Driver Injury in Automobile Accidents Involving Certain Car Models

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ABSTRACT

This study deals with the variation in injury to unbelted drivers involved in crashes while driving various car makes and models. Data were extracted from a pool of reports on 270 thousand vehicles involved in crashes in North Carolina in 1966 and 1968.

Driver injury in each car make was compared to driver injury in the aggregate of all vehicles, and the comparisons were made on the basis of a set of crash circumstances, similar as to speed, impact site, and accident type.

Index scores for many make-year combinations were calculated. It was found that indices ranged among car models from 50 or less (half as frequent injury as in the aggregate) up to 200 or more (twice as frequent injury as in the aggregate).

Injury values tended (as would be expected) to be less frequent among heavier cars and more frequent among lighter cars, and to be less frequent among later model cars and more frequent among earlier model cars. In terms of body style, among the standard Chevrolet, Ford, and Plymouth, drivers of station wagons and hardtops were injured significantly less frequently than in the aggregate.

DRIVER INJURY IN AUTOMOBILE ACCIDENTS INVOLVING CERTAIN CAR MODELS

I. INTRODUCTION

In recent years increasing attention has been given to passenger car safety design, with emphasis on items intended to reduce injury resulting from a crash. Some of these injury-reducing features are common to all newer cars, such as seat belts and head restraints. Other relevant items such as the configuration of control knobs, instrument panel shape and padding, steering wheel stiffness and others are more uniquely identified with the interior design of specific car makes and models.

This is a study of car accidents from the standpoint of the frequency and severity of injury to unbelted drivers. The sample is divided into many subgroups according to the specific make and year of the car driven. The assumption is that if the subgroups are compared on the basis of similar accident situations (speed, impact site, and accident type), then resulting differences in driver injury may be related to car factors. This would seem especially likely if shifts in resulting driver injury coincided with identifiable car changes.

The study is based on analyses of official accident reports filed by police agencies all over the state, and collected by the North Carolina Department of Motor Vehicles.

II. CHARACTERISTICS OF THIS STUDY

Two Collisions: Foremost in understanding what this study is and what it is not, is the difference between "the first collision" and "the second collision." These terms are used to separate accident causation factors from factors that operate during the collision to determine whether the persons involved will be killed, injured, or will escape injury. The second collision is the impact between the human occupant and the interior of the car, and occurs a split second after the "first" collision of the car with some external object.

This distinction is made because it bears on the reason for studying the car itself. While it is possible that car factors play a relatively minor role in the causation of the first collision, it is evident that they play a prominent role in determining the outcome of the "second collision," through safety features, interior design, structural crash properties, etc. This study has no bearing on car factors in accident causation, but deals solely with the matter of resultant driver injuries.*

Determiners of Injury: Several factors influence presence or absence of driver injury, as well as injury degree. Speed is important as is the part of the car sustaining the impact. It is generally worse for car drivers if a truck rather than another car is struck. It is usually worse to strike a fixed object than to strike another car, etc. Thus, one set of factors influencing injury is situational in nature, pertaining to the character of the accident event.

In addition, car variables can play a role. The presence or absence of safety features such as padding on the instrument panel, safety door latches, energy absorbing steering wheels, etc., have a collective influence on driver injury. In addition to these specific characteristics of the driver station, other less "visible" features could be relevant, such as the stiffness and size of the structure. By statistically controlling for the aforementioned situational factors, the stage is set for emergence of car-associated variables in the production of driver injury.

Finally, there is at least the possibility of driver-related injury variables. Under most circumstances one would assume that if a person hits an object, say a broken windshield, the potential for injury should be about the same for one person as for another. However, there is evidence that in roughly comparable accidents, older persons more often die than do younger people.** This possibility was examined by calculating the average driver age for each car group to see whether older drivers are disproportionately represented in car groups that manifest higher injury ratings. It was found that the opposite is true, and older drivers if anything are slightly more associated with cars with lower index values.

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* Another study, now underway at HSRC, will take at least the first step toward dealing with car factors in the "first collision," by amassing data to show the accident rate per million vehicle miles for cars of various makes. In that study the complex relationship between the car and the driver in the production of accidents will be discussed.

** Driver Age and Sex Related to Accident Time and Type," by B. J. Campbell, Cornell Aeronautical Laboratory, Inc., Report VJ-1823-R-19, Buffalo, New York 1964.

report is submitted if someone is injured or killed, or if property damage exceeds $100.00. More than 100,000 accidents were reported in each of the years in question, most involving two vehicles.

For this analysis cases were eliminated if data were so incomplete that they could not be properly classified. Also, due to computer processing problems, some vehicles were excluded in crashes involving more than four vehicles. However, in a rural state like North Carolina, this did not constitute much of an exclusion. Some accidents involve only one vehicle, most involve two vehicles, and some more than two.

The basic data pool from which the rest of the study proceeds consists of information on 270,697 drivers and their vehicles involved in accidents in North Carolina in 1966 or 1968. This large reference set includes drivers of passenger cars, trucks, and other motor vehicles (excluding bicycle and motorcycle operators), and is representative of the whole data set from those years.

In the specific analysis by car models, only passenger cars are compared to the overall reference set. Also, because of insufficient numbers, certain cars were not shown in the analysis though they were included in the reference set. Moreover, cars prior to 1960 models were not analyzed individually, but they, too, were in the reference set.

IV. DATA PROCESSING

As a part of the in-processing routine of all accident reports received by the North Carolina Department of Motor Vehicles, certain information on each driver and each vehicle is keypunched and later transferred to computer tape. This data processing is done jointly by the Department of Motor Vehicles and the State Highway Commission. As a part of the process, copies of the cards or tape are provided to the University of North Carolina Highway Safety Research Center for use in many special research projects of which this is one.

Unfortunately, not all information necessary to this study is routinely punched from the report forms onto cards. The key missing variable is the car's Vehicle Identification Number (VIN). It was therefore necessary to prepare 300,000 or more supplementary punched cards to add the necessary information. These supplementary cards were transferred to tape, then they were matched, item by item to the original materials in order to join the VINs with the proper accident cases. Once the data were on tape, an extensive process of classifying, editing, and data analysis began. This is described in the next section.

Driver injury data in this study are quite general, and do not reflect either the specific part of the body involved or the part of the car contacted in producing the injury. Therefore, this analysis must be regarded as more of an overall indication of any car-injury association, rather than a direct evaluation of particular car features.

Statistical Association and Cause and Effect: A word should be said as to the general question of any association between driver injury and certain car groups. In a purely statistical study such as this one, an association may be shown, and the data may suggest possible explanations for the relationship. However, the statistical results must also be considered in view of known engineering features and structural characteristics of the cars in question.

If the statistics indicate that a certain model car appears much better in one year than in the preceding year, then the question is whether relevant engineering changes occurred between those years which might have accounted for the injury shift. Sometimes a design change may be quite obvious, such as addition of an energy absorbing steering assembly. Other times the change in injury might be associated with a much less obvious car characteristic, such as a change in the stiffness of the structure.

Sometimes of course the injury shift may appear when no known relevant engineering change was introduced, or on the other hand, no injury shift may be detected when in fact a significant structural change was made. In these cases, the injury data could be called into more serious question. When there is a correspondence between a shift in injury statistics and a physical change in the car, then the indications could be regarded as stronger.

III. THE DATA BASE

Data for this study are based on police reported accidents that occurred in North Carolina in 1966 and 1968. The data base contains materials from all reporting police agencies including the State Highway Patrol, city police and others. Accident reports submitted by the police are public documents under North Carolina law, and nearly all police agencies use the standard form specified by the North Carolina Department of Motor Vehicles. (A copy is shown as Appendix 1.)

Reporting is widespread, and there are no known "holes" in the reporting system in the sense of sizable cities not reporting, etc. The quality of reporting varies over the range that one expects in this kind of data. Some reports are very poor while others are quite good. A

V. STUDY VARIABLES

The variables in this study include:

1. Speed of car
2. Site of impact on car
3. Type of accident
4. Injury to driver
5. Year of car
6. Make and body style of car

<u>1. Speed of Car</u>: The police officer is provided a space on the accident report form for the estimated speed of each vehicle just before onset of the accident process. For analysis purposes, in single vehicle-crashes, this speed is used directly. In two-vehicle front-rear crashes, the difference in the two speeds is used. In front-side or front-front crashes, the highest speed reported for either car is assigned to <u>both</u> cars. Thus, if a parked car (zero mph) is struck by a car traveling 30 mph, then the value of 30 mph is assigned to both cars.* This is not a particularly sophisticated way of handling speeds, but is felt to be refined enough, considering possible errors in speed estimates, and also considering the fact that the speeds were rather grossly grouped as follows.

Lower Speed Group - 0 to 29 mph
Middle Speed Group - 30 to 49 mph
Higher Speed Group - 50 mph and greater
Unspecified Speed Group - speed not reported

<u>2. Site of Impact on Car</u>: Each car was classified according to the part of the car on which the principal damage was located. The groupings were as follows:

Front
Right Side
Left Side
Rear
Unspecified

Obviously in some crashes, damage is sustained on more than one part of the car, but the officer usually only reports one area of damage, and that is usually the area of most severe damage. Note that the unspecified category is more than just those cases in which no report is made. It includes most of the single-vehicle, ran off-road-crashes, and therefore includes most of the overturn accidents.

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* Because of complications, in the event of a 3-or-more car crash, each car was assigned its own speed without reference to the other cars. All these cars are placed in the multiple-vehicle category.

3. Type of Accident: The data were also classified according to type of crash, and the following categories were used:

Car ran off roadway
Car hit fixed object (in roadway area; including railway trains)
Car hit other object (in roadway area)
Car collided with other car
Car collided with truck
Cars in crashes involving 3 or more cars
Other crashes

The first category includes all vehicles that ran off the roadway before striking any object, and includes those that went off the road and struck a tree as well as those that went off the road and rolled over without striking anything.

In reference to the "multiple" vehicle category, all cars in a 3-or-more vehicle crash are included in the Multiple-Vehicle class. When the number of cars exceeded 4, the cars depicted on the "trailer cards" were eliminated because of processing difficulties.

Both vehicles in a car-to-car crash are classified. If one car strikes the other in the side, both are placed in the car-vs.-car category. One is classed as having struck with the front, and the other is classed as having been struck on the side. If a car and a truck collide, both are placed in the car-vs.-truck category (for purposes of defining the reference group). If two trucks collide, both are placed in the "other" category.

It was possible to classify nearly all cases with respect to these variables. The principal cases that were discarded in this edit-check process were those that had "illegal" punches on the card, some vehicles in 4- or-more vehicle crashes, and vehicles that struck bicyclists, pedestrians, or animals.

4. Injury to Driver: Driver injuries are classified by the officer at the scene (or on the basis of the officer's follow-up investigation). The classification follows the nationally used Manual on Classification of Motor Vehicle Traffic Accidents, (USA Standards Institute Standard D 16.1), National Safety Council, Chicago, 1962. On page 14 of this manual, injuries are classified on a five-point scale as follows:

1. no injury

2. "C" injury. Non-Visible Injury - is a complaint of pain without visible signs of injury, or momentary unconsciousness.

3. "B" injury. Minor Visible Injury - is an abrasion, bruise, swelling, limping or obviously painful movement.

4. "A" injury. Serious Visible Injury - is a bleeding wound, distorted member, or any condition that requires the victim to be carried from the scene of the accident.

5. Fatal injury. An injury that results in death within 12 months of the accident.

It should be noted here that while the definitions manual provides that death within one year following the accident (and directly attributable thereto) is counted as a motor vehicle fatality, and while the state and national figures are corrected for such delayed fatalities, and while the relevant accident report forms themselves are corrected where possible, it is nevertheless true that the accident report itself may not always be corrected. Therefore, there may be at least some cases in which the driver is reported as having an "A" injury based on the situation a few days following the crash, but the patient eventually dies. In those cases in which the records are not updated such an event would sometimes be counted as an "A" injury.

In order to compare all driver injuries on the same basis, the study deleted from each specific make-model group those drivers who were reported as wearing a seat belt. A separate study will deal with seat belted drivers.

5. Year of Car: The accident report form includes a space for the officer to record the make and year of the vehicle in question. Whatever year the officer records is transcribed to computer tape and used in this study as the year of the car. There is, however, one circumstance in which the computer program overrides the officer's year designation. This is based on the fact that the VIN has a digit or letter denoting the year of the car.

Therefore, if all three of the following conditions hold, , the the computer program overrides the officer's year designation: (1) the officer's year designation is inconsistent with the VIN, (2) the VIN appears correct in every respect (this implies several consistency checks) and (3) the year indicated by the VIN is only one year different from the officer's entry.

When all these conditions are met, the computer program substitutes the year indicated in the VIN in place of the year indicated by the officer. If the officer's entry disagrees with the VIN by more than one year, the case is discarded.

This procedure is based on the assumption that with cars a few years old the officer may designate the correct make, and may be able to recall the "vintage" of that particular car within a year or so, but he may be unable to recall the specific year. Such an occurrence is reasonable in view of the fact that sometimes only minor styling changes differentiate the external appearance of one year's model from the next.

6. Make and Body Style of Car: On the accident report form, the officer is instructed to write down the make of the car, and of course many spelling variations are seen. For example, the officer may write down "Ford" or "Galaxie" to designate a standard-sized Ford, or he may write "Chevelle," "Malibu," "Chevrolet," "Chevy," or "Chevvy" to indicate the Chevelle series. The computer program first reads the officer's English language indication

of the make, using only the first four letters of the word. The program accepts many spellings. Thus, the following initial spellings would be accepted and would activate the computer search program:

Dodg
Ford
GTO
Dart
Plym
Must (ang)

Spellings to be used were decided with assistance of a dictionary of all spellings in the entire data file. All but the least common are included. The various spellings that might represent a particular make of car are then channelled into the same computer program routine.

Next, the VIN written down by the officer is checked by the computer program. The question is two-fold. First, does the VIN indicate the same brand of car the officer indicated? And, second, is the VIN formatted properly and acceptably?

The VIN varies from 6 to 13 characters, and has both alpha and numeric characters. The format of the VIN varies from corporation to corporation within the same year, and from car line to car line within a single corporation in a single year. Sometimes, for example, the model year is indicated by a number and sometimes by a letter; sometimes the year designation is the first character in the string, and sometimes it is in another position.

In any event, for a car to be accepted as a given make, the VIN must be formatted properly for that particular car make in terms of number of characters, proper placement of alpha and numeric characters within the sequence, and also "legality" of characters in a given position. As an example, one corporation designates the factories where the car was made by a letter in a certain position, and not all letters are used; therefore, the program will accept only a correct letter in that particular position. For some campanies the VIN is just a sequence number which does not carry any information, and does not therefore lend itself to any checks.

Naturally, this detailed checking process resulted in the elimination of many cars because the reported VIN was not correctly formatted. The recording error could have been committed by the policeman at the scene, trying to copy the number under less-than-ideal conditions, or it could have been a clerical error in the various transcriptions of the data. Perhaps it is not beyond the realm of possibility that the number may even have been affixed erroneously at the factory.

In preparing the computer program to ascertain car make from VIN, the reference materials were:

Motor Vehicle Identification Manual, National Automobile Theft Bureau, published by Palmer Publications Company, Downers Grove, Illinois.

NADA Official Used Car Guide, published by National Automobile Dealers Used Car Guide Company, Washington, D. C.

Unfortunately, these two books did not always agree exactly as to VIN for a given make, but in such cases we allowed for both possibilities. (Appendix 2 gives further details of how the computer program works.)

As a result of the computer program, very many make-model-body style combinations were uniquely identified -- several hundred, in fact. These were eventually consolidated into 49 American and 6 foreign car groups. Each of these 55 groups were subdivided according to model year beginning with 1960 models and going through and including 1968 models. (The reference group, however, included models prior to 1960.)

Of the 55 car groups, there were many for which the sample size was not sufficient for analysis. No data were shown for any make-year combination if fewer than 100 cases were available. As a result, only 35 of the 55 car groups are presented in this analysis. Later reports, based on a larger sample, will include models not shown in this initial report.

These 35 groups represent a great reduction from the hundreds (if not thousands) of groups that would have resulted if data had permitted use of every single variation in car "nameplate." Even for the 35 groups used, we adopted a process of consolidating models where the basic car is very much the same except for trim variations or luxury features. For example, in the case of the standard-size Chevrolet, we combined the Impala, Biscayne, Bel-Air and Caprice. The group was called standard Chevrolet and included all body styles of these cars. In defining the group of large Pontiacs (those with the longest wheel base), the Star Chief and the Bonneville designations were combined. A complete constituency of the make-model groups is given in Appendix 3.

VI. ANALYTICAL DESIGN OF THE STUDY

The general approach of the study is to define a large reference group which is, as nearly as possible, the aggregate of all crashes. Injuries of all drivers in this reference group are depicted. Then, one by one, the drivers of individual groups of specified passenger cars are compared to the reference group. This is done by comparing injuries of unbelted drivers of each given car make to injuries in the reference group. The reference group depicts injuries to 270,697 drivers whose injury distribution is as follows:

Table 1: Reference Group: Driver Injury Distribution

	Total	Not Injured	"C" Inj.	"B" Inj.	"A" Inj.	Killed
N	270,697	226,947	11,027	11,474	19,900	1,349
%	100.0	83.8	4.1	4.2	7.4	0.5

As can be seen in Table 1, more than 80 percent of the drivers escaped injury altogether, and one-half of one percent were killed. About seven and one-half percent suffered class "A" injuries -- the most serious category short of death. Combining the two most serious categories (as will be done throughout this report) reveals that nearly eight percent of all drivers sustained serious injury or were killed.

The total reference group is, of course, an "average" summed over all types of accident conditions. Some specific accident conditions are milder than average, and some are more serious than average. To illustrate this, the 270,697 drivers are divided according to the speed categories as earlier defined. Forty-five percent were in the lowest speed group, 32% in the middle group, 16% in the highest group, with about 8% not specified. The injury results for these speed groups are shown below:

Table 2: Reference Group: Driver Injury Distributions for Varying Speed Categories

		Total	Not Inj.	"C" Inj.	"B" Inj.	"A" Inj.	Killed
Lower Speed	N	120,796	109,641	4,830	2,920	3,316	89
0-29	%	100.0	90.8	4.0	2.4	2.7	0.1
Middle Speed	N	85,500	70,339	3,637	4,356	6,915	253
30-49 mph	%	100.1	82.3	4.3	5.1	8.1	0.3
Higher Speed	N	43,692	30,811	1,697	3,197	7,339	648
50 mph and more	%	100.0	70.5	3.9	7.3	16.8	1.5
Speed Unspecified	N	20,709	16,156	863	1,001	2,330	359
	%	100.0	78.0	4.2	4.8	11.3	1.7
TOTAL	N	270,697	226,947	11,027	11,474	19,900	1,349
	%	100.0	83.8	4.1	4.2	7.4	0.5

Table 2 shows that in the lowest speed group, a little more than 90 percent of the drivers escaped injury, and only a very small fraction of one percent were killed. In contrast, in the highest speed group only 70 percent escaped injury and 1.5 percent were killed. In the highest speed group, the percentage killed is 15 times as high as in the lowest. The unspecified speed group is characterized by severe injuries. Officers sometimes use this speed category when the speed is high, but they do not feel they are able to give a good estimate.

Additional insight into the characteristics of the reference group can be obtained by dividing it another way, this time by impact site on the car. From Table 3 it can be calculated that 49% were involved in front impacts, 5% on the right, 6% on the left, 23% on the rear, and for 17% the impact site was unspecified.

Table 3: Reference Group: Driver Injury Distributions for Various Car Impact Sites

		Total	Not Inj.	"C" Inj.	"B" Inj.	"A" Inj.	Killed
Front Impact	N	132,587	114,902	3,837	5,010	8,342	496
	%	100.0	86.7	2.9	3.8	6.3	0.4
Right Side	N	13,648	12,062	371	423	727	65
	%	100.0	88.4	2.7	3.1	5.3	0.5
Left Side	N	15,829	13,460	696	659	914	100
	%	100.0	85.0	4.4	4.2	5.8	0.6
Rear Impact	N	61,393	55,366	3,943	1,030	1,005	49
	%	100.0	90.2	6.4	1.7	1.6	0.1
Unspecified	N	47,240	31,157	2,180	4,352	8,912	639
	%	100.0	66.0	4.6	9.2	18.9	1.4
TOTAL	N	270,697	226,947	11,027	11,474	19,900	1,349
	%	100.0	83.8	4.1	4.2	7.4	0.5

With respect to drivers killed, rear impacts, as would be expected, are the least severe, while front and side impacts have a percent killed that is about 5 times higher. The percent of drivers that escape injury also reflects this relationship. Most severe is the unspecified impact, in which the percent killed is 14 times as great as the rear impact, and the percent drivers not injured is the lowest of any of the groups. This category is known to include many crashes involving leaving the road, overturn and driver ejection. Note that injury associated with impacts on the left side -- proximate to the driver, may be a little more severe than those on the car's right side.

