. Assuming a ratio of variance to mean frequency of 1.10 (the actual Exhibit II figure is 1.113), the estimated variance is 5.8%. Using the negative binomial distribution one should expect the risks to fall into the following grouping:

Number of Accidents	*Risks*
0	95.1%
1	4.6
2 or more	0.3
All	100.0%

Similarly, expected distributions might be computed for 1 and 2 abstracts, etc.

After the plan had been in use, its efficiency might be appraised against the theoretical yardsticks. Again, suppose that actual experience of the company showed the mean frequency to be 5.3% but that the proportion of risks in the no accident category was less than expected and in the one and two or more accident category significantly more than expected. At this point, the company should look to a reconsideration of its rules, definitions, underwriting, practices, etc. as applied to its plan.

It is believed this hypothetical description indicates that a method is at hand for utilization of the negative binomial distribution in a practical way so that the avenues for improved underwriting are opened up. Further exploration of application of the negative binomial distribution in connection with merit plans should be most welcome.

EXHIBIT I

STUDY OF ACCIDENT INVOLVEMENT OF DRIVERS IN CALIFORNIA FOR THREE YEARS ENDED IN 1958 COMPARISON BY NUMBER OF ABSTRACTS

No. of Abstracts	*Accident Involvement*	
	Average	*Ratio to Total*
None	.0866	.531
1	.1935	1.186
2	.2737	1.678
3	.3535	2.167
4	.4262	2.613
5	.5572	3.416
6	.5076	3.112
7	.5022	3.079
8	.5451	3.342
9 or more	.6563	4.024
5 or more	.5531	3.391
TOTAL	.1631	1.000

EXHIBIT II

ACCIDENT INVOLVEMENT ACCORDING TO NUMBER OF ABSTRACTS ON RECORD FOR THE THREE YEAR PERIOD ENDING IN 1958

(FROM THE CALIFORNIA DRIVER RECORD STUDY—1958)

Number of Accidents	*0 ABSTRACTS* *No. of Drivers*	*1 ABSTRACT* *No. of Drivers*	*2 ABSTRACTS* *No. of Drivers*
0	51,365	17,081	6,729
1	3,997	3,131	1,711
2	357	353	262
3	34	41	44
4	4	6	6
5 or more	—	1	1
Total	55,757	20,613	8,753
A. Mean Frequency	8.661%	19.352%	27.37%
B. Variance	9.643%	20.672%	29.93%
C. Ratio B ÷ A	1.113	1.068	1.094

EXHIBIT II (Cont.)

Number of Accidents	*3 ABSTRACTS No. of Drivers*	*4 ABSTRACTS No. of Drivers*	*5 OR MORE ABSTRACTS No. of Drivers*	*ALL ABSTRACTS No. of Drivers*
0	3,098	1,548	1,893	81,714
1	963	570	934	11,306
2	221	138	287	1,618
3	31	34	66	250
4	6	4	14	40
5 or more	1	3	1	7
Total	4,320	2,297	3,195	94,935
A. Mean Frequency	35.35%	42.62%	55.31%	16.313%
B. Variance	39.52%	50.05%	60.96%	19.294%
C. Ratio B ÷ A	1.118	1.174	1.102	1.183

EXHIBIT III

STUDY OF ACCIDENT INVOLVEMENT ADJUSTED FOR EXCLUSION OF NON-DRIVERS ESTIMATED AT 0%, 5%, 10% OF GRAND TOTAL

(BASED ON THE CALIFORNIA DRIVER RECORD STUDY—1958)

ITEM	*EXCLUDING NON-DRIVERS ESTIMATED AT PER CENT OF GRAND TOTAL* 0%	5%	10%
		ALL ABSTRACTS	
Number Excluded	0	4,747	9,493
Total Less Excluded Non-Drivers	94,935	90,188	85,442
A. Mean Frequency	.16313	.17172	.18126
B. Variance	.19294	.20162	.21108
C. Ratio B ÷ A	1.183	1.174	1.165
		NO ABSTRACTS	
Number	0	4,747	9,493
Total Less Non-Drivers	55,757	51,010	46,264
A. Mean Frequency	.08661	.09467	.10438
B. Variance	.09643	.10465	.11436
C. Ratio B ÷ A	1.113	1.105	1.096