Still another way of examining the characteristics of the reference group is to subdivide according to type of impact. In this respect 55% of the 270,697 drivers were in Car-vs.-Car crashes, 17% ran off the roadway, 15% were in Car-vs.-Truck encounters, 8% were in Multiple-Vehicle crashes, about one percent collided with fixed or other object in the roadway area, and finally, about 4% were in other types of crashes. Table 4 shows the driver injury experience associated with each of these crash types:

Table 4: Reference Group: Driver Injury Distribution for Various Accident Types

		Total	Not Inj.	"C" Inj.	"B" Inj.	"A" Inj.	Killed
Ran Off Road	N	45,007	29,532	2,100	4,140	8,625	610
	%	100.1	65.6	4.7	9.2	19.2	1.4
Hit Fixed Obj.	N	1,635	1,222	46	109	232	26
	%	100.0	74.7	2.8	6.7	14.2	1.6
Hit Other Obj.	N	1,744	1,199	69	200	258	18
	%	100.1	68.8	4.0	11.5	14.8	1.0
Car vs. Car	N	149,987	132,634	5,768	4,600	6,663	322
	%	99.9	88.4	3.8	3.1	4.4	0.2
Car vs. Truck	N	41,143	36,614	1,394	1,078	1,861	196
	%	100.0	89.0	3.4	2.6	4.5	0.5
Mult. Vehicle	N	20,950	17,632	1,297	740	1,215	66
	%	100.0	84.2	6.2	3.5	5.8	0.3
Other	N	10,231	8,114	353	607	1,046	111
	%	100.0	79.3	3.5	5.9	10.2	1.1
TOTAL	N	270,697	226,947	11,027	11,474	19,900	1,349
	%	100.0	83.8	4.1	4.2	7.4	0.5

Note that the most common group, car vs. car, is the one in which the percent killed is lowest, and the Car-Ran-Off-Road and Car-Hit-Object groups show a percent killed that is 5 to 8 times as high. Naturally, speed is part of the reason -- since many Car-vs.-Car Accidents are at low speed, whereas many Ran-Off-Road crashes are at high speeds.

This, in fact, is the primary reason why the foregoing three variables cannot really be treated separately. The fact is that speed, site of impact, and type of collision are not independent -- there is considerable interaction among them. An example of this interaction is seen in contrasting the Car-vs.-Car category and the Car-Ran-Off-Roadway category. Within these two categories the distribution of speed and impact site differs sharply from one to the other. Speeds are higher in the Ran-Off-Roadway group than in the Car-vs.-Car group. In addition, impact site is different. In the Car-Ran-Off-Roadway category, almost all impacts were reported as unspecified.

In view of all these foregoing characteristics, the reference group is divided into 108 subgroups -- each representing a unique combination of speed, impact site, and accident type. Within each of the 7 accident types, there are potentially 5 impact site categories, and within each of these, the 4 speed categories can appear. If every combination existed, there would be 7 x 5 x 4 = 140 categories. However, only 108 are used in this matrix, because some of the combinations either did not occur at all among the 270-thousand data elements, or occurred so few times that their inclusion was not warranted. Appendix 4 shows the complete format of the 108 categories in the reference group, including all the injuries observed in the various categories.

In summary, the constituency of the reference group is as nearly as possible like the aggregate of all vehicles on the road. It includes belted and unbelted drivers, male and female, drivers of cars as well as trucks, and drivers in severe accidents as well as minor ones. This exact same reference group is used as the baseline against which unbelted drivers of each passenger car model are compared.

VII. COMPARING INDIVIDUAL CAR GROUPS TO THE REFERENCE GROUP

The reason for dividing the reference group into 108 accident situations is to facilitate closer comparison between the various individual car makes and the reference group. Without this, the comparison might not be fair. Consider the following example: It was shown in Table 1 (p.10) that in the overall reference group, a total of 7.9% of the drivers sustained injuries that were either degree "A" or killed. Suppose it were found in car "X" that 12% of the drivers sustained injuries of the "A" or "Killed" variety. That would be an amount more than half again as frequent in Brand X as in the aggregate of all cars. Would this be a fair comparison of the safety of Brand X relative to the reference group? Not necessarily.

If, as a group, Brand X cars happened to be involved in many high-speed crashes, then the number of drivers sustaining serious injuries would naturally be higher because of the higher speed. On the other hand, if Brand X cars had been involved in the same variety of crashes as the reference group, then the comparison would be more meaningful. The point is that there is no guarantee that the variety of accident conditions to which one car happens to be exposed will be the same as that to which another is exposed.

In order to achieve a fair comparison, it is necessary to compare "Brand X" to the reference group on the basis of the same variety of crashes. This is where the reference matrix with its 108 specific conditions comes into play. Each given car is compared to the reference group on the basis of the same conditions. The computer program first allocates all Brand X cases into the same 108 accident situations as the reference group. Then the computer compares injuries to unbelted drivers of Brand X with injuries in the reference group with respect to Condition 1. The results of the comparison are noted. Then, the drivers of Brand X car and the drivers in the reference group are compared with respect to condition 2 -- then condition 3, and so forth through the 108 situations. Finally, the individual outcomes are summed over the 108 conditions, weighted according to the frequency of each condition in Brand X cars, and an overall comparison is effected. This final overall comparison is based on comparable crash conditions.

Specifically, an expected injury value is calculated for each matrix line based on reference group injuries. The expected value is the frequency of the injury among "Brand X" car drivers that would have occurred if the proportion had been the same as in the reference group. The expected values are compared to those observed in the same matrix line on the Brand-X side. Expected and observed values are summed over the matrix and tested by Chi Square. A modified variance is used (see Appendix 5).

An injury index is used to describe the results. This is simply the ratio of the total observed value divided by the total expected value times 100. An index value of 100 would mean that under the same variety of crash conditions, driver injuries in Brand X cars are no more or no less frequent than in the aggregate of all cars. An index of 120 would indicate that under the circumstances that produced 100 injuries in the reference group, 120 injuries occurred in Brand X -- about the same as saying that injuries were 20% more frequent in Brand X. An Index value of 85 would mean that only 85 injuries occurred in Brand-X cars whereas 100 injuries would be sustained in the reference group under the same variety of accident circumstances. Depending on the size of the associated Chi Square value, these indices may or may not reflect a statistically significant departure from the reference group. If the sample is very large, an index of 110 may be significantly greater than the aggregate. On the other hand, if the sample is small, then an index of even as much as 200 may nevertheless not be statistically significant.

Throughout this study, two different injury indices are used. One is a comparison of each make-year combination to the aggregate with respect to the number of driver injuries <u>of any kind</u> reported (this is the sum of "C," "B," "A," and Killed as defined on p. 6). The other injury indicator deals with <u>severity</u> of driver injury and is based on the frequency of injuries serious enough to be classified as "A" or Fatal. Not enough data are available at this time to warrant using fatal injuries alone as an index.

VIII. RESULTS: General

The results of this study contain few if any surprises. First, trends show that cars in general have been improving over the last few years. Driver injuries are less frequent and less severe under comparable crash circumstances in the later model years than in earlier years. This is expected in view of the increased attention to safety design in the last few years. Indeed, the surprise would be if no improvement were noted, which would happen only if the combined effect of <u>all</u> the safety features produced no benefits.

The second general trend relates to car size. As has already been indicated in the literature,* injuries tend to be more severe in smaller cars than in larger cars under comparable conditions. The data in the present study show that larger cars like the standard Ford and Plymouth, and the larger-than-standard cars like Pontiac show generally less injury than average, while smaller cars like Chevy II, Falcon, and Volkswagen show generally more than average injury.

The third point is that when various model years of the "Big 3" are combined and then re-divided by body style, it is found that drivers of 4-door station wagons and 2 and 4-door hardtops sustain significantly fewer serious and fatal injuries. None of the other body styles of the "Big 3" are <u>significantly</u> lower than average, although all the rest of the body style index values are slightly less than 100.

The fourth comment concerns the truly staggering data requirements for this kind of analysis. There are so many make-model-year combinations, and so many body styles that the number of unique car groups eligible for analysis is in the thousands. Furthermore, in order to be able to analyze effectively the performance of any given make-model-year combination, it is desirable to be able to study a large sample of the car in question.

This means that for a low-volume car like the Corvette it may be that even if all current model year crashes in the entire nation in a year were compiled, there might still be an insufficient sample for analysis. On the other hand, for popular makes there are adequate data from just North Carolina. Consequently, if public policy dictates the kind of analysis illustrated in this report, then the data base should be many times the size of the one used in this study.

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* "Automobile Crash Injuries in Relation to Car Size," Cornell Aeronautical Laboratory, Buffalo, New York, 1964, VI 1823R11, B. J. Campbell, J. K. Kihlberg, and E. Narragon.

* "A Study of Volkswagen Accidents in the United States," Cornell Aeronautical Laboratory, Buffalo, New York, 1968, VJ 1823R32, J. W. Garrett and A. Stern.

IX. RESULTS: Injury by Car Make

Group I. "The Big 3" (Standard Chevrolet, Ford, and Plymouth)

Perhaps the easiest way to show the character of the results is to report first the injury indicators for the "Big 3" automobiles -- the standard-size Chevrolet, Ford, and Plymouth (Groups 6, 22, and 32 in Appendix 3). Figure 1 shows the driver index values for these three cars for model years 1960 through 1968, with respect to "all injury." Figure 2 shows the same models for the injury index "A + K" (or serious plus fatal injuries).

In Figure 1 each index is plotted as a point on a graph, and the index value is printed beside the point. Sample size is indicated by the number in parentheses following the car make. A single asterisk along side means that the index value is associated with a Chi Square large enough to be significant at the five percent level. Two asterisks means the one percent level.

First, with respect to the index of any driver injury, Figure 1 shows that only two points fall above the 100, or average line, and neither of these (the 1960 Plymouth and the 1961 Ford) even remotely approaches a significant elevation.

All of the remaining values fall on the less-than-average-injury side, and in seven cases the value is significantly below. The ones that are statistically significant have indices in the range of 79 to 91, roughly equivalent to a 10 to 20 percent lower frequency of injury in those cars than in the average of all cars. There is very little difference among the "Big 3," and little suggestion of any systematic advantage or disadvantage of one or the other.

Figure 2 depicts the results of the same type comparison, but this time with respect to the frequency of serious and fatal injuries. The results are about the same as already shown except that there is more variation in the observed values, and only four are significantly below the aggregate.

Summing up Figures 1 and 2, the indications are that (a) most of the values are on the "better-than-average side," (b) there is a slight tendency for the more favorable injury values to fall among the later models, and (c) the "Big 3" differ little from one another.

Readers who have interest in the details of the study may wish to know the exact procedures by which a given index is calculated. For each of the values in Figure 1 (and all following Figures) there is a computer printout. When sample size is sufficient, this printout shows the comparison of that particular make to the reference group with respect to each of the 108 accident situations specified. The printout also shows the summaries and statistical test results. For illustration, Appendix 6 shows the complete printout for the 1960 Ford.

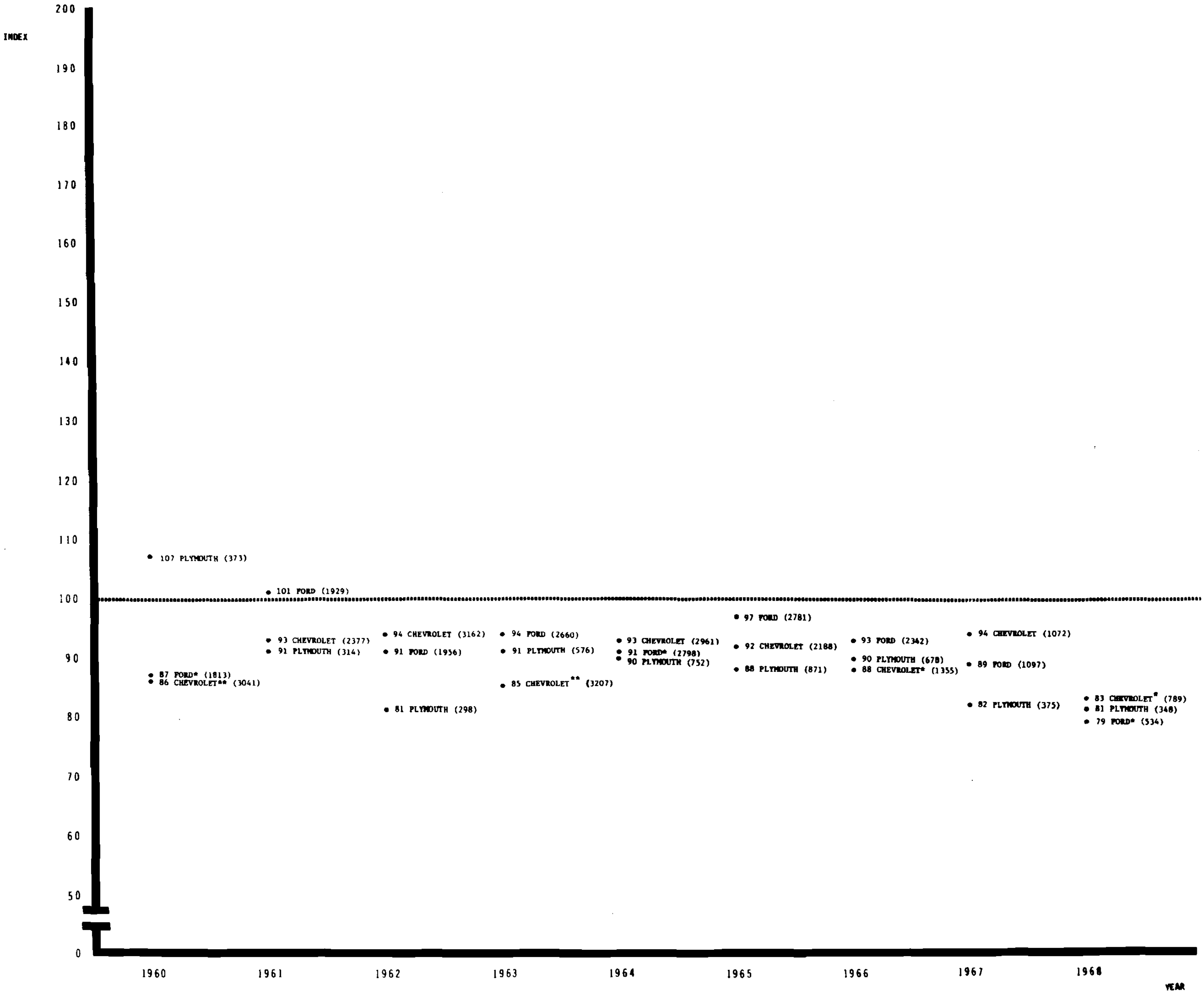

FIGURE 1. DRIVER INJURY INDEX VALUES IN "BIG 3" AUTOS, (APPENDIX 3 -- GROUPS 6,22,32)

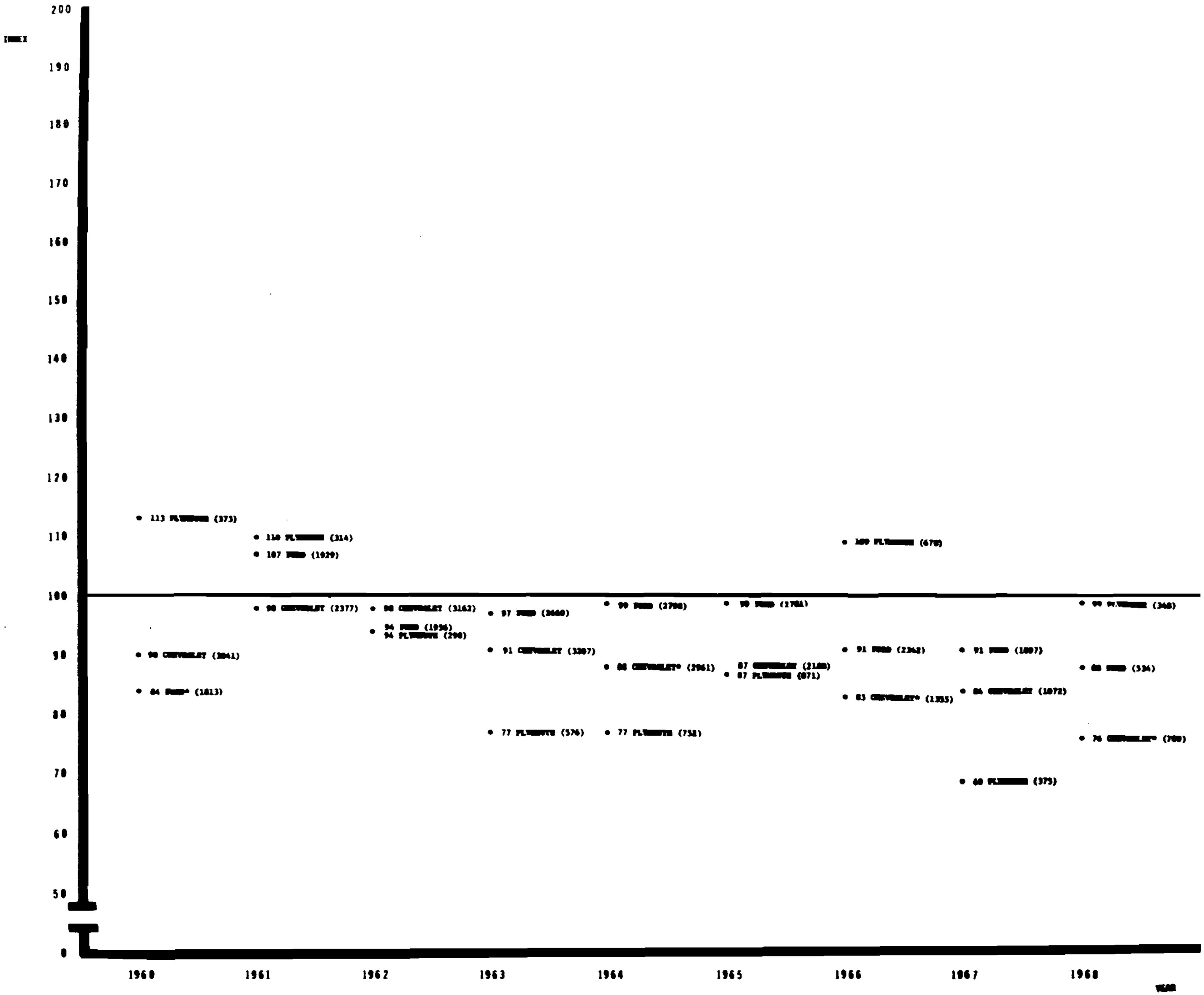

FIGURE 2. SERIOUS + FATAL DRIVER INJURY INDEX VALUES IN "BIG 3" AUTOS. (APPENDIX 3 -- GROUPS 6,22,32)

Space limitations rule out inclusion of such information for each car group; however, the detailed information for each car can be produced for further study. As a service to the reader, Appendix 7 contains a summary table for each make-model-year combination reported, giving the sample size, expected and observed values, the Chi squares, and the index values.

The statistical procedures used in this study consist of testing each car model against the same aggregate reference group. This does not provide a direct comparison of one model to the other. For example, from Figure 1 it can be said that among 1966 models, driver injuries in the Chevrolet are significantly different from the aggregate. This does not, however, necessarily indicate that Chevrolet had fewer driver injuries that year than drivers of Fords or Plymouths.

Since each car is compared to the same reference group, there is a temptation to compare them to each other. However, to be able to do this would require a separate statistical comparison of each car to every other car -- this would be too many thousands of comparisons to be handled by the present computer procedure -- not to mention the problems of trying to describe, classify, and interpret these comparisons. (The data do, however, lend themselves to this kind of analysis, and such could be undertaken later.)

On the basis of the present analysis it is possible to say that one model is higher or lower than another model when one is significantly above the aggregate, and the other is significantly below the aggregate.

Group II: The Largest Cars (such as Buick Electra, Dodge Monaco, Oldsmobile 98, Pontiac Bonneville, etc.

Figures 3 and 4 depict injuries, and serious and fatal injuries, respectively, among drivers of the largest cars analyzed. These include the largest of the Buick, Oldsmobile, Dodge, and Pontiac cars (Groups 1, 12, 17, 26 in Appendix 3). Indices are shown only when the sample size of a given car is 100 or more. Thus, in Figure 3 it is not the case that all four cars appear for every model year.*

Figure 3 shows that with respect to driver injury frequency, most of the twenty values shown are on the lower-than-average side. Of the two values that are statistically significant, the 1965 Dodge is above the line with an index of 139, and the 1967 Buick is below the line with an index less than 50.

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* Many other cars do not appear in this study at all, and for the same reason of too small sample size. For example, this study does not deal with large cars like Cadillac, Lincoln, or Imperial, or certain specialty cars such as the American Motors AMX, and many other cars because the presently available accident data pool does not contain a sufficient sample of these cars.

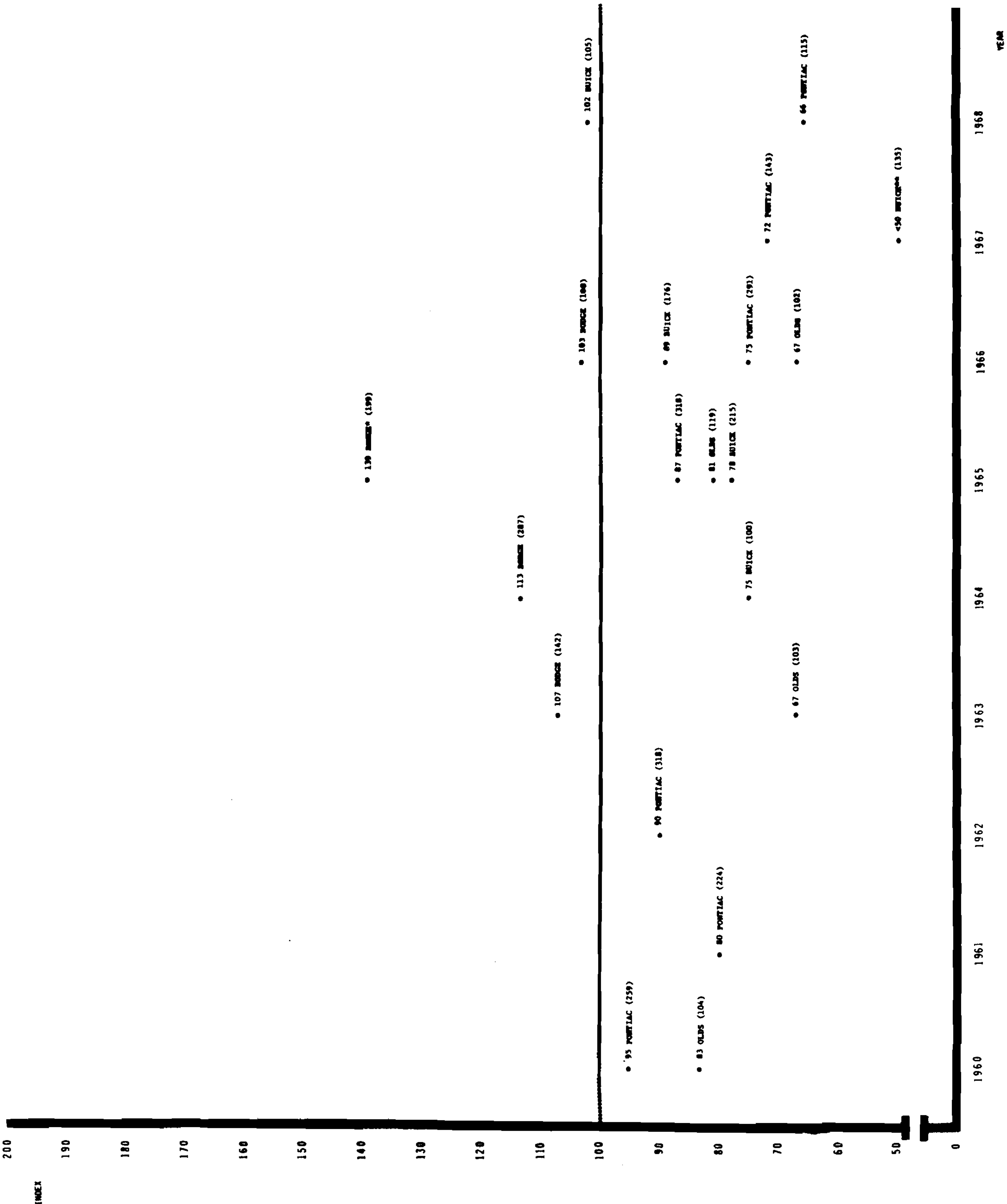


FIGURE 3. DRIVER INJURY INDEX VALUES IN BUICK ELECTRA, DODGE MONACO, OLDSMOBILE 98, PONTIAC BONNEVILLE (APPENDIX 3 -- GROUPS 1,12,17,26)

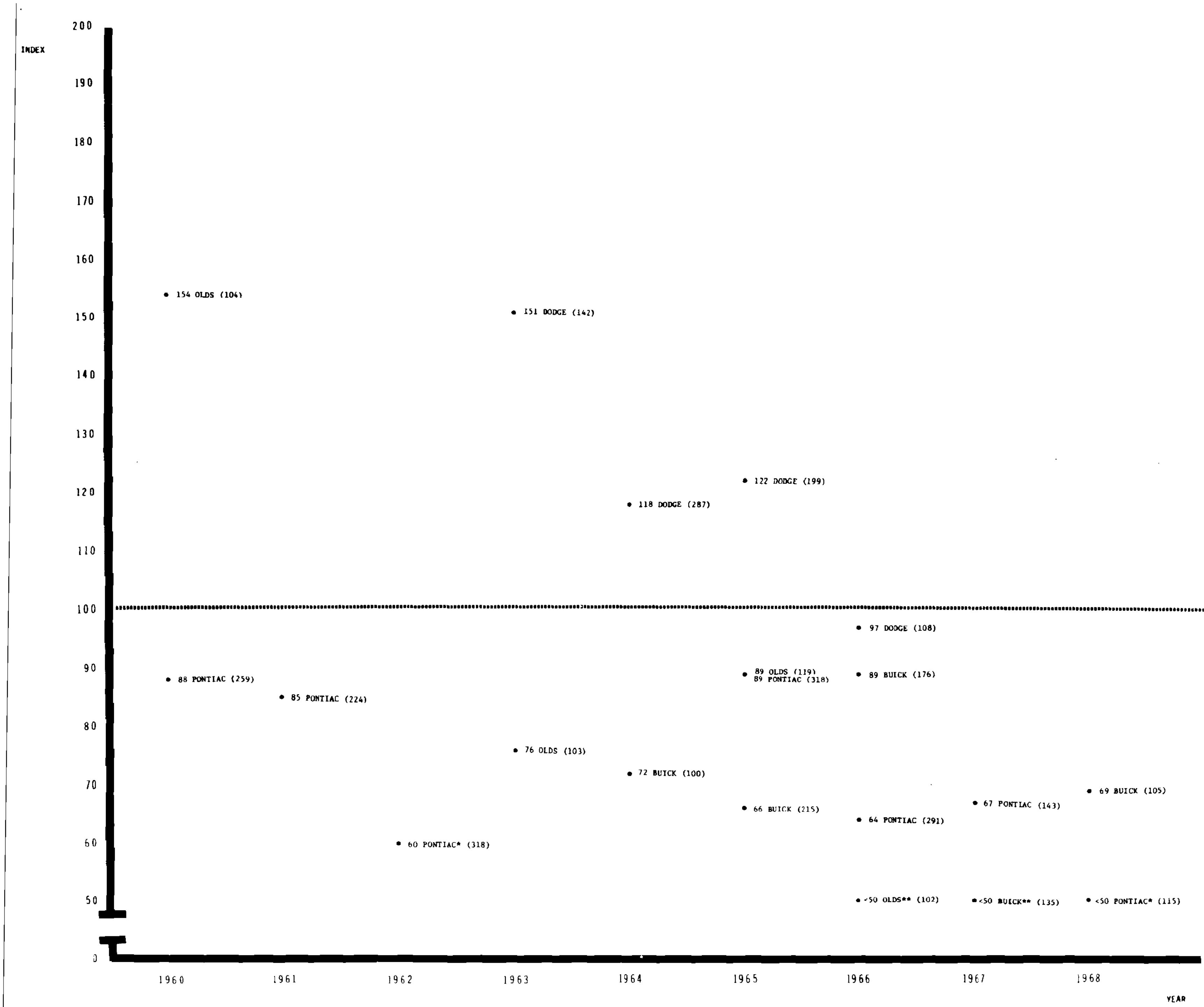


FIGURE 4. SERIOUS - FATAL DRIVER INJURY INDEX VALUES IN BUICK ELECTRA, DODGE MONACO, OLDSMOBILE 98, PONTIAC BONNEVILLE (APPENDIX 3 -- GROUPS 1,12,17,26)

Figure 4 shows the results for serious and fatal injury. As before, only cars with sample size 100 or greater are shown. Of the twenty cars shown, most are below the line and four are significant: the 1966 Oldsmobile, 1967 Buick, and 1962 and 1968 Pontiac all have indices of 60 or less.

In Figures 3 and 4, General Motors products are the most frequent. This is a result of the great volume of GM cars on the road. Sample sizes for GM cars tend to be large enough to yield statistically meaningful results. Other cars in this size class were not present in the sample in quantities requisite for inclusion in the analysis. As larger quantities of data are amassed later, it will become possible to include other models.

The only hint of a trend in Figures 3 and 4 is that all but one of the Dodge values is on the higher-than-average-injury side of the line, and one of these is statistically significant. In contrast to Dodge all but 2 of the other cars are below the line.

With respect to serious and fatal injuries, the earlier model years do not show as favorable an injury experience as the later models. There is a considerably greater range in the injury indices among these cars than was seen for the "Big 3," but this would be expected in view of the smaller sample sizes.

Group III: Standard Size Buick, Dodge, Mercury, Oldsmobile, Pontiac (such as the Buick LeSabre, Dodge Seneca and "440," Mercury Monterey, Olds 88, and Pontiac Catalina)

Figures 5 and 6 respectively portray injuries, and serious and fatal injuries, to unbelted drivers of cars one step larger than the "Big 3." In each case the models are compared to the same reference group as before. The models in this group are defined by Groups 2, 13, 18, 27, and 37 in Appendix 3.

The overall indications are rather like those seen in the preceding groups. That is, (a) most of the values are not significantly different from the mean line, (b) most of the values are on the better-than-average side of the line, (c) those that are significant are in the lower than average injury direction, and (d) there is a slight trend toward lower injury values for the later model cars.

In Figure 5 (depicting the relative frequency of all driver injuries), values are shown for thirty-six cars, of which five are significantly lower than the baseline -- the 1962, 1964, and 1965 Olds, and the 1965 and 1968 Pontiac. As can be seen, other cars have similar index values but are based on smaller samples or else are not quite as far away from the mean line, and are not statistically significant.

In Figure 6, concerning the relative frequency of serious and fatal injuries, three of the thirty-six values are statistically significant on the lower-than-average side; the 1962 and 1966 Olds and the 1968 Pontiac.

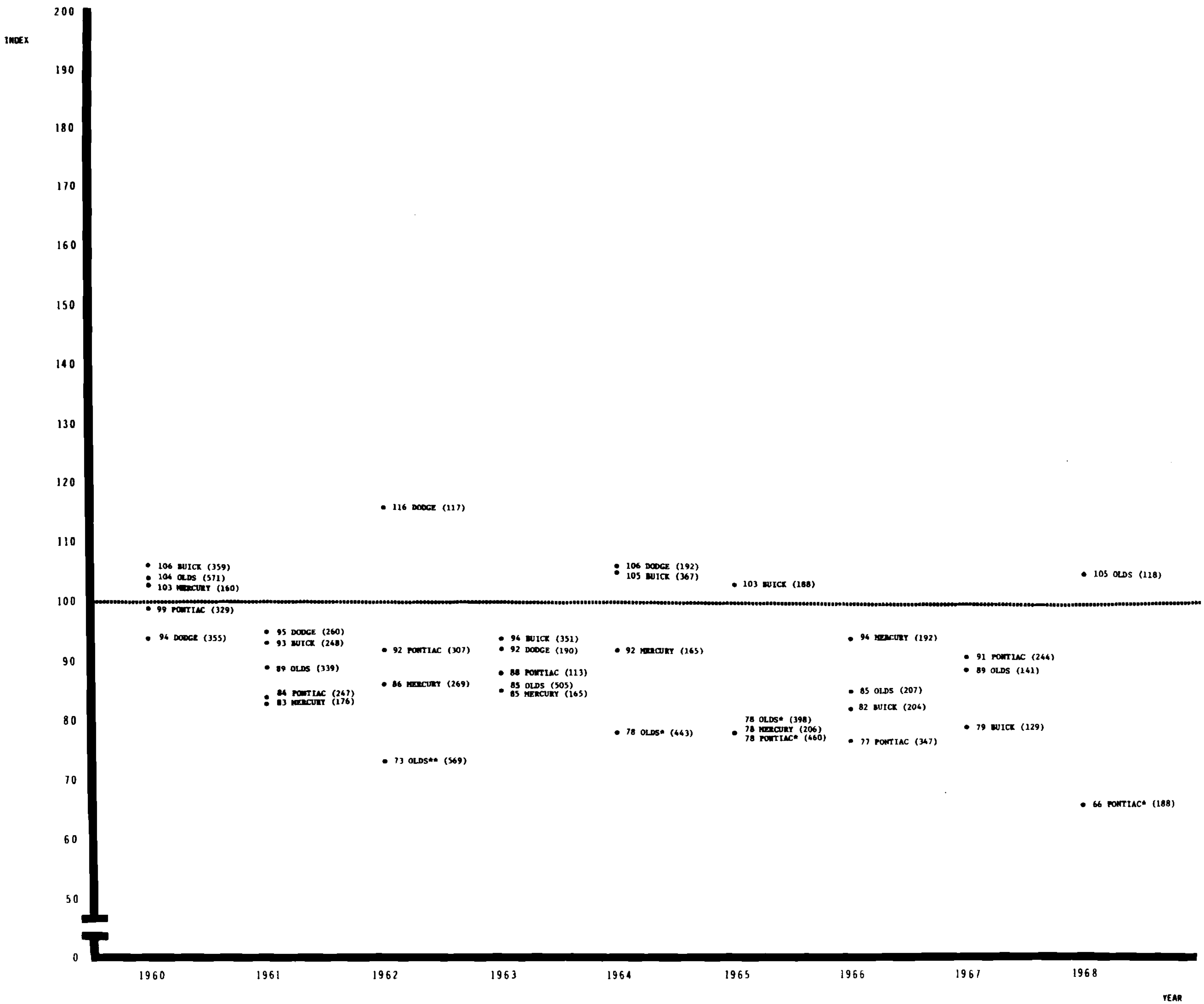


FIGURE 5. DRIVER INJURY INDEX VALUES IN BUICK LESABRE, DODGE SENECA AND "440", MERCURY MONTEREY, OLDSMOBILE "88", PONTIAC CATALINA
(APPENDIX 3 -- GROUPS 2,13,18,27,37)

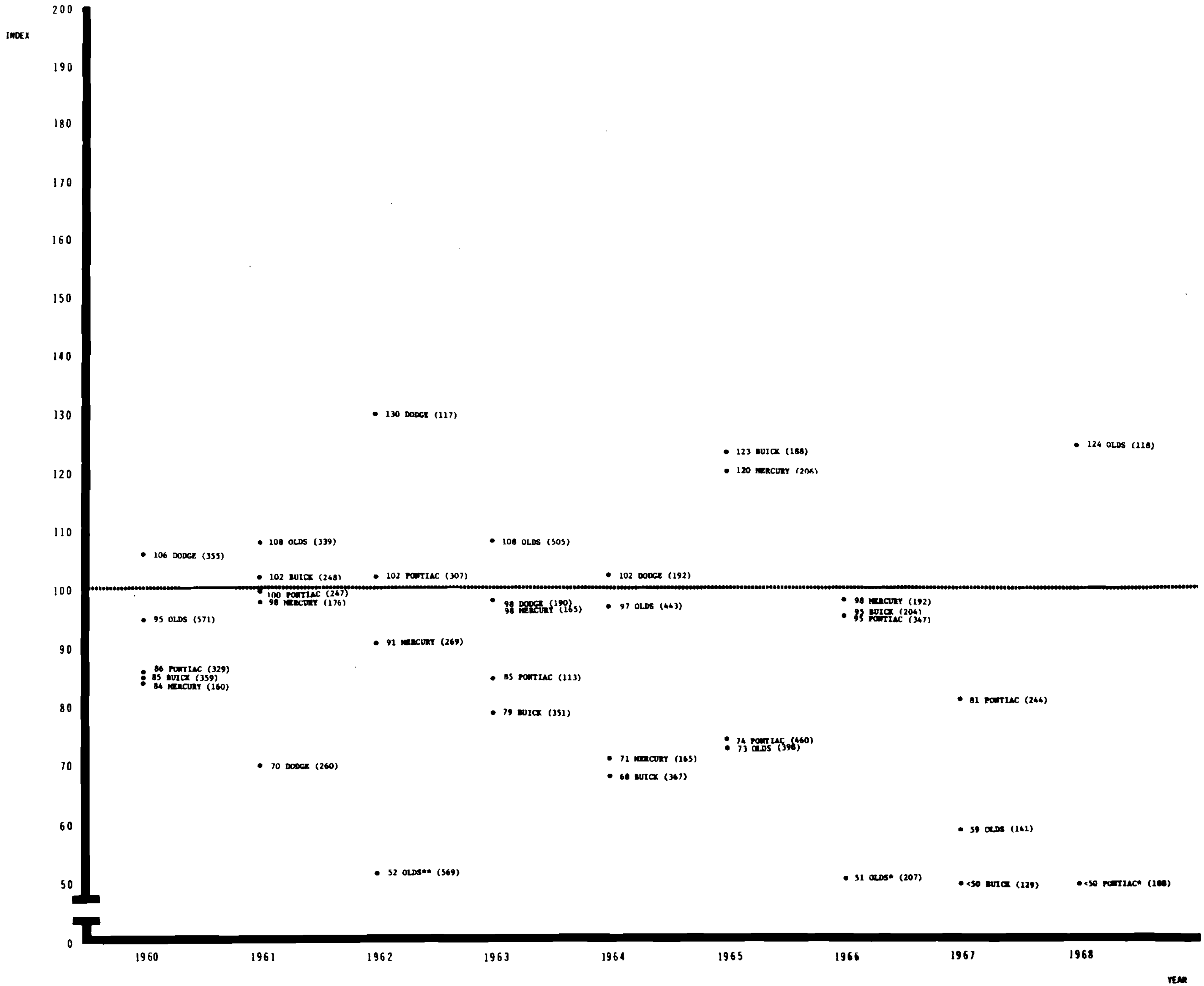


FIGURE 6. SERIOUS + FATAL DRIVER INJURY INDEX VALUES IN BUICK LESABRE, DODGE SENECA AND "440", MERCURY MONTEREY, OLDSMOBILE "88", PONTIAC CATALINA (APPENDIX 3 -- GROUPS 2,13,18,27,37)

In some model years, cars that are similar in construction (like the Buick, Olds, and Pontiac) have quite similar index values, but in other years they do not. It is not known at this stage whether this represents random fluctuations, or whether there are identifiable physical details of the car that can be associated with such shifts. Such insight can be gained only through simultaneous detailed comparison of the statistical data and the physical characteristics of the cars.

Group IV: Cars Just Smaller than Standard (such as the Buick Special, Chevrolet Chevelle, Dodge Dart, Ford Fairlane, Oldsmobile F-85, Plymouth Belvedere-Satellite, Pontiac GTO, and Pontiac Tempest)

Figures 7 and 8 respectively portray injury and serious or fatal driver injury relative to the reference group for the car models listed. These models are defined in Appendix 3 as Groups 3, 4, 7, 14, 19, 23, 28, and 33.

This group of cars more than any other reflects improvement with model years. In Figure 7 it is seen, for example, that the Olds F-85 and the Ford Fairlane show significantly higher than average values in the earlier model years and significantly lower than average values in the later model era. Both of these vehicles went from 20 or more percent higher than average to 20 or more percent lower than average.

Overall, significantly above-the-line indices were shown in the 1961 Olds F-85, 1962 and 1963 Fairlane with index values of 122 to 144. Significantly below-the-line indices were shown in the 1965 and 1967 Olds F-85, the 1966 Pontiac GTO and the 1968 Fairlane with index values ranging from 71 to 79.

The situation with respect to serious and fatal injuries is shown in Figure 8, and is not greatly different from the situation portrayed in Figure 7. However, note that there are some differences in the identity of the cars in which driver injury was significantly different from the mean. Above average: 1962 and 1963 Fairlane and 1964 Dodge Dart. Below average: 1967 Olds F-85 and 1968 Chevelle and 1968 Fairlane.

Group IV cars differ from the preceding groups in that the index values fall generally higher. In preceding groups a clear majority of the index values fell below 100, whereas in Figures 7 and 8 the points are almost exactly divided above and below the line.

As before, certain models are not portrayed due to small sample size.

FIGURE 7. DRIVER INJURY INDEX VALUES IN BUICK SPECIAL, CHEVROLET CHEVELLE, DODGE DART, FORD FAIRLANE, OLDSMOBILE F-85, PLYMOUTH BELVEDERE-SATELLITE, PONTIAC GTO, PONTIAC TEMPEST (APPENDIX 3 -- GROUPS 3,4,7,14,19,23,28,33)

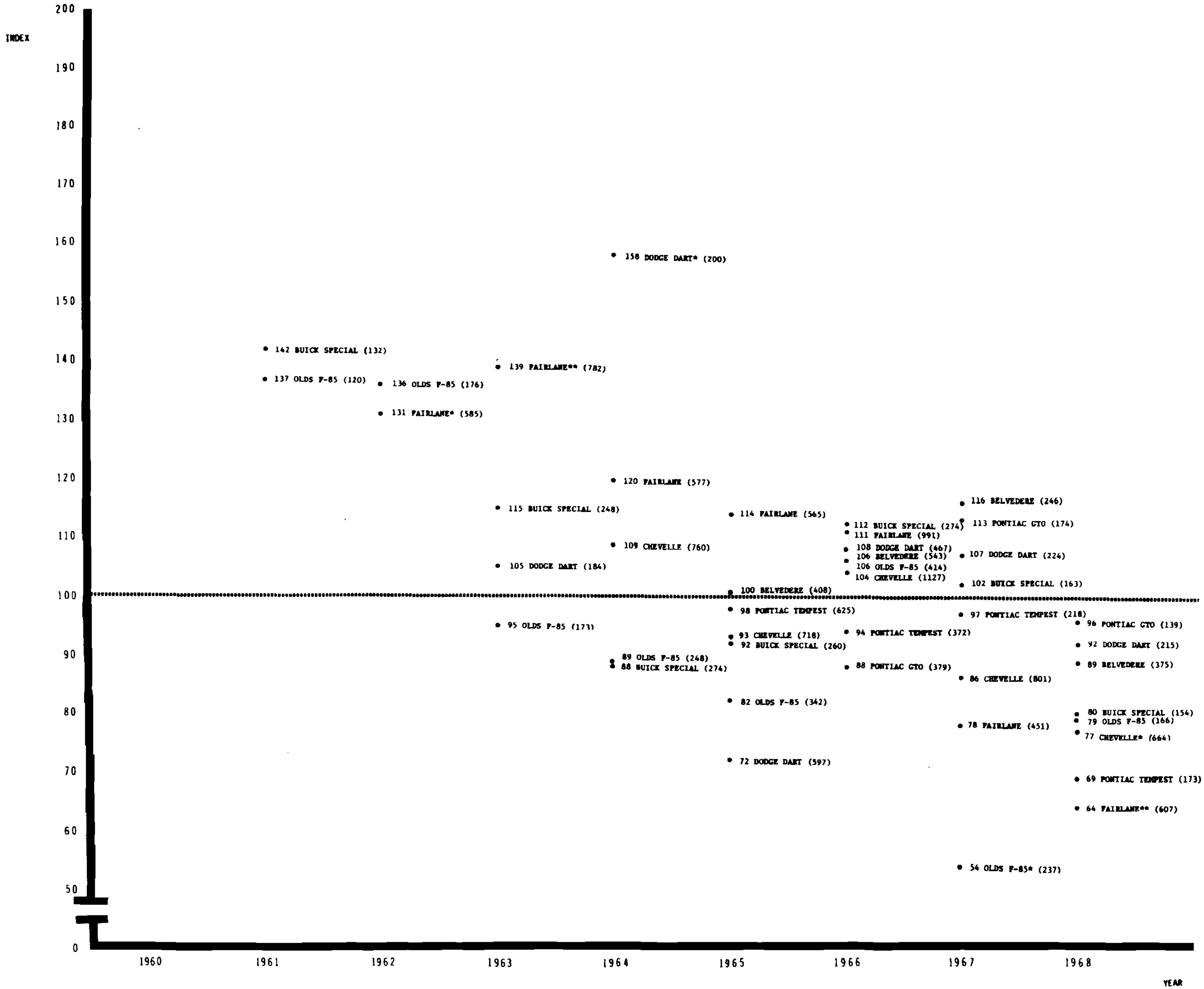


FIGURE 8. SERIOUS + FATAL DRIVER INJURY INDEX VALUES IN BUICK SPECIAL, CHEVROLET CHEVELLE, DODGE DART, FORD FAIRLANE, OLDSMOBILE F-85, PLYMOUTH BELVEDERE-SATELLITE, PONTIAC GTO, PONTIAC TEMPEST (APPENDIX 3 -- GROUPS 3,4,7,14,19,23,28,33)

Group V: Domestic Compact Cars: Chevrolet Chevy II, Chevrolet Corvair, Ford Falcon, Plymouth Valiant

Figures 9 and 10 deal with four compact cars and refer to the same unbelted driver injuries shown in the several preceding pairs of figures. The four car groups are defined in Appendix 3 as Groups 8, 9, 24, and 34.

In sharp contrast to preceding groups, virtually all of the index values are above the baseline, and in many cases statistically significantly so. With respect to driver injury (in any degree) twenty-nine values are shown in Figure 9, and all but one are on the higher-than average side of the line. Seventeen of the values are significantly elevated, including the 1960, 61, 62 and 63 Falcon with values from 123 to 133: the 1962, 64 and 1965 Chevy II with values from 125 to 176; the 1961, 63, 64, 65, and 66 Valiant with values from 130 to 169: and the 1960, 61, 62, 63, and 64 Corvair with indices from 118 to 161.

Figure 10 shows the same general trends for the serious injury index. All but one of the twenty-nine index values exceed 100 and for ten, there is a statistically significant elevation. These significant values are accompanied by index numbers ranging from 135 to 197.

Group VI: Other Cars: Foreign, American Specialty Cars, and a Re-Grouping of American Compact Cars.

This final group contains the greatest number of car makes. Throughout this group, the model year distinction is either dropped altogether, or at least several model years are combined. This is because cars in this group do not undergo as frequent changes as do cars in the preceding groups. Some, in fact, are quite similar throughout the 1960-1968 period depicted. Even if changes were substantial (as in the Corvette), the sample was in some cases too small to permit separation by model year. The car makes included in Group VI are:

Foreign Cars

MG	-- all years combined
Renault	-- all years combined
Volvo	-- all years combined
VW Type I (standard sedan -- "beetle")	-- 60-67
VW Type I (standard sedan -- "beetle")	-- 68
VW Type II (van configuration)	-- all years combined
VW Type III ("fastback and squareback")	-- all years combined

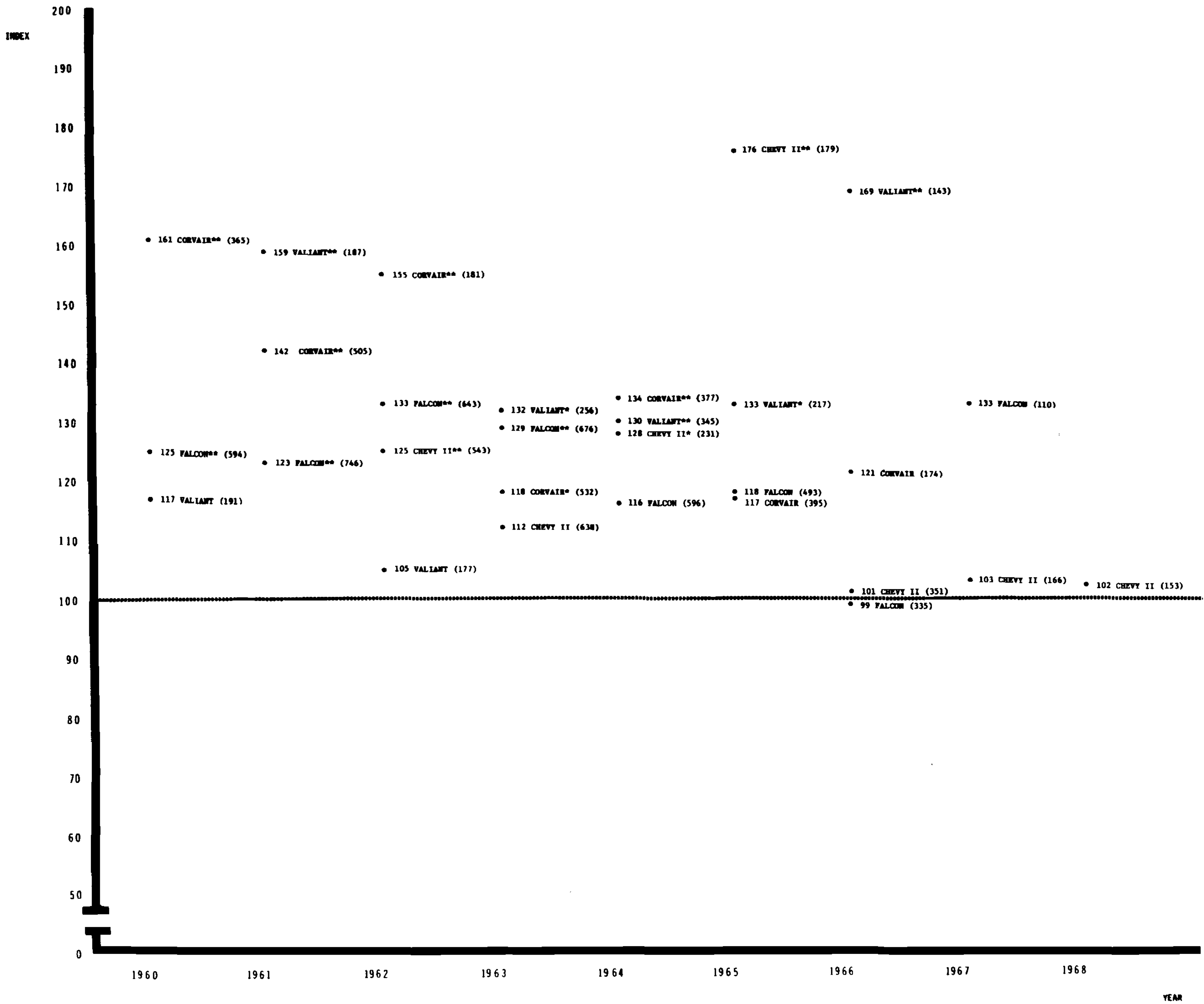


FIGURE 9. DRIVER INJURY INDEX VALUES IN CHEVROLET CHEVY II, CHEVROLET CORVAIR, FORD FALCON, PLYMOUTH VALIANT (APPENDIX 3 -- GROUPS 8,9,24,34)

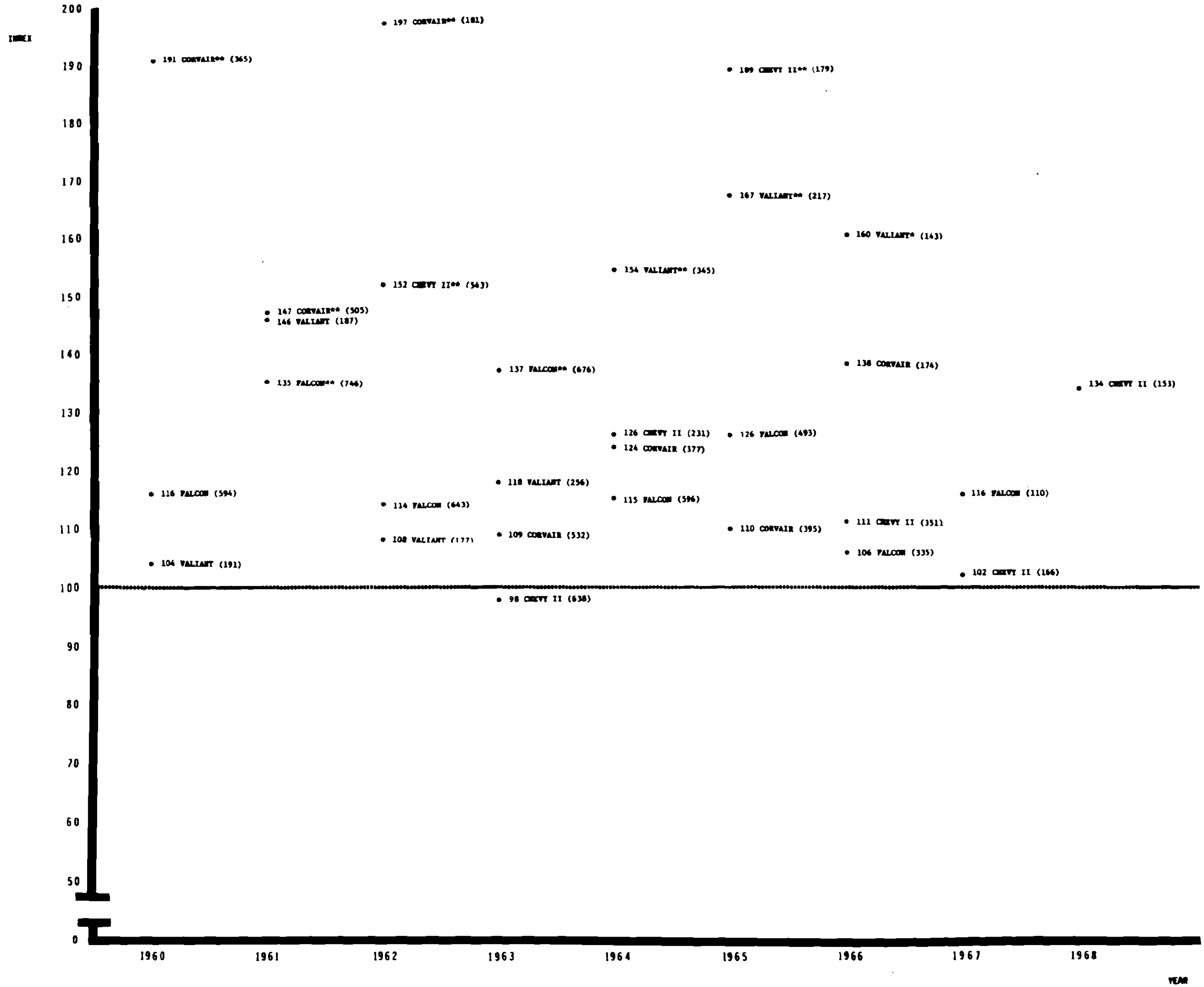


FIGURE 10. SERIOUS + FATAL DRIVER INJURY INDEX VALUES IN CHEVROLET CHEVY II, CHEVROLET CORVAIR, FORD FALCON, PLYMOUTH VALIANT (APPENDIX 3 -- GROUPS 8,9,24,34)

American Specialty Cars

Camaro	-- all years combined
Corvette	-- all years combined
Cougar	-- all years combined
Firebird	-- all years combined
Mustang	-- all years combined

American Compacts

Chevy II	-- 62-67
Chevy II	-- 68
Corvair	-- 60-63
Corvair	-- 64
Corvair	-- 65-68
Falcon	-- 60-65
Falcon	-- 66-68
Valiant	-- 60-66

(too few 67-68 Valiants for inclusion)

These cars are defined in Appendix 3 by Groups 5, 8, 9, 10, 11, 24, 34, 36, 40, 50, 51, 52, 53, 54, and 55. A comment should be made with regard to the VW Type II. It is the only van configuration included in this study. Therefore, the VW Type II is in the position of being compared with fundamentally different cars. No comparison is presently available with the van-type vehicles produced by other companies, but in a subsequent study others will be included.

With respect to any degree of injury, Figure 11 shows several cars not to be significantly different from the average. This includes the Mustang, Camaro, Corvette, and Cougar all with index values from 90 to 98. Also not significantly different is the Firebird, Volvo, the Falcons (66-68), and the newer Chevy II (68). These cars range from 102 to 122 in index values.

Several cars, however, are significantly above average in injury value. This includes the Renault (index 185), VW Type II (bus) (index 170), MG (index 158), the 60-67 VW Type I (index 141) and the 68 VW Type I (index 136), the VW Type III (index 134), the 1960-1963 Corvair (index 139), the 1964 Corvair (index 134), 1965-1968 Corvair (index 122), the 1960-1966 Valiant (index 134), the 1962-1967 Chevy II (index 119), and the 1960-1965 Falcon (index 124).

The situation is similar when the serious and fatal injury index is considered. Again, several cars are not associated with significantly elevated frequency of these severe injuries. These non-significant values include Volvo (142), 1968 VW Type I (128), 1968 Chevy II (134), VW Type III (132), 1964 Corvair (124), 1965-1968 Corvair (124), 1966-1968 Falcon (116), Corvette (108), Camaro (107), Mustang (93), Firebird (84), and Cougar (78).

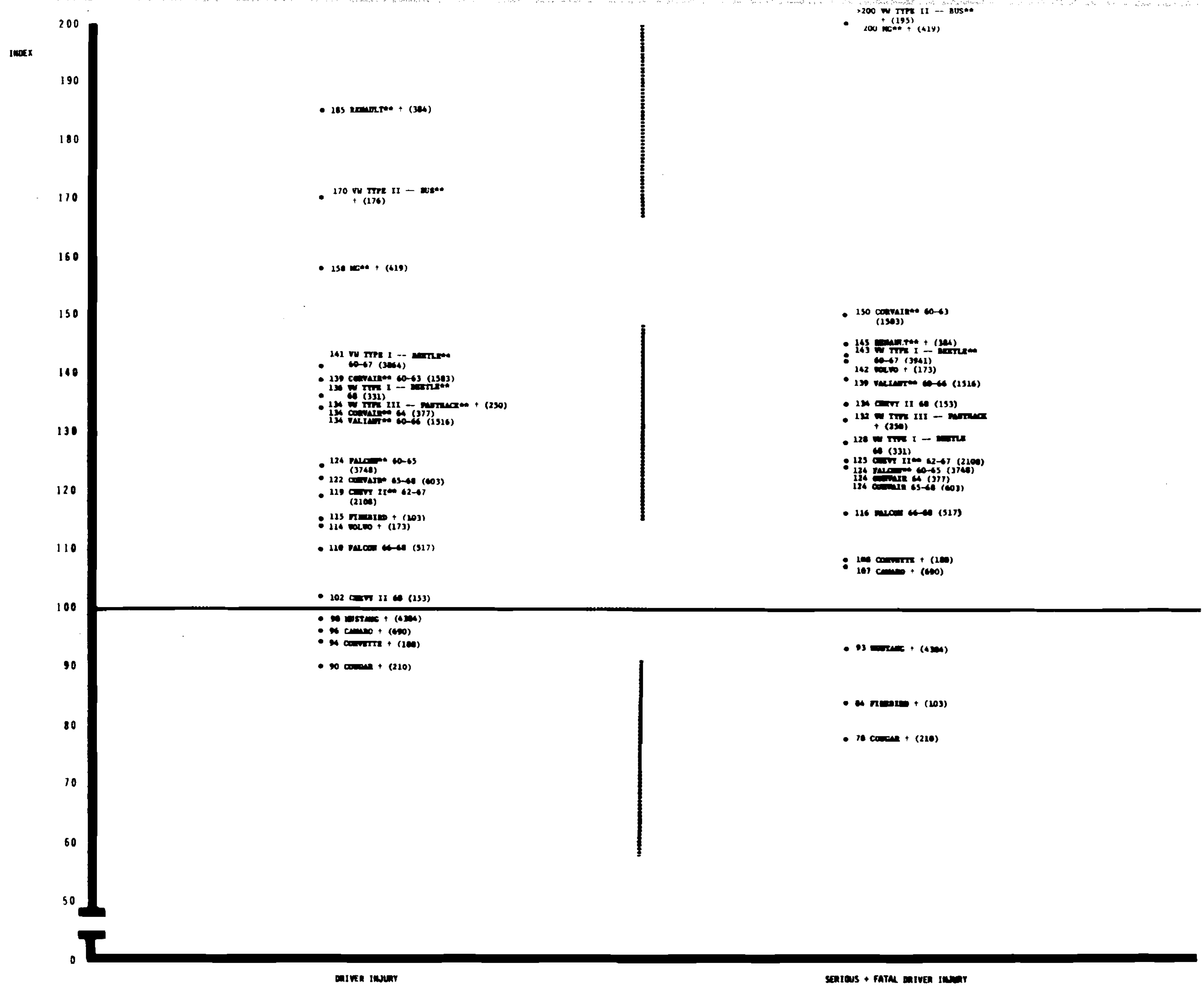


FIGURE 11. DRIVER INJURY AND SERIOUS + FATAL INJURY INDEX VALUES IN VARIOUS MODEL YEAR COMBINATIONS OF FOREIGN CARS, AMERICAN SPECIALTY CARS, AMERICAN COMPACTS (APPENDIX 3 -- GROUPS 5,8,9,10,11,24,34,36,40,50-55)

+ denotes that all model years have been combined

Drivers of several other cars, however, showed a significantly higher than average frequency of serious and fatal injury. These include: VW Type II (> 200), MG (200), 1960-1963 Corvair (150), Renault (145), 1960-1967 VW Type I (143), 1960-1966 Valiant (139), 1962-1967 Chevy II (125) and 1960-1965 Falcon (124).

These cars are re-grouped, and the changes in injury index are summarized below:

		All Injury Index		A + K Injury Index	
1960-1963	Corvair	139	significant	150	significant
1964	Corvair	134	significant	124	not significant
1965-1968	Corvair	122	significant	124	not significant
1960-1967	VW Type I	142	significant	143	significant
1968	VW Type I	136	significant	128	not significant
1960-1965	Falcon	124	significant	143	significant
1966-1968	Falcon	110	not significant	125	significant
1962-1967	Chevy II	119	significant	124	significant
1968	Chevy II	102	not significant	134	not significant

The above groupings are based on rather substantial car changes. The 1965-1968 Corvairs reflect both a styling change, a fundamental change in car suspension, and a steering assembly change designed to prevent rearward displacement of the steering column relative to the driver compartment. The VW grouping represents a basic change in car suspension. The changes in Falcon and Chevy II indicate general re-styling and change in wheelbase, overall length, width, etc.

By showing the data in these groups, a tendency is seen in one injury index or the other toward improvement in the later model years. This indication of improvement was not readily apparent in the findings as presented in Group V.

Summary of the Six Groups

Tables 5 and 6 show a list of all the make-year combinations cited previously, ranked by index number. The tables show the make and year of the car, the index, the indication (or lack) of statistical significance, the sample size of the particular make in question, and the group in which that model was classified in the previous sections of the Results chapter.

Table 5. Driver Injury Index Values by Make and Model Including Group and Sample Size

Index	Make and Model (Group)	(Sample Size)
185	† Renault (VI)**	(384)
176	65 Chevy II (V)**	(179)
170	† VW Type II -- Bus (VI)**	(176)
169	66 Valiant (V)**	(143)
161	60 Corvair (V)**	(365)
159	61 Valiant (V)**	(187)
158	† MG (VI)**	(419)
155	62 Corvair (V)**	(181)
144	61 Olds F-85 (IV)*	(120)
142	61 Corvair (V)**	(505)
141	60-67 VW Type I -- Beetle (VI)**	(3864)
139	60-63 Corvair (VI)**	(1583)
139	65 Dodge (II)*	(199)
136	68 VW Type I -- Beetle (VI)**	(331)
134	† VW Type III -- Fastback (VI)**	(250)
134	60-66 Valiant (VI)**	(1516)
134	64 Corvair (VI)**	(377)
133	67 Falcon (V)	(110)
133	65 Valiant (V)*	(217)
133	62 Falcon (V)**	(643)
132	63 Valiant (V)*	(256)
130	64 Valiant (V)**	(345)
129	63 Fairlane (IV)**	(782)
129	63 Falcon (V)**	(676)
128	64 Chevy II (V)*	(231)
125	60 Falcon (V)**	(594)
125	62 Chevy II (V)**	(543)
124	60-65 Falcon (VI)**	(3748)
124	61 Buick Special (IV)	(132)
123	61 Falcon (V)**	(746)
122	65-68 Corvair (VI)*	(603)
122	62 Fairlane (IV)*	(585)
121	66 Corvair (V)	(174)
121	62 Olds F-85 (IV)	(176)
119	62-67 Chevy II (VI)**	(2108)
118	63 Corvair (V)*	(532)
118	65 Falcon (V)	(493)
117	60 Valiant (V)	(191)
117	65 Corvair (V)	(395)
116	64 Falcon (V)	(596)
116	62 Dodge (III)	(117)
115	† Firebird (VI)	(103)
114	† Volvo (VI)	(173)
113	64 Dodge (II)	(287)
112	63 Chevy II (V)	(638)
111	64 Chevelle (IV)	(760)
111	66 Dodge Dart (IV)	(467)
110	66-68 Falcon (VI)	(517)
110	64 Dodge Dart (IV)	(200)
110	63 Buick Special (IV)	(248)

† denotes that all model years have been combined

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

Table 5. Continued

Index	Make and Model (Group)	(Sample Size)
109	64 Fairlane (IV)	(577)
109	67 Belvedere (IV)	(246)
107	63 Dodge (II)	(142)
107	65 Pontiac Tempest (IV)	(625)
107	60 Plymouth (I)	(373)
106	60 Buick (III)	(359)
106	64 Dodge (III)	(192)
106	66 Pontiac Tempest (IV)	(372)
105	64 Buick (III)	(367)
105	68 Olds (III)	(118)
105	62 Valiant (V)	(177)
105	63 Dodge Dart (IV)	(184)
105	66 Chevelle (IV)	(1127)
104	60 Olds (III)	(571)
104	64 Olds F-85 (IV)	(248)
103	60 Mercury (III)	(160)
103	65 Buick (III)	(188)
103	66 Dodge (II)	(108)
103	67 Chevy II (V)	(166)
103	63 Olds F-85 (IV)	(173)
102	68 Buick (II)	(105)
102	68 Chevy II (V)	(153)
102	66 Fairlane (IV)	(991)
102	66 Olds F-85 (IV)	(414)
101	66 Chevy II (V)	(351)
101	66 Buick Special (IV)	(274)
101	61 Ford (I)	(1929)
100	67 Pontiac Tempest (IV)	(218)
100	67 Pontiac GTO (IV)	(174)
99	60 Pontiac (III)	(329)
99	66 Falcon (V)	(335)
99	67 Buick Special (IV)	(163)
98	† Mustang (VI)	(4304)
97	66 Belvedere (IV)	(543)
97	67 Chevelle (IV)	(801)
97	65 Ford (I)	(2781)
96	† Camaro (VI)	(690)
96	65 Buick Special (IV)	(260)
96	65 Belvedere (IV)	(408)
95	61 Dodge (III)	(260)
95	60 Pontiac (II)	(259)
94	† Corvette (VI)	(188)
94	60 Dodge (III)	(355)
94	63 Buick (III)	(351)
94	66 Mercury (III)	(192)
94	62 Chevrolet (I)	(3162)
94	63 Ford (I)	(2660)
94	67 Chevrolet (I)	(1072)
93	61 Buick (III)	(248)
93	67 Fairlane (IV)	(451)
93	68 Dodge Dart (IV)	(215)
93	61 Chevrolet (I)	(2377)
93	64 Chevrolet (I)	(2961)
93	66 Ford (I)	(2342)
92	63 Dodge (III)	(190)
92	64 Mercury (III)	(165)

† denotes that all model years have been combined

Table 5. Continued

Index	Make and Model (Group)	(Sample Size)	Index	Make and Model (Group)	(Sample Size)
92	62 Pontiac (III)	(307)	85	63 Olds (III)	(505)
92	65 Chevrolet (I)	(2188)	85	63 Mercury (III)	(165)
91	67 Pontiac (III)	(244)	85	66 Olds (III)	(207)
91	61 Plymouth (I)	(314)	85	68 Chevelle (IV)	(664)
91	62 Ford (I)	(1956)	85	68 Belvedere (IV)	(375)
91	63 Plymouth (I)	(576)	85	63 Chevrolet (I) **	(3207)
91	64 Ford (I)*	(2798)	84	61 Pontiac (III)	(247)
90	† Cougar (VI)	(210)	84	64 Buick Special (IV)	(274)
90	62 Pontiac (II)	(318)	84	68 Buick Special (IV)	(154)
90	64 Plymouth (I)	(752)	83	61 Mercury (III)	(176)
90	66 Plymouth (I)	(678)	83	60 Olds (II)	(104)
89	61 Olds (III)	(339)	83	68 Olds F-85 (IV)	(166)
89	67 Olds (III)	(141)	83	68 Chevrolet (I)*	(789)
89	66 Buick (II)	(176)	82	67 Plymouth (I)	(375)
89	65 Dodge Dart (IV)	(597)	82	66 Buick (III)	(204)
89	65 Chevelle (IV)	(718)	81	65 Olds (II)	(119)
89	67 Ford (I)	(1097)	81	68 Pontiac GTO (IV)	(139)
88	63 Pontiac (III)	(113)	81	62 Plymouth (I)	(298)
88	65 Fairlane (IV)	(565)	81	68 Plymouth (I)	(348)
88	67 Dodge Dart (IV)	(224)	80	61 Pontiac (II)	(224)
88	65 Plymouth (I)	(871)	79	67 Buick (III)	(129)
88	66 Chevrolet (I)*	(1355)	79	68 Fairlane (IV)*	(607)
87	65 Pontiac (II)	(318)	79	68 Ford (I)*	(534)
87	60 Ford (I)*	(1813)	78	64 Olds (III)*	(443)
86	62 Mercury (III)	(269)	78	65 Mercury (III)	(206)
86	68 Pontiac Tempest (IV)	(173)	78	65 Olds (III)*	(398)
86	60 Chevrolet (I)**	(3041)	78	65 Pontiac (III)*	(460)

† denotes that all model years have been combined

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

Table 5. Continued

Index	Make and Model (Group)	(Sample Size)
78	65 Buick (II)	(215)
77	66 Pontiac (III)	(347)
76	65 Olds F-85 (IV)*	(342)
75	64 Buick (II)	(100)
75	66 Pontiac (II)	(291)
74	66 Pontiac GTO (IV)*	(379)
73	62 Olds (III)**	(569)
72	67 Pontiac (II)	(143)
71	67 Olds F-85 (IV)*	(237)
67	63 Olds (II)	(103)
67	66 Olds (II)	(102)
66	68 Pontiac (III)*	(188)
66	68 Pontiac (II)	(115)
<50	67 Buick (II)**	(135)

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

Table 6. Serious and Fatal Driver
Injury Index Values by Make and Model Year

Index	Make and Model (Group)	(Sample Size)
>200	† VW Type II -- Bus (VI)**	(195)
200	† MG (VI)**	(419)
197	62 Corvair (V)**	(181)
191	60 Corvair (V)**	(365)
189	65 Chevy II (V)**	(179)
167	65 Valiant (V)**	(217)
160	66 Valiant (V)*	(143)
158	64 Dodge Dart (IV)*	(200)
154	64 Valiant (V)**	(345)
154	60 Olds (II)	(104)
152	62 Chevy II (V)**	(543)
151	63 Dodge (II)	(142)
150	60-63 Corvair (VI)**	(1583)
147	61 Corvair (V)**	(505)
146	61 Valiant (V)	(187)
145	† Renault (VI)**	(384)
143	60-67 VW Type I -- Beetle (VI)**	(3941)
142	61 Buick Special (IV)	(132)
142	† Volvo (VI)	(173)
139	60-66 Valiant (VI)**	(1516)
139	63 Fairlane (IV)**	(782)
138	66 Corvair (V)	(174)
137	63 Falcon (V)**	(676)
137	61 Olds F-85 (IV)	(120)
136	62 Olds F-85 (IV)	(176)
135	61 Falcon (V)**	(746)
134	68 Chevy II (V)	(153)
132	† VW Type III -- Fastback (VI)	(250)
131	62 Fairlane (IV)*	(585)
130	62 Dodge (III)	(117)
128	68 VW Type I -- Beetle (VI)	(331)
126	65 Falcon (V)	(493)
126	64 Chevy II (V)	(231)
125	62-67 Chevy II (VI)**	(2108)
124	65-68 Corvair (VI)	(603)
124	64 Corvair (VI)	(377)
124	60-65 Falcon (VI)**	(3748)
124	68 Olds (III)	(118)
123	65 Buick (III)	(188)
122	65 Dodge (II)	(199)
120	64 Fairlane (IV)	(577)
120	65 Mercury (III)	(206)
118	63 Valiant (V)	(256)
118	64 Dodge (II)	(287)
116	66-68 Falcon (VI)	(517)
116	60 Falcon (V)	(594)
116	67 Belvedere (IV)	(246)
116	67 Falcon (V)	(110)
115	64 Falcon (V)	(596)
115	63 Buick Special (IV)	(248)

† denotes that all model years have been combined

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

Table 6. Continued

Index	Make and Model (Group)	(Sample Size)
114	62 Falcon (V)	(643)
114	65 Fairlane (IV)	(565)
113	60 Plymouth (I)	(373)
113	67 Pontiac GTO (IV)	(174)
112	66 Buick Special (IV)	(274)
111	66 Chevy II (V)	(351)
111	66 Fairlane (IV)	(991)
110	65 Corvair (V)	(395)
110	61 Plymouth (I)	(314)
109	63 Corvair (V)	(532)
109	64 Chevelle (IV)	(760)
109	66 Plymouth (I)	(678)
108	† Corvette (VI)	(188)
108	62 Valiant (V)	(177)
108	66 Dodge Dart (IV)	(467)
108	61 Olds (III)	(339)
108	63 Olds (III)	(505)
107	† Camaro (VI)	(690)
107	67 Dodge Dart (IV)	(224)
107	61 Ford (I)	(1929)
106	66 Olds F-85 (IV)	(414)
106	66 Falcon (V)	(335)
106	66 Belvedere (IV)	(543)
106	60 Dodge (III)	(355)
105	63 Dodge Dart (IV)	(184)
104	60 Valiant (V)	(191)
104	66 Chevelle (IV)	(1127)
102	67 Chevy II (V)	(166)
102	67 Buick Special (IV)	(163)
102	61 Buick (III)	(248)
102	62 Pontiac (III)	(307)
102	64 Dodge (III)	(192)
100	65 Belvedere (IV)	(408)
100	61 Pontiac (III)	(247)
99	65 Ford (I)	(2781)
99	68 Plymouth (I)	(348)
99	64 Ford (I)	(2798)
98	66 Mercury (III)	(192)
98	63 Chevy II (V)	(638)
98	65 Pontiac Tempest (IV)	(625)
98	61 Chevrolet (I)	(2377)
98	63 Dodge (III)	(190)
98	61 Mercury (III)	(176)
98	63 Mercury (III)	(165)
98	62 Chevrolet (I)	(3162)
97	63 Ford (I)	(2660)
97	66 Dodge (II)	(108)
97	67 Pontiac Tempest (IV)	(218)
97	64 Olds (III)	(443)
96	68 Pontiac GTO (IV)	(139)

† denotes that all model years have been combined

Table 6. Continued

Index	Make and Model (Group)	(Sample Size)
95	60 Olds (III)	(571)
95	63 Olds F-85 (IV)	(173)
95	66 Buick (III)	(204)
95	66 Pontiac (III)	(347)
94	62 Ford (I)	(1956)
94	66 Pontiac Tempest (IV)	(372)
94	62 Plymouth (I)	(298)
93	† Mustang (VI)	(4304)
93	65 Chevelle (IV)	(718)
92	68 Dodge Dart (IV)	(215)
92	65 Buick Special (IV)	(260)
91	63 Chevrolet (I)	(3207)
91	66 Ford (I)	(2342)
91	67 Ford (I)	(1097)
91	62 Mercury (III)	(269)
90	60 Chevrolet (I)	(3041)
89	65 Olds (II)	(119)
89	64 Olds F-85 (IV)	(248)
89	68 belvedere (IV)	(375)
89	66 Buick (II)	(176)
89	65 Pontiac (II)	(318)
88	64 Chevrolet (I)*	(2961)
88	60 Pontiac (II)	(259)
88	64 Buick Special (IV)	(274)
88	66 Pontiac GTO (IV)	(379)
88	68 Ford (I)	(534)
87	65 Chevrolet (I)	(2188)
87	65 Plymouth (I)	(871)
86	67 Chevelle (IV)	(801)
86	60 Pontiac (III)	(329)
85	61 Pontiac (II)	(224)
85	60 Buick (III)	(359)
85	63 Pontiac (III)	(113)
84	60 Ford (I)*	(1813)
84	† Firebird (VI)	(103)
84	67 Chevrolet (I)	(1072)
84	60 Mercury (III)	(160)
83	66 Chevrolet (I)*	(1355)
82	65 Olds F-85 (IV)	(342)
81	67 Pontiac (III)	(244)
80	68 Buick Special (IV)	(154)
79	68 Olds F-85 (IV)	(166)
79	63 Buick (III)	(351)
78	67 Fairlane (IV)	(451)
78	† Cougar (VI)	(210)
77	68 Chevelle (IV)*	(664)
77	64 Plymouth (I)	(752)
77	63 Plymouth (I)	(576)
76	63 Olds (II)	(103)
76	68 Chevrolet (I)*	(789)
74	65 Pontiac (III)	(460)

† denotes that all model years have been combined

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

Table 6. Continued

Index	Make and Model (Group)	(Sample Size)
73	65 Olds (III)	(398)
72	65 Dodge Dart (IV)	(597)
72	64 Buick (II)	(100)
71	64 Mercury (III)	(165)
70	61 Dodge (III)	(260)
69	68 Pontiac Tempest (IV)	(173)
69	68 Buick (II)	(105)
69	67 Plymouth (I)	(375)
68	64 Buick (III)	(367)
67	67 Pontiac (II)	(143)
66	65 Buick (II)	(215)
64	66 Pontiac (II)	(291)
64	68 Fairlane (IV)**	(607)
60	62 Pontiac (II)*	(318)
59	67 Olds (III)	(141)
54	67 Olds F-85 (IV)*	(237)
52	62 Olds (III)**	(569)
51	66 Olds (III)*	(207)
<50	67 Buick (III)	(129)
<50	68 Pontiac (III)*	(188)
<50	68 Pontiac (II)*	(115)
<50	66 Olds (II)**	(102)
<50	67 Buick (II)**	(135)

* indicates significance at the 0.05 level; ** indicates significance at the 0.01 level

X. RESULTS: Injury by Car Body Style

Another subject of interest is that of any association between car body style and driver injury in a series of comparable crashes. Various opinions have been expressed as to differences thought to exist among the body styles. In certain instances criticism has been leveled at the convertible and the "hardtop," usually on the grounds that they may not have adequate roof structure to provide protection in the event of an overturn crash.

In this section, the "Big 3" cars (the standard Chevrolet, Ford, and Plymouth) for 1960-1968 model years are grouped together and then separated by body style:

2-door sedans
4-door sedans
2-door hardtops
4-door hardtops
2-door convertibles
4-door station wagons

The "Big 3" cars are chosen for this analysis because in each of the years studied each of the companies produced all of the body styles in question. In some of the other car groups described in the preceding section, a breakdown by body style would have created problems. For example, in Group VI (p. 28) almost all of the Volkswagen Type I cars would have been classified as 2-door sedans, whereas almost all of the 65 and later Corvairs would have been classified as 2-door hardtops. Thus, in that group a comparison of 2-door sedans vs. 2-door hardtops would have been more of a Volkswagen-vs.-Corvair comparison.

In contrast, among the "Big 3" cars used here, there is a good representation of all model years and all makes in each of the body style classes.

Each body style is compared to the reference group that has been used throughout the study, and the comparison is with respect to the two measures of driver injury already used several times in the preceding section. Table 7 shows the index values:

and severity of resulting driver injuries. For some individual cars, the relative frequency of driver injuries is significantly higher than the comparable value for the aggregate of all cars. For some cars the injuries are twice the aggregate of all cars.

At the other end of the scale, some cars are associated with driver injuries that are significantly lower than the average value. These significantly below-the-mean values indicate that circumstances that produce 100 injuries in the average of all cars produce as few as 50 in these cars.

It was stated before and is worth repeating that statistical results such as these must be examined in view of physical features of the cars in question. These findings alone cannot pinpoint the particular characteristics of the cars that are associated with the higher or lower injury values reported. These figures can only be taken as a beginning point to encourage a search for a physical basis to confirm or fail to confirm these findings.

Future HSRC studies and similar studies being carried out in the state of New York, and elsewhere, will answer the question of the amount of variation to be expected in these injury indicators. It seems probable that there will be considerable variation from time to time and place to place. There will be a better understanding of the potentialities and limits of this kind of analysis once several such studies are in the research literature.

HSRC plans to make this kind of general statistical analysis on an annual basis, each time updating the models to include the most recent cars. Future studies will reflect greater currency of late model years than does this first study.

One point of some importance is the statistical design compatability of the several studies. In the next HSRC study on this subject, the same reference group will be used to create the index numbers, and the same "control variables" will also be used.

Perhaps it would be well also to discuss the question of what, if any action, is to be done on the basis of studies such as these. Perhaps some will argue that cars that are above average in injury potential should be "legislated" off the road. But of course as long as there is a variety of cars, there will always be some that are higher and some that are lower in injury indices. Some may say that since small cars are the ones that tend to come out worse, that all cars should be big. Others will counter that all should be small.

In any case, safety is but one of many variables which users consider in the question of their personal transportation. A person may be willing to accept a higher crash injury risk in return for other factors such as operating economy, or even the increased probability of finding a place to park!

Table 7: Driver Injury Index for Various Car Body Styles

Body Style	Sample Size	Any Injury Observed	Any Injury Expected	Any Injury Index	Serious and Fatal Injury Observed	Serious and Fatal Injury Expected	Serious and Fatal Injury Index
2-door sedan	2,843	448	476.4	94	218	233.6	93
4-door sedan	13,444	2,003	2,103.8	95*	957	1,001.2	96
2-door hardtop	14,681	2,309	2,559.4	90**	1,200	1,279.0	94*
4-door hardtop	4,050	554	641.9	86**	262	306.7	85**
2-door convertible	1,854	311	336.9	92	171	172.4	99
4-door station wagon	2,702	330	412.8	80**	153	193.8	79**

* indicates significance with p < .05 but > .01

** indicates significance with p < .01

Table 7 shows that with respect to the frequency of serious or fatal injury, drivers in the hardtop models (both 2 and 4-door versions) and four-door station wagons have injury indices significantly less than in the reference group.

With respect to the index of any degree of injury, the same body styles also show a significant departure below the baseline, and in addition, the four-door sedan is also significant.

None of the index values exceed 100, but that is not necessarily surprising in view of the fact that overall the "Big 3" had index values less than 100 as previously shown in Figures 1 and 2.

XI. DISCUSSION

From this statistical compilation of car crash reports, there is evidence of differences among various make-model groups in the frequency

For my part, I would like to make two points. First, this type of information can give the consumer an added dimension of information he can use if he desires as a part of his decision process regarding choice of personal transportation. In addition to cost, style, economy, repairability, "flair," etc., he can, if he wishes, take into account the question of how others have fared in crashes in such cars. My second point is that information such as this may play a part in suggesting where more intensive research and innovation may be appropriate to improve the crash performance of particular cars.

Among some of the smaller cars this may mean that even more attention will have to be paid to safety design. Of course, this tends to work against the notion that small cars are economy cars, but perhaps economy considerations have to be downgraded at least as far as passenger protection is concerned.

In any event, as can be seen, there are indications of substantial and statistically significant differences in injury severity among certain American and foreign cars shown in this series. Taking the ones with the highest compared to the ones with the lowest injury frequency, it is seen that the difference exceeds three-fold.

APPENDIX 1: North Carolina Accident Report Form

TRAFFIC ACCIDENT REPORT

N. C. Department of Motor Vehicles DMV-349 (Rev. 4-1-65)

ADDED BY ______ (Initial)

DATE Date of Accident ______ 19 ______ Day of Week ______ Hour ______ A.M. ☐ P.M. ☐

LOCATION

Accident occurred: in ______ County, In City or town of ______

Outside City or Town ______ Miles ☐ N ☐ E ☐ S ☐ W of ______ (City or Town) ☐ Limits ☐ Center

On ______ Hwy. No. (I., U.S., N.C., R.P., R.U.) If no Hwy. No., identify by name. at its intersection with ______ Street or Hwy. no.

If not at intersection, ______ ☐ Miles ☐ Feet ☐ N ☐ E ☐ S ☐ W From ______ Highway No., or Adjacent County Line toward ______ Highway No., City, or Adjacent County Line

ACCIDENT TYPE

Ran off Road		Non-collision in Road		Collision of Motor Vehicle in Road With:							
1. Right	2. Left	3. Overturned	4. Other in road	5. Pedestrian	6. Other Motor Vehicle	7. Parked Vehicle	8. Train	9. Bicycle	10. Animal	11. Fixed Object	12. Other Object

No. of Vehicles Involved ______

VEHICLE NO. 1

Driver: ______ First ______ Middle ______ Last Name ______ Street or RFD ______ City and State ______ Date of Birth ______ Month, Date, Year

Age ______ Sex ______ Race ______ Driving Experience ______ Years Driver's License ______ Number, State ☐ Oper ☐ Chauff ______ Specify Restriction Member of Armed Forces Yes ☐ No ☐

Veh: Year ______ Make ______ Color ______ Registration ______ Number ______ State ______ Year ______ M.V.No. ______

Amount of Damage $ ______

Owned By: ______ Name ______ Street or RFD ______ City and State ______ Parts Damaged ______

Drivable: Yes ☐ No ☐ Vehicle Removed To ______ By ______

VEHICLE NO. 2 OR PEDESTRIAN

Driver or Pedestrian: ______ First ______ Middle ______ Last Name ______ Street or RFD ______ City and State ______ Date of Birth ______ Month, Date, Year

Age ______ Sex ______ Race ______ Driving Experience ______ Years Driver's License ______ Number, State ☐ Oper ☐ Chauff ______ Specify Restriction Member of Armed Forces Yes ☐ No ☐

Veh: Year ______ Make ______ Color ______ Registration ______ Number ______ State ______ Year ______ M.V.No. ______

Amount of Damage $ ______

Owned By: ______ Name ______ Street or RFD ______ City and State ______ Parts Damaged ______

Drivable: Yes ☐ No ☐ Vehicle Removed To ______ By ______

Amt. of Dam. $ ______ Other Property Damage ______ Owner and Address ______

Injury Class K. Killed | A. Visible sign of injury as bleeding wound, distorted member or had to be carried from scene. | B. Other visible injury or bruises, abrasions, swelling, limping, etc. | C. No visible sign of injury but complaint of pain or momentary unconsciousness

INJURED PERSONS (Include fatally injured)

Veh.	Age	Sex	Race	Inj. Cl.	Name	Street or RFD	City	State

INDICATE NORTH

Injured taken to ______

Describe what happened: ______

Tire impressions prior to impact: No. 1 ______ No. 2 ______

Distance of travel after impact: No. 1 ______ No. 2 ______

WITNESSES

Name ______ Address ______

Name ______ Address ______

Arrests:

Name ______ Charge(s) ______ (Cit. No.) ______

Name ______ Charge(s) ______ (Cit. No.) ______

Sign Here ______ Officer's rank and name ______ Number ______ Department ______ Date of report

City Case No.

Zone No.

Tract No.

If city vehicle or prop. dam. give name of liability ins. co.

Veh. 1

Veh. 2

Authority for removal of vehicles:

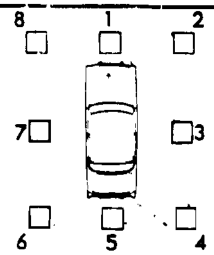
Veh. 1

Veh. 2

Remarks:

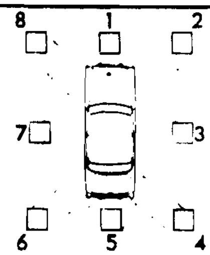
VEHICLE 1

POINT OF INITIAL CONTACT



VEHICLE 2

POINT OF INITIAL CONTACT



DIRECTION OF TRAVEL

VEH. 1 ☐ ☐ ☐ ☐ ON ____
N E S W

VEH. 2 OR PED. ☐ ☐ ☐ ☐ ON ____
N E S W

POLICE ACTIVITY

Time Notified of Accident ____ Date ____ Hour ☐ a.m. ☐ p.m.

Time Arrived at Scene ____ Hour ☐ a.m. ☐ p.m.

Source of information: ____
(Officer at scene, drivers contacted station, etc.)

ROADWAY FEATURE
(Check if applicable)

- ☐ 2. Bridge or Underpass
- ☐ 3. Driveway
- ☐ 4. Alley Intersection
- ☐ 5. Intersection of Two Roadways
- ☐ 6. Non-intersection Median Crossover
- ☐ 7. End or Beginning of Divided Highway

LOCALITY
(Check one)

- ☐ 8. Business
- ☐ 10. Residential
- ☐ 11. School & Playground
- ☐ 12 Open Country

FIXED OBJECT STRUCK
(Check first struck only)

- ☐ 1. Tree
- ☐ 2. Utility Pole
- ☐ 3. Fence or Fence Post
- ☐ 4. Guard Rail or Guard Post in Median
- ☐ 5. Guard Rail or Guard Post on Shoulder
- ☐ 6 Bridge
- ☐ 7. Underpass
- ☐ 8. Traffic island, curb, or median
- ☐ 9. Sign or Sign Post
- ☐ 10. Other Object
- ☐ 11. No object involved

ROAD CHARACTER
(Check one)

- ☐ 1. Straight road—level
- ☐ 2. Straight road—hillcrest
- ☐ 3. Straight road—on grade
- ☐ 4. Sharp Curve—level
- ☐ 5. Sharp curve—hillcrest
- ☐ 6. Sharp curve—on grade
- ☐ 7. Other curve—level
- ☐ 8. Other curve—hillcrest
- ☐ 9. Other curve—on grade

ROAD CONDITION
(Check one)

- ☐ 1. Dry
- ☐ 2. Wet
- ☐ 3. Oily
- ☐ 4 Muddy
- ☐ 5. Snowy
- ☐ 6 Icy

TRAFFIC CONTROL
(Check one or more)

- ☐ 1. Stop Sign
- ☐ 2. Yield Sign
- ☐ 3. Stop and Go Signal
- ☐ 4. Flashing Signal with Stop Sign
- ☐ 5. Flashing Signal without Stop Sign
- ☐ 6. R. R. Gate and Flasher
- ☐ 7. R. R. Flasher
- ☐ 8. Officer
- ☐ 9. Other Device
- ☐ 10. No Control Present
- ☐ 11. Control not operating properly
- ☐ 12. Control not visible or legible

ROAD DEFECTS
(Check one)

- ☐ 1. Loose material on surface
- ☐ 2. Holes, deep ruts
- ☐ 3. Low shoulders
- ☐ 4. Soft shoulders
- ☐ 5. Other defects
- ☐ 6. Road under construction
- ☐ 7. No defects

CONSTRUCTION
(Check one)

- ☐ 1. Concrete
- ☐ 2. Smooth Asphalt
- ☐ 3. Coarse Asphalt
- ☐ 4. Gravel
- ☐ 5. Dirt or Sand
- ☐ 6. Other .... (Specify)

LIGHT CONDITION
(Check one)

- ☐ 1. Daylight
- ☐ 2. Dusk
- ☐ 3. Dawn
- ☐ 4. Darkness (street lighted)
- ☐ 5. Darkness (street not lighted)

WEATHER
(Check one)

- ☐ 1. Clear
- ☐ 2. Cloudy
- ☐ 3. Raining
- ☐ 4. Snowing
- ☐ 5. Fog
- ☐ 6. Sleet or Hail

VEHICLE TYPE
Vehicle 1 2

- ☐ ☐ 1. Car ☐ House Trailer ☐ Trailer
- ☐ ☐ 2. Taxicab
- ☐ ☐ 3. Truck—2 axles
- ☐ ☐ 4. Truck—3 axles
- ☐ ☐ 5. Truck-Tractor and Semi-Trailer
- ☐ ☐ 6. Truck and Trailer
- ☐ ☐ 7. Bus .... (Specify)
- ☐ ☐ 8. Other .... (Describe)
- ☐ ☐ 9. Emergency Vehicle

VEHICLE CONDITION
Vehicle 1 2 (Check one or more)

- ☐ ☐ 1. Defective brakes
- ☐ ☐ 2. Defective headlights
- ☐ ☐ 3. Defective rear lights
- ☐ ☐ 4. Defective steering
- ☐ ☐ 5. Defective tires
- ☐ ☐ 6. Other defective equipment .... (Specify)
- ☐ ☐ 7. Not known if defective
- ☐ ☐ 8 No defects detected

VISION OBSTRUCTION
(Check one)
Driver 1 2

- ☐ ☐ 10. Windshield or windows
- ☐ ☐ 11 Buildings, signs, bushes, etc.
- ☐ ☐ 12. No vision obstruction

Posted speed limit ....mph

Speed of vehicle 1.........mph

Speed of vehicle 2.........mph

VIOLATION INDICATED
(Check one or more for each driver)
Driver 1 2

- ☐ ☐ 1. Exceeding stated limit
- ☐ ☐ 2. Failed to yield right of way
- ☐ ☐ 3. Drove left of center
- ☐ ☐ 4. Improper overtaking
- ☐ ☐ 5. Passed stop sign
- ☐ ☐ 6. Disregarded traffic signal
- ☐ ☐ 7. Followed too closely
- ☐ ☐ 8. Made improper turn
- ☐ ☐ 9. Improper or no signal
- ☐ ☐ 10. Improper parking location
- ☐ ☐ 11. Other improper driving .... (Describe)
- ☐ ☐ 12. No violation indicated

WHAT DRIVERS WERE DOING BEFORE ACCIDENT
Driver 1 2

(NON-MOVING Vehicles)

- ☐ ☐ 10. Stopped in Travel Lane
- ☐ ☐ 11. Parked out of travel lanes
- ☐ ☐ 12. Parked in travel lanes

(MOVING Vehicles)

- ☐ ☐ 1. Going straight ahead
- ☐ ☐ 2. Changing Lanes or Merging
- ☐ ☐ 3. Passing
- ☐ ☐ 4. Making right turn
- ☐ ☐ 5. Making left turn
- ☐ ☐ 6. Making U turn
- ☐ ☐ 7. Backing
- ☐ ☐ 8. Slowing or Stopping
- ☐ ☐ 9. Starting in Roadway
- ☐ ☐ 10. Parking
- ☐ ☐ 11. Leaving Parked Position
- ☐ ☐ 12. All Other

WHAT PEDESTRIAN WAS DOING
(Check one)

- ☐ 1. Crossing at intersection
- ☐ 2. Crossing not at intersection
- ☐ 3. Coming from behind parked Vehicle
- ☐ 4. Walking in roadway with traffic
- ☐ 5. Walking in roadway against traffic
- ☐ 6. Getting on or off vehicle
- ☐ 7. Standing in roadway
- ☐ 8. Working in roadway
- ☐ 9. Playing in roadway
- ☐ 10. Lying in roadway
- ☐ 11. Other in roadway............ (Specify)
- ☐ 12. Not in roadway

APPARENT PHYSICAL CONDITION
(Other than sobriety)
Driver 1 2 or PED.

- ☐ ☐ 1. Ill
- ☐ ☐ 2. Fatigued
- ☐ ☐ 3. Asleep
- ☐ ☐ 4. Other Physical Impairment
- ☐ ☐ 5 Restriction not Complied with
- ☐ ☐ 6. Normal
- ☐ ☐ 7. Condition not known

APPARENT SOBRIETY

- ☐ ☐ 10. Had not been drinking
- ☐ ☐ 11. Drinking—Ability impaired
- ☐ ☐ 12. Drinking—Unable to determine impairment
- ☐ ☐ 13. Chemical test given

APPENDIX 2
Discussion of Computer Program Used to "Decode" VIN

The vehicles examined in this study were catalogued on the basis of their reported production year, the VIN (vehicle identification number), and a four-character English name. The year, name, and VIN are supplied by the policeman at the accident scene. The computer program begins by checking the production year. Only those vehicles which were reported as produced after 1959 and before 1970 were catalogued. All others were classified as either pre-60 or post-69.

The four-character English name is used to assign each vehicle to a particular Make category. This is needed because each Make category may have a unique VIN format for each individual model year. Without this name it would be difficult to verify and decode the VIN. Following are a few examples of the 62 names recognized by the computer program and their corresponding Makes.

AMBA	American
BUIC	Buick
CADI	Cadillac
CHEV	Chevrolet
CORV	Chevrolet
DODG	Dodge
FORD	Ford
GTO	Pontiac
MUST	Ford
PLYM	Plymouth
PONT	Pontiac
MG	MG
VOLK	Volkswagen
VOLV	Volvo

If the program is unable to match a vehicle's name with one of those in the listing, the vehicle will be considered an uncommon make, and will be classified as such. Once a vehicle is tentatively classified by Make, the next step in the program is to check the VIN to determine whether or not it is valid.

The following are the specifications used to verify most of the VINs. Unless a vehicle meets all the following specifications, it will be coded as having an invalid VIN and then be deleted from analysis in any of the make groups.

1. Length - the VIN enters the program left justified. It must be the correct length with no spaces between the characters. All trailing characters must be blank.

2. Manufacturer's Symbol - this is usually the first character, and it must have a specific value depending on the Make.
   Examples:
   American (65-69) - 'A'
   Buick (65-69) - '4'
   Chevrolet (65-69) - '1'
   Pontiac (65-69) - '2'

3. Assembly Plant - this will have particular values for each year within a Make category.
   Examples:
   Chevrolet -
   'G' is valid for 68 but not for 69
   Chrysler -
   'C' is valid for 69 but not for 66
   '3' is valid for 67 but not for 68
   Dodge -
   'D' is valid for 68 but not for 67
   '4' is valid for 66 but not for 69
   'C' is valid for 69 but not for 68
   Ford -
   'L' is valid for 65 but not for 68
   Mercury -
   'F' is valid for 67 but not for 66
   Oldsmobile -
   'D' is valid for 68 but not for 67
   'G' is valid for 68 but not for 69
   Plymouth -
   'A' is valid for 68 but not for 67
   '9' is valid for 67 but not for 68
   Pontiac -
   'G' is valid for 67 and 68 but not for 66

These are only a few examples of acceptable Assembly Plant symbols, and the symbols do not necessarily fall in the same place within the VIN for all makes.

4. Model Year - the year in the VIN must agree with year estimated by the patrolman. There is an option in the program (used in this study) which applies to all vehicles not successfully classified the first time through. The program adds a year and then subtracts a year from the one reported by the patrolman. This is to allow for an error of one year by the patrolman. The checking of the VIN is then begun again. If the VIN meets all tests in the plus or minus year, it is accepted as that year, rather than the year reported by the officer.

5. Production Number - this is usually the last part of the VIN. This number must be at least as large as the minimum value set by the Manufacturer. This number is usually 100001, although Mercury begins with 500001. In the older models, this number is sometimes smaller.

6. Model Series Number - this is the Manufacturer's coding within the VIN to identify the model, the body style and sometimes the engine type.
Examples:
Buick -
'3307' is acceptable in 67 but not in 68
'4466' is acceptable in 69 but not in 68 or 67
Chevrolet -
'1111' is acceptable in 66 and 67 but not in 69
'0539' is acceptable in 67 but not in 68
'2437' is acceptable in 67 and 68 but not in 66
Dodge -
'LL23' is valid in 69 but not in 68
Ford -
'85' is acceptable in 68 but not in 69
Mercury -
'69' is acceptable in 68 but not in 69
Oldsmobile -
'3169' is valid for 68 but not in 69

These are only a few of the thousands of acceptable categories. A VIN must have a model series that matches one of the possibilities, otherwise, it will be considered as unknown.

The only other symbol that is sometimes in the VIN is the engine symbol. If this character is not valid, contrary to the treatment of the other symbols, the vehicle is not classed unknown, but rather only the engine type for the classed vehicle will be unknown.

The only vehicles which were not required to meet these specifications[1] were the three foreign makes (MG, Volvo, Renault). They were classified only on the basis of the production year and the four-character English name reported by the patrolman.

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[1]All specifications used to classify the vehicles were obtained from Motor Vehicle Identification Manual which is controlled by the National Automobile Theft Bureau and published by Palmer Publications Company, Downers Grove, Illinois, and the NADA Official Used Car Guide which is published by the National Automobile Dealers Used Car Guide Company, Washington, D. C.

APPENDIX 3
Groups for HSR Numbers

TYPE	YEAR
Group 1: BIG PONTIAC	
Star Chief	60-68
Bonneville	60-68
Group 2: MIDDLE PONTIAC	
Catalina	60-68
Grand Prix	62-68
2 + 2	66
Ventura	60-61
Group 3: SMALL PONTIAC	
Tempest	61-68
Tempest Custom	64-68
Tempest Safari	67-68
Lemans	63-68
Group 4: GTO	
GTO	66-68
Group 5: FIREBIRD	
Firebird	67-68
Group 6: STANDARD CHEVROLET	
Biscayne	60-68
Bel-Air	60-68
Impala	60-68
Impala SS	64-67
Caprice	66-68

TYPE	YEAR
Group 7: CHEVELLE	
Chevelle	64-68
Chevelle SS	66-68
Concours	67-68
Group 8: CHEVY II	
Chevy II	62-68
Group 9: CORVAIR	
Corvair	60-68
Group 10: CORVETTE	
Corvette	60-68
Group 11: CAMARO	
Camaro	67-68
Group 12: BIG BUICK	
Wildcat	65-68
Electra	60-68
Group 13: STANDARD BUICK	
LeSabre	60-68
Invicta	60-64
Group 14: SMALL BUICK	
Special & Deluxe	61-68
Sport Wagon	65-68
Skylark & Custom	62-68
Skylark Gran Sport	66-67
Group 17: BIG OLDSMOBILE	
98 & Luxury	60-68

TYPE	YEAR
Group 18: STANDARD OLDSMOBILE	
Jetstar I	64-65
All 88's	60-68
Starfire	61-66
Group 19: SMALL OLDSMOBILE	
F-85	61-68
F-85 Cutlass & Supreme	64-68
Group 22: STANDARD PLYMOUTH	
Belvedere Standard	60-64
Fury Police & Taxi	65-68
Fury I	60-68
Fury II	65-68
Fury III	65-68
Sport Fury	62-68
VIP	66-68
Savoy	60-64
Plymouth Police & Taxi	60-64
Group 23: SMALL PLYMOUTH	
Belvedere Standard	67-68
Belvedere I	65-67
Belvedere II	65-67
Belvedere Sport Satellite	68
Belvedere GTX	67-68
Belvedere Police & Taxi	65-68
Road Runner	68
Group 24: COMPACT PLYMOUTH	
Valiant V-100	60-68
Valiant V-200	60-66
Valiant Signet	62-68

TYPE		YEAR
Group 26: BIG DODGE		
Dodge Polara		60-68
Dodge Monaco		65-68
Dodge Monaco 500		66-68
Dodge Polara 318		66-67
Dodge Polara 500	62-64	67-68
Dodge Police & Taxi		63-68
Matador		60
"880"		62-65
Group 27: STANDARD DODGE		
Seneca		60-61
Pioneer		60-61
Phoenix		60-61
Dart "330"		62
Dart "440"		62
Dodge "330"		63-64
Dodge "440"		63-64
Group 28: SMALL DODGE		
Dart		62-68
Dart 270		64-68
Dart GT		64-68
Dart GTS		68
Coronet Deluxe & Standard		65-68
Coronet 440		65-68
Coronet 550		65-68
Coronet Police & Taxi		65-68
Coronet R/T		67-68
Coronet Super Bee		68
Group 32: STANDARD FORD		
Fairlane		60-61
Fairlane 500		60-61
Ford Custom		64-68
Ford Custom 500		64-68
Ford Galaxie 500		62-68
Ford Galaxie 500 XL		63-68
Ford Galaxie 500 LTD		65-68
Ford Galaxie 500 7 Liter		66
Station Wagon		60-67
Ford Galaxie		60-63
Ford 300		63

TYPE		YEAR
Group 33: FAIRLANE		
Fairlane		62-68
Fairlane 500		62-68
Fairlane Tornio		68
Fairlane Torino GT		68
Fairlane 500 XL		66-67
Fairlane GT & GTA		66-67
Fairlane Ranchero		66-68
Group 34: FALCON		
Falcon		60-68
Falcon Futura		62-68
Falcon Sprint		64-65
Group 36: MUSTANG		
Mustang		65-68
Group 37: MERCURY		
Monterey		60-68
Montclair	60	64-68
Parklane	60	64-68
Brougham		67
Marquis		67-68
Station Wagon		66-68
Meteor		61-63
Group 40: COUGAR		
Cougar		67-68
Group 50: VW -- TYPE I		
Bug		65-68
Karmann-Ghia		65-68
Type I		60-64
Group 51: VW -- Type II		
Station Wagon		65-68
Kombi or Campmobile		65-68
Pick-Up		65-68
Type II		60-64

TYPE	YEAR
Group 52: VW TYPE III	
Fastback	65-68
Squareback	65-68
Type III	60-64
Group 53: VOLVO	
All	60-68
Group 54: MG	
All	60-67
Group 55: RENAULT	
All	60-66

APPENDIX 4: The Reference Group

ERRATA: This Appendix was to have portrayed the 108 lines of the reference matrix.

A page was omitted depicting lines 65-86.

Fortunately, Appendix 6 also contains the reference matrix and the left hand of page 81 shows the material missing from this Appendix.

ALL CARS

CUMULATIVE ROW NO.		TOT - UN	NOT INJ	C INJ	B INJ	A INJ	KILLED	UNSPE
001	CAR RAN OFF ROAD 0-29 mph	004026	002980	00199	00334	00504	00009	00104
		100.00	074.01	04.94	08.29	12.51	00.22	
002	30-49 mph	014856	010374	00726	01342	02336	00078	00008
		100.00	069.83	04.88	09.03	15.72	00.52	
003	50+	020970	013316	00937	02021	04410	00286	00000
		100.00	063.50	04.46	09.63	21.03	01.36	
004	speed unspec.	005155	002862	00238	00443	01375	00237	00142
		100.00	055.51	04.61	08.59	26.67	04.59	
005	CAR HIT FIXED OBJECT (ON ROAD WAY) FRONT IMPACT 0-29	000230	000185	00008	00010	00027	00000	00001
		100.00	080.43	03.47	04.34	11.73	00.00	
006	30-49	000474	000367	00017	00029	00059	00002	00001
		100.00	077.42	03.58	06.11	12.44	00.42	
007	50+	000403	000277	00009	00035	00073	00009	00000
		100.00	068.73	02.23	08.68	18.11	02.23	
008	UNSP	000139	000079	00004	00012	00036	00008	00002
		100.00	056.83	02.87	08.63	25.89	05.75	
009	RIGHT SIDE IMPACT 0-29	000035	000034	00000	00001	00000	00000	00000
		100.00	097.14	00.00	02.85	00.00	00.00	
010	30-49	000028	000021	00001	00003	00002	00001	00000
		100.00	075.00	03.57	10.71	07.14	03.57	
011	50+	000033	000022	00000	00002	00009	00000	00000
		100.00	066.66	00.00	06.06	27.27	00.00	
012	UNSP	000011	000007	00000	00002	00002	00000	00000
		100.00	063.63	00.00	18.18	18.18	00.00	
013	LEFT SIDE 0-29	000017	000014	00000	00003	00000	00000	00000
		100.00	082.35	00.00	17.64	00.00	00.00	
014	30-49	000018	000014	00000	00001	00002	00001	00000
		100.00	077.77	00.00	05.55	11.11	05.55	
015	50+	000021	000016	00002	00002	00001	00000	00000
		100.00	076.19	09.52	09.52	04.76	00.00	
016	UNSP	000012	000006	00001	00000	00004	00001	00000
		100.00	050.00	08.33	00.00	33.33	08.33	
017	REAR 0-29	000016	000015	00000	00001	00000	00000	00001
		100.00	093.75	00.00	06.25	00.00	00.00	
018	30-49	000038	000036	00000	00000	00002	00000	00000
		100.00	094.73	00.00	00.00	05.26	00.00	
019	50+	000041	000034	00002	00001	00004	00000	00000
		100.00	082.92	04.87	02.43	09.75	00.00	
020	UNSP	000010	000009	00000	00001	00000	00000	00002

			*100.00	090.00	00.00	10.00	00.00	00.00	
IMPACT SITE		0-29	*000047	000041	00001	00001	00004	00000	00000
			*100.00	087.23	02.12	02.12	08.51	00.00	
UNSPEC.		30-49	*000034	000028	00001	00003	00001	00001	00000
			*100.00	082.35	02.94	08.82	02.94	02.94	
	023	50+	*000015	000006	00000	00002	00006	00001	00000
			*100.00	040.00	00.00	13.33	40.00	06.66	
	024	UNSP mph	*000013	000011	00000	00000	00000	00002	00000
			*100.00	084.61	00.00	00.00	00.00	15.38	
CAR HIT OTHER OBJECT	025	0-29	*000423	000308	00016	00041	00054	00004	00002
			*100.00	072.81	03.78	09.69	12.76	00.94	
	026	30-49	*000642	000445	00016	00091	00089	00001	00000
			*100.00	069.31	02.49	14.17	13.86	00.15	
	027	50+ mph	*000510	000333	00025	00056	00087	00009	00000
			*100.00	065.29	04.90	10.98	17.05	01.76	
	028	UNSP mph	*000169	000113	00012	00012	00028	00004	00001
			*100.00	066.86	07.10	07.10	16.56	02.36	
	029	0-29	*045719	042385	01074	01117	01131	00012	01103
			*100.00	092.70	02.34	02.44	02.47	00.02	
FRONT	030	30-49	*030460	025719	01052	01447	02206	00036	00350
			*100.00	084.43	03.45	04.75	07.24	00.11	
	031	50+	*008846	006490	00277	00488	01458	00133	00065
			*100.00	073.36	03.13	05.51	16.48	01.50	
	032	UNSP	*006474	005611	00210	00239	00377	00037	00006
			*100.00	086.66	03.24	03.69	05.82	00.57	
	033	0-29	*003482	003270	00079	00069	00064	00000	00139
			*100.00	093.91	02.26	01.98	01.83	00.00	
RIGHT	034	30-49	*003624	003197	00112	00121	00190	00004	00023
			*100.00	088.21	03.09	03.33	05.24	00.11	
CAR vs. CAR	035	50+	*001219	000979	00023	00054	00145	00018	00008
			*100.00	080.31	01.88	04.42	11.89	01.47	
	036	UNSP	*000796	000693	00026	00028	00044	00005	00000
			*100.00	087.06	03.26	03.51	05.52	00.62	
	037	0-29	*003878	003470	00177	00115	00114	00002	00597
			*100.00	089.47	04.56	02.96	02.93	00.05	
LEFT	038	30-49	*004165	003482	00219	00203	00249	00012	00103
			*100.00	083.60	05.25	04.87	05.97	00.28	
	039	50+	*001782	001449	00056	00093	00151	00033	00021
			*100.00	081.31	03.14	05.21	08.47	01.85	
	040	UNSP	*000915	000778	00044	00052	00035	00006	00000
			*100.00	085.02	04.80	05.68	03.82	00.65	
	041	0-29	*023442	021459	01486	00273	00214	00010	02363
			*100.00	091.54	06.33	01.16	00.91	00.04	
	042	30-49	*010268	009174	00704	00211	00174	00005	00876

			*100.00	089.34	06.85	02.05	01.69	00.04	
REAR	043	50+	*002699	002425	00127	00061	00079	00007	00117
			*100.00	089.84	04.70	02.26	02.92	00.25	
	044	UNSP	*002100	001942	00101	00028	00027	00002	00015
			*100.00	092.47	04.80	01.33	01.28	00.09	
	045	0-29	*000039	000038	00000	00000	00001	00000	00002
			*100.00	097.43	00.00	00.00	02.56	00.00	
UNSP	046	30-49	*000025	000024	00001	00000	00000	00000	00001
			*100.00	096.00	04.00	00.00	00.00	00.00	
	047	50+	*000032	000027	00000	00001	00004	00000	00000
			*100.00	084.37	00.00	03.12	12.50	00.00	
	048	UNSP	*000022	000022	00000	00000	00000	00000	00000
			*100.00	100.00	00.00	00.00	00.00	00.00	
	049	0-29	*011307	010603	00216	00218	00258	00012	00274
			*100.00	093.77	01.91	01.92	02.28	00.10	
FRONT	050	30-49	*008377	007108	00249	00334	00642	00044	00063
			*100.00	084.85	02.97	03.98	07.66	00.52	
	051	50+	*002803	002070	00088	00170	00394	00081	00023
			*100.00	073.84	03.13	06.06	14.05	02.88	
	052	UNSP	*001278	001104	00049	00034	00079	00012	00001
			*100.00	086.38	03.83	02.66	06.18	00.93	
CAR vs TRUCK	053	0-29	*001175	001105	00022	00020	00027	00001	00035
			*100.00	094.04	01.87	01.70	02.29	00.08	
RIGHT	054	30-49	*001140	001027	00023	00026	00056	00008	00012
			*100.00	090.08	02.01	02.28	04.91	00.70	
	055	50+	*000456	000366	00021	00024	00037	00008	00002
			*100.00	080.26	04.60	05.26	08.11	01.75	
	056	UNSP	*000223	000203	00011	00000	00007	00002	00000
			*100.00	091.03	04.93	00.00	03.13	00.89	
	057	0-29	*001151	001070	00037	00019	00025	00000	00159
			*100.00	092.96	03.21	01.65	02.17	00.00	
LEFT	058	30-49	*001337	001144	00050	00046	00087	00010	00026
			*100.00	085.56	03.73	03.44	06.50	00.74	
	059	50+	*000547	000453	00021	00022	00042	00009	00010
			*100.00	082.81	03.83	04.02	07.67	01.64	
	060	UNSP	*000190	000152	00014	00009	00013	00002	00000
			*100.00	080.00	07.36	04.73	06.84	01.05	
	061	0-29	*006843	006306	00375	00071	00088	00003	00509
			*100.00	092.15	05.48	01.03	01.28	00.04	
REAR	062	30-49	*002885	002592	00168	00062	00060	00003	00145
			*100.00	089.84	05.82	02.14	02.07	00.10	
	063	50+	*000748	000675	00026	00018	00028	00001	00033
			*100.00	090.24	03.47	02.40	03.74	00.13	
	064	UNSP	*000485	000446	00023	00003	00013	00000	00001

			*100.00	085.00	05.00	00.00	10.00	00.00	
UNSP	087	50+	*000014	000012	00000	00000	00002	00000	00013
			*100.00	085.71	00.00	00.00	14.28	00.00	
	088	UNSP	*000037	000011	00007	00003	00010	00006	02127
			*100.00	029.72	18.91	08.10	27.02	16.21	
	089	0-29	*002815	002321	00080	00171	00236	00007	00138
			*100.00	082.45	02.84	06.07	08.38	00.24	
FRONT		30-49	*001917	001347	00072	00163	00311	00024	00002
			*100.00	070.26	03.75	08.50	16.22	01.25	
	091	50+	*000708	000496	00017	00047	00124	00024	00000
			*100.00	070.05	02.40	06.63	17.51	03.38	
	092	UNSP	*000467	000324	00014	00042	00073	00014	00005
			*100.00	069.37	02.99	08.99	15.63	02.99	
OTHER CRASHES — RIGHT	093	0-29	*000472	000399	00015	00014	00037	00007	00027
			*100.00	084.53	03.17	02.96	07.83	01.48	
	094	30-49	*000191	000154	00005	00009	00019	00004	00001
			*100.00	080.62	02.61	04.71	09.94	02.09	
	095	50+	*000066	000048	00002	00005	00010	00001	00000
			*100.00	072.72	03.03	07.57	15.15	01.51	
	096	UNSP	*000063	000044	00000	00004	00014	00001	00000
			*100.00	069.84	00.00	06.34	22.22	01.58	
LEFT	097	0-29	*000510	000392	00016	00030	00064	00008	00073
			*100.00	076.86	03.13	05.88	12.54	01.56	
	098	30-49	*000229	000166	00011	00015	00033	00004	00002
			*100.00	072.48	04.80	06.55	14.41	01.74	
	099	50+	*000053	000041	00002	00000	00009	00001	00000
			*100.00	077.35	03.77	00.00	16.98	01.88	
	100	UNSP	*000077	000050	00007	00005	00011	00004	00001
			*100.00	064.93	09.09	06.49	14.28	05.19	
REAR	101	0-29	*001848	001625	00090	00066	00063	00004	00215
			*100.00	087.93	04.87	03.57	03.40	00.21	
	102	30-49	*000397	000349	00009	00021	00017	00001	00003
			*100.00	087.90	02.26	05.28	04.28	00.25	
	103	50+	*000128	000111	00003	00003	00009	00002	00000
			*100.00	086.71	02.34	02.34	07.03	01.56	
	104	UNSP	*000158	000134	00008	00007	00007	00002	00003
			*100.00	084.81	05.06	04.43	04.43	01.26	
UNSP	105	0-29	*000045	000039	00000	00001	00003	00002	00001
			*100.00	086.66	00.00	02.22	06.66	04.44	
	106	30-49	*000040	000033	00002	00001	00003	00001	00000
			*100.00	082.50	05.00	02.50	07.50	02.50	
	107	50+	*000015	000011	00000	00001	00003	00000	00000
			*100.00	073.33	00.00	06.66	20.00	00.00	
	108	UNSP	*000032	000030	00000	00002	00000	00000	00006
			*100.00	093.75	00.00	06.25	00.00	00.00	
	TOTALS		*270697	226947	11027	11474	19900	01349	12260
			*100.00	083.83	04.07	04.23	07.35	00.49	

APPENDIX 5: Underlying Theory for Statistical Analysis

This study is concerned with comparisons among various types of automobiles involved in highway accidents with respect to the extent of personal injury to the drivers so involved. In order to control for the effects of factors pertaining to the severity of an accident on the degree of personal injury, the statistical evaluations reported here have been adjusted for the following:

1. accident type
2. area of impact
3. traveling speed just before the crash

The theoretical principles which are the basis of this analysis will be described in the remainder of this appendix.

Let $n_{hijk\ell}$ denote the frequency of the h-th degree of personal injury to occupants in the ℓ-th vehicle make and model involved in the i-th accident type with the j-th area of impact and the k-th speed. The subscripts h, i, j, k, ℓ have levels defined as follows:

h = 1	uninjured
= 2	C injury
= 3	B injury
= 4	A injury
= 5	Killed

i	= 1	car off road
	= 2	car vs fixed object
	= 3	car vs other object
	= 4	car vs car
	= 5	car vs truck
	= 6	multiple vehicle
	= 7	other
j	= 1	front
	= 2	right
	= 3	left
	= 4	rear
	= 5	unspecified
k	= 1	0-29 mph
	= 2	30-49 mph
	= 3	50+ mph
	= 4	unspecified
ℓ	= 1	some specified make and/or model
	2	all other makes and models

For the accident types "car off road" and "car vs other object", only the unspecified point of impact is used (i.e., the officer usually classifies the impact site for these types of accidents as unspecified). Hence, there are 108 combinations of accident type, impact site, and speed which are used in the analysis.

Define $r_{hijk} = \sum_{\ell} n_{hijk\ell}$. This quantity represents the frequency of the h-th degree of personal injury to drivers involved in the (i,j,k)-th accident situation. The set of $\{r_{hijk}\}$ describe the distribution of injury severity for the overall reference population consisting of the totality of all makes and models. Finally, define $r_{.ijk} = \sum_h r_{hijk}$. This quantity represents the frequency of the (i,j,k)-th accident situation in the overall reference population. Hence

$$p_{hijk} = (r_{hijk}/r_{.ijk})$$

represents the conditional probability of the h-th degree of injury to a driver in the (i,j,k)-th accident situation within the overall reference population of 270,697 drivers involved in reportable accidents in North Carolina during 1966 and 1968 for which the required information was available.

If driver injury in a specific make and model (ℓ=1) is no different from the overall reference population (in the sense of proportion uninjured or the proportion seriously injured, etc.), then the expected frequency for the h-th degree of injury for that model in the (i,j,k)-th accident situation is given by

$$m_{hijk\ell} = n_{.ijk\ell}\, p_{hijk}$$

where $n_{.ijk\ell} = \sum_h n_{hijk\ell}$ represents the frequency of the (i,j,k)-th accident situation for drivers of the ℓ-th model.

In order to obtain an overall comparison of driver injuries in a specific make and model with the reference population, both $n_{hijk\ell}$ and $m_{hijk\ell}$ are summed over the totality of accident situations (i,j,k) to determine

$$n_{h\ell} = \sum_{i,j,k} n_{hijk\ell}, \; m_{h\ell} = \sum_{i,j,k} m_{hijk\ell}.$$

If $n_{h\ell} \approx m_{h\ell}$, then the specific make and model is said to be no different from the overall reference population with respect to the distribution of injury severity. However, if $n_{1\ell} > m_{1\ell}$ and $n_{h\ell} < m_{h\ell}$ for $h \neq 1$, then the indicated vehicle is better than the reference population in the sense of having fewer injuries than expected. On the other hand, if $n_{1\ell} < m_{1\ell}$ and $n_{h\ell} > m_{h\ell}$ for $h \neq 1$, then the indicated vehicle is poorer than the reference population. The ratios $(n_{h\ell}/m_{h\ell})$ reflect the relationship between observed and expected levels of injury. Graphs showing these appear elsewhere in this report.

The statistical significance of the difference between $n_{h\ell}$ and $m_{h\ell}$ can be evaluated by means of a X^2-test where

$$X^2 = (n_{h\ell} - m_{h\ell})^2 / v_{h\ell}, \; D.F. = 1$$

where $v_{h\ell}$ is an appropriate estimate of the variance of $(n_{h\ell} - m_{h\ell})$. If the hypothesis that $n_{h\ell} \approx m_{h\ell}$ is true, then X^2 has approximately the chi-square distribution with D.F. = 1. This may be used as the basis for determining significant differences between $n_{h\ell}$ and $m_{h\ell}$. To perform the X^2-test, however, one needs an estimate of $v_{h\ell}$. There are a number of choices for $v_{h\ell}$ depending on the extent to which the researcher wants to be more or less conservative. This can be seen more clearly by considering the following aspects of contingency table theory.

For a specific accident situation (i,j,k), let the following 2×2 table reflect the injury by make and model frequency distribution

	$\ell=1$	$\ell=2$	Total
Uninjured h=1	N_{11}	N_{12}	r_1
Injured h=2,3,4,5	N_{21}	N_{22}	r_2
Total	$N_{.1}$	$N_{.2}$	N

If the marginal total frequencies r_1 and r_2 for degree of injury and $N_{.1}$ and $N_{.2}$ for make and model are viewed as fixed pre-specified constants and N_{11} is viewed as a random variable, then the distribution of N_{11} under the hypothesis that the classifications for injury severity and vehicle make and model are statistically independent is

$$p\{N_{11}\} = (r_1!r_2!N_{.1}!N_{.2}!)/N!N_{11}!N_{12}!N_{21}!N_{22}!.$$

From this distribution, it follows that

$$E\{N_{11}\} = (r_1N_{.1})/N \equiv M_{11}$$

$$Var\{N_{11}\} = (r_1r_2N_{.1}N_{.2})/N^2(N-1)$$

$$= M_{11}\ \{(1-\frac{r_1}{N})(1-\frac{N_{.1}-1}{N-1})\}\ .$$

Since $Var(N_{11})$ can be determined for each (i,j,k) combination as

$$var(n_{1ijk\ell}) = m_{1ijk\ell}\{(1-\frac{r_{1ijk}}{r_{.ijk}})(1-\frac{n_{.ijk\ell}-1}{r_{.ijk}-1})\},$$

then the expression for v_{11} is given by

$$v_{11} = \sum_{i,j,k} \mathrm{var}(n_{1ijk\ell}).$$

Alternatively, one may prefer to view only $N_{.1}$ and $N_{.2}$ as fixed. In this case, then under the hypothesis of no difference between the specific model and the reference population, it can be assumed that both N_{11} and N_{12} have binomial distributions $Bi(N_{.1},\theta_1)$ and $Bi(N_{.2},\theta_1)$ where θ_1 represents the probability of no injury in the reference population. From these conditions, it follows that

$$\begin{aligned} E\{(N_{11}-M_{11})\} &= E\{(N_{11} - \frac{(N_{11}+N_{12})N_{.1}}{N})\} \\ &= E\{N_{11} (\frac{N_{.2}}{N}) - N_{12} (\frac{N_{.1}}{N})\} \\ &= 0 \end{aligned}$$

$$\begin{aligned} \mathrm{Var}\{(N_{11}-M_{11})\} &= (\frac{N_{.2}}{N})^2 N_{.1}\theta_1(1-\theta_1) + (\frac{N_{.1}}{N})^2 N_{.2}\theta_1(1-\theta_1) \\ &= \frac{N_{.1}N_{.2}}{N} \theta_1(1-\theta_1). \end{aligned}$$

Since the most appropriate estimate of θ_1 is (r_1/N) which is based on the overall reference population, an estimate v for the variance of $(N_{11}-M_{11})$ is

$$\begin{aligned} v &= \frac{N_{.1}N_{.2}}{N} (\frac{r_1}{N})(1 - \frac{r_1}{N}) \\ &= M_{11}\{(1-(r_1/N))(1-N_{.1}/N)\}. \end{aligned}$$

On the other hand, the unbiased estimate for $\theta_1(1-\theta_1)$ is $(\frac{N}{N-1})(\frac{r_1}{N})(1 - \frac{r_1}{N})$. If this is used to determine v, then

$$v = M_{11}\{(1 - \frac{r_1}{N})(1 - \frac{N_{.1}-1}{N-1})\}$$

as before. Again either v may be determined for each (i,j,k) combination and added as indicated before.

Finally, if only N is fixed as representing the total number of accidents and if the frequencies in the 2×2 table follow a multinomial distribution, then under the hypothesis of independence between accident severity and vehicle make and model, it follows that

$$E\{(N_{11}-M_{11})\} = 0$$

$$\begin{aligned} Var\{(N_{11}-M_{11})\} &= E\{\frac{N_{.1}N_{.2}}{N}\,\theta_1(1-\theta_1)\} \\ &= (N-1)\phi_1(1-\phi_1)\theta_1(1-\theta_1) \end{aligned}$$

where ϕ_1 represents the probability that the specified make and model is involved in an accident. As before, (r_1/N) can be used to estimate θ_1 and $(N_{.1}/N)$ can be used to estimate ϕ_1. Hence, an estimate v for the variance of $(N_{11}-M_{11})$ in this situation is

$$\begin{aligned} v &= \frac{r_1}{N}\,\frac{N_{.1}}{N}(1 - \frac{r_1}{N})(1 - \frac{N_{.1}}{N})(N-1) \\ &= M_{11}(1 - \frac{r_1}{N})(1 - \frac{N_{.1}}{N})(1 - \frac{1}{N}). \end{aligned}$$

Alternatively, if $\theta_1(1-\theta_1)$ is replaced by its unbiased estimate $(\frac{N}{N-1})(\frac{r_1}{N})(1 - \frac{r_1}{N})$ and $\phi_1(1-\phi_1)$ is replaced by its unbiased estimate $(\frac{N}{N-1})(\frac{N_{.1}}{N})(1 - \frac{N_{.1}}{N})$, then v becomes

$$v = \frac{r_1}{N}\frac{N_{.1}}{N}(1 - \frac{r_1}{N})(1 - \frac{N_{.1}}{N})(\frac{N}{N-1})^2(N-1)$$

$$= \frac{r_1 N_{.1}}{N}\{(1 - \frac{r_1}{N})(1 - \frac{N_{.1}-1}{N-1})\}$$

as in the two preceding cases. Hence, each of these three different points of view lead to essentially the same v.

Each of the analyses thus far presented was based on considering the statistical properties of 2×2 contingency tables contrasting injury with make and model. Another point of view is to interpret the data for the reference population as a pre-specified standard to which all makes and models are to be compared and which has statistical properties which are completely independent of the various makes and models which comprise it. This perspective does not at first appear intuitively appealing. However, if one recalls that there are a very large number of makes and models which are each making a small contribution to the reference population, then it does have some properties in its favor; particularly if one wishes to say that the comparison of specific makes and models to it are independent. The statistical analysis for this situation is based on considering the (1×2) table reflecting injury for the specific make and model as compared to

	$\ell=1$
Uninjured h=1	N_{11}
Injured h=2,3,4,5	N_{21}
Total	$N_{.1}$

the distribution in the reference population. Hence if N_{11} has the binomial distribution $Bi(N_{.1},\theta_1)$, then

$$E\{(N_{11}-M_{11})\} = E\{(N_{11} - \frac{r_1 N_{.1}}{N})\}$$

$$= N_{.1}\{\theta_1 - E(\frac{r_1}{N})\}$$

$$Var\{(N_{11}-M_{11})\} = N_{.1}\theta_1(1-\theta_1)+(\frac{N_{.1}}{N})^2 Var(r_1).$$

There are two cases of interest here with respect to the distribution in the reference population. In the first situation, both r_1 and r_2 are viewed as fixed constants and θ_1 is taken to be $\theta_1 = (r_1/N)$. In this case, $E(r_1/N) = \theta_1$ and $Var(r_1) = 0$, and hence

$$E\{(N_{11}-M_{11})\} = 0$$

$$Var\{(N_{11}-M_{11})\} = N_{.1}(\frac{r_1}{N})(1 - \frac{r_1}{N})$$

$$= M_{11}(1 - \frac{r_1}{N}).$$

On the other hand, r_1 can be presumed to have the binomial distribution $Bi(N, \theta_1)$ and to be statistically independent of N_{11}. Hence $E(r_1/N) = \theta_1$ and $Var(r_1) = N\theta_1(1-\theta_1)$. As a result,

$$E\{(N_{11}-M_{11})\} = 0$$

$$Var\{(N_{11}-M_{11})\} = N_{.1}\theta_1(1-\theta_1)+(\frac{N_{.1}}{N})^2 N\theta_1(1-\theta_1)$$

$$= N_{.1}\theta_1(1-\theta_1)(1 + \frac{N_{.1}}{N}).$$

On replacing θ_1 by its unbiased estimate (r_1/N) based on the reference population, the appropriate estimate $\tilde{v}$ for the variance of $(N_{11}-M_{11})$ is

$$\tilde{v} = N_{.1}(\frac{r_1}{N})(1 - \frac{r_1}{N})(1 + \frac{N_{.1}}{N})$$

$$= M_{11}(1 - \frac{r_1}{N})(1 + \frac{N_{.1}}{N}).$$

Alternatively, if $\theta_1(1-\theta_1)$ is replaced by its unbiased estimate $(\frac{N}{N-1})(\frac{r_1}{N})(1 - \frac{r_1}{N})$ in the reference population, then $\tilde{v}$ becomes

$$\tilde{v} = N_{.1}(\frac{r_1}{N})(1 - \frac{r_1}{N})(1 + \frac{N_{.1}}{N})(\frac{N}{N-1})$$

$$= M_{11}(1 - \frac{r_1}{N})(1 + \frac{N_{.1}+1}{N-1}).$$

In each of these expressions for $\tilde{v}$, the estimate for θ_1 is based on the reference population in order to make the comparisons of specific makes and models to the reference population based on the same standard and to be consistent with other types of analyses. Again $\tilde{v}$ can be computed for each accident situation (i,j,k) and then summed. This then provides the estimate of variance for the overall comparison and X^2-statistic.

The previous discussion has been focused on the comparison of a specific make and model to the overall reference population. Another hypothesis of interest pertains to the comparison of a specific make and model to the totality of all other makes and models. Let us again recall the 2×2 table

	$\ell=1$	$\ell=2$	Total
Uninjured h=1	N_{11}	N_{12}	r_1
Injured h=2,3,4,5	N_{21}	N_{22}	r_2
Total	$N_{.1}$	$N_{.2}$	N

and assume that $N_{.1}$ and $N_{.2}$ are fixed constants and N_{11} and N_{12} have independent binomial distributions $Bi(N_{.1},\theta_1)$ and $Bi(N_{.2},\theta_2)$ respectively. The hypothesis of interest is H_0: $\theta_1=\theta_2$.

Given that this hypothesis is true, then an estimate for the expected value of N_{11} based on the value of N_{12} is $N_{.1}(N_{12}/N_{.2})$. Let

$$U = N_{11} - (\frac{N_{12}}{N_{.2}})N_{.1} \ .$$

It then follows that

$$E\{U\} = 0$$

$$\begin{aligned} Var\{U\} &= N_{.1}\theta_1(1-\theta_1)+(\frac{N_{.1}}{N_{.2}})^2 N_{.2}\theta_1(1-\theta_1) \\ &= N_{.1}\theta_1(1-\theta_1)(1 + \frac{N_{.1}}{N_{.2}}). \end{aligned}$$

If θ_1 is replaced by its estimate (r_1/N) in the reference population, then an estimate v* for Var{U} is

$$v^* = N_{.1}\left(\frac{r_1}{N}\right)\left(1 - \frac{r_1}{N}\right)\left(1 - \frac{N_{.1}}{N}\right)^{-1}$$

$$\approx M_{11}\left(1 - \frac{r_1}{N}\right)\left(1 + \frac{N_{.1}}{N}\right)$$

where $(1 - \frac{N_{.1}}{N})^{-1} \approx (1 + \frac{N_{.1}}{N})$ is a reasonable approximation if $(N_{.1}/N)<0.10$. Hence, $v^* \approx \tilde{v}$. A similar result is obtained if $\theta_1(1-\theta_1)$ is replaced by $(\frac{N}{N-1})(r_1/N)(1 - (r_1/N))$. Finally, the expression for U may also be approximated by a familiar quantity

$$U = N_{11} - \frac{N_{12}}{N_{.2}} N_{.1}$$

$$= N_{11} - \frac{(r_1-N_{11})N_{.1}}{N-N_{.1}}$$

$$= N_{11} - \frac{r_1 N_{.1}}{N}\left\{\left(1 - \frac{N_{11}}{r_1}\right)\left(1 - \frac{N_{.1}}{N}\right)^{-1}\right\}$$

$$\approx N_{11}-M_{11}\left\{1 + \frac{N_{.1}}{N} - \frac{N_{11}}{r_1}\right\}$$

$$\approx N_{11}-M_{11}$$

where the approximation is reasonable if $(N_{11}/r_1)\approx(N_{.1}/N) < 0.10$. If the hypothesis is true and if the reference population contains many different makes and models as the one reported here does, both of these approximations are justified. Hence, the X^2-test for U given by $X^2 = (U^2/v^*)$ where both U and v^* have been summed over (i,j,k) is approximately equal to the X^2-test for comparing the specific make and model with the reference population based on $\tilde{v}$ (i.e., the reference population distribution is random and independent of the specific make and model).

Because the X^2-test based on $\tilde{v}$ (or v*) arises from the two previously cited different connotations, it was the one used in the statistical analysis reported in this paper. Moreover, since $\tilde{v} > v$, this approach is conservative in the sense of finding fewer significant results than would have been reported if v had been used. On the other hand since the difference between $\tilde{v}$ and v is small whenever $(N_{.1}/N)$ is small and since $(N_{.1}/N)$ is always less than 0.10 and usually less than 0.05 for the makes and models in this study, the results of all of these various X^2-test procedures are felt to be very similar.

<u>Example</u>: Volkswagen and all injuries. $N_{.1}$=4209 and N=270,697.

$$N_{11} = 1050 \qquad M_{11} = 747.57 \qquad \tilde{v}_{11} = 575.00$$

$$X^2_{11} = 159.07, \quad \text{D.F.} = 1$$

Since $(N_{.1}/N) < 0.02$ and X^2 is very large, the conclusions for this example as well as numerous others really are not overly sensitive to the minor details of statistical test procedures previously discussed in this appendix. This fact has already been justified by the various arguments presented here which have been given so that the reader has a clearer understanding of the statistical methodology involved.

Finally, for the "injury by car body style" comparisons, standard 95% and 99% confidence intervals for binomial proportions were constructed with an appropriate correction for continuity. Hence, these methods are also conservative with respect to the detection of statistical significance.

APPENDIX 6: Sample Print-Out for 1960 Ford

1960 FORD

320060

ALL CARS

CUMULATIVE ROW NO.		TOT - UN	NOT INJ	C INJ	B INJ	A INJ	KILLED	UNSPEC	TOT - UN	NOT INJ	C INJ	B INJ	A INJ	KILLED	UNSPEC	F INJ	F A+K	E K	O-E IA+KK
001	CAR RAN OFF ROAD 0-29 MPH	004026	002980	00199	00334	00504	00009	00104	000017	000010	00001	00003	00001	00000	00000	*000004.41	00002.16	0000.03	+ + -
		100.00	074.01	04.94	08.29	12.51	00.22		100.00	058.82	05.88	17.64	17.64	00.00		*000003.27	00001.89	0000.03	
002	30-49 MPH	014856	010376	00726	01342	02336	00078	00009	000089	000068	00007	00007	00007	00000	00000	*000026.85	00014.45	0000.46	- - -
		100.00	069.83	04.88	09.03	15.72	00.52		100.00	076.40	07.86	07.86	07.86	00.00		*000018.85	00012.17	0000.46	
003	50+	020970	013316	00937	02021	04410	00286	00003	000159	000108	00005	00014	00028	00004	00000	*000058.03	00035.60	0002.36	- - +
		100.00	063.50	04.46	09.63	21.03	01.36		100.00	067.92	03.14	08.80	17.61	02.51		*000037.12	00027.83	0002.14	
004	speed unsp.	005155	002862	00238	00483	01375	00237	00142	000039	000025	00001	00005	00008	00000	00001	*000017.35	00012.19	0001.79	- -
		100.00	055.51	04.61	08.59	26.67	04.59		100.00	064.10	02.56	12.82	20.51	00.00		*000009.70	00008.44	0001.12	
005	FRONT IMPACT 0-29	000232	000185	00009	00010	00027	00000	00001	000001	000000	00000	00000	00001	00000	00000	*000000.19	00000.11	0000.[illegible]	- + 0
		100.00	[illegible]	[illegible]	[illegible]	11.71	00.00		100.00	000.00	00.00	00.00	00.00	00.00		*000000.15	00000.09	0000.[illegible]	
006	30-49	[illegible]	000367	[illegible]	[illegible]	00059	00002	00001	000002	000002	00000	00000	00000	00000	00000	*000000.45	00000.25	0000.[illegible]	- - 0
		[illegible]	[illegible]	[illegible]	[illegible]	12.[illegible]	[illegible]		100.00	100.00	00.00	00.00	00.00	00.00		*000000.34	00000.21	0000.00	
007	50+	[illegible]	[illegible]	[illegible]	[illegible]	00071	[illegible]	00000	000004	000002	00000	00001	00001	00000	00000	*000001.[illegible]	00000.81	0000.08	+ + -
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	02.[illegible]		[illegible]	050.00	00.00	25.00	25.00	00.00		*000000.85	00000.65	0000.07	
008	UNSP	[illegible]	[illegible]	[illegible]	[illegible]	00036	[illegible]	00002	000001	000000	00000	00001	00000	00000	00000	*000000.43	00000.11	0000.[illegible]	+ - -
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		100.00	000.00	00.00	00.00	00.00	00.00		*000000.28	00000.21	0000.08	
009	RIGHT SIDE IMPACT 0-29	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
010	30-49	000028	000021	[illegible]	[illegible]	00002	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	075.00	03.57	[illegible]	[illegible]	03.57		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
011	50+	000033	000022	00000	00002	00009	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	066.66	00.00	06.06	27.27	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
012	UNSP	000011	000007	00000	00002	00002	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	063.63	00.00	18.18	18.18	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
013	LEFT SIDE 0-29	000017	000014	00000	00003	00000	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	082.35	00.00	17.64	00.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
014	30-49	000018	000014	00000	00001	00002	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	077.77	00.00	05.55	11.11	05.55		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
015	50+	000021	000016	00002	00002	00001	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	076.19	09.52	09.52	04.76	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
016	UNSP	000012	000006	00001	00000	00004	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	050.00	08.33	00.00	33.33	08.33		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
017	REAR 0-29	000016	000015	00000	00001	00000	00000	00001	000001	000001	00000	00000	00000	00000	00000	*000000.06	00000.00	0000.00	- 0 0
		100.00	093.75	00.00	06.25	00.00	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000000.05	00000.00	0000.00	
018	30-49	000038	000036	00000	00000	00002	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	094.73	00.00	00.00	05.26	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
019	50+	000041	000034	00002	00001	00004	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		100.00	082.92	04.87	02.43	09.75	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
020	UNSP	000010	000009	00000	00001	00000	00000	00002	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0

CAR HIT FIXED OBJECT

			*100.00	090.00	00.00	10.00	00.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
IMPACT SITE		0-29	*000047	000041	00001	00001	00004	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	087.23	02.12	02.12	08.51	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
UNSPEC.		30-49	*000034	000028	00001	00003	00001	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	082.35	02.94	08.82	02.94	02.94		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
	023	50+	*000015	000006	00000	00002	00006	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	040.00	00.00	13.33	40.00	06.66		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
	024	UNSP mph	*000013	000011	00000	00000	00000	00002	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	084.61	00.00	00.00	00.00	15.38		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
CAR HIT OTHER OBJECT	025	0-29	*000423	000308	00016	00041	00054	00004	00002	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	072.81	03.78	09.69	12.76	00.94		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
	026	30-49	*000642	000445	00016	00091	00089	00001	00000	000001	000000	00000	00001	00000	00000	00000	*000000.30	00000.14	0000.00	+ - 0
			*100.00	069.31	02.49	14.17	13.86	00.15		100.00	000.00	00.00	00.00	00.00	00.00		*000000.20	00000.12	0000.00	
	027	50+ mph	*000510	000333	00025	00056	00087	00009	00000	000003	000002	00001	00000	00000	00000	00000	*000001.04	00000.56	0000.05	- - -
			*100.00	065.29	04.90	10.98	17.05	01.76		100.00	066.66	33.33	00.00	00.00	00.00		*000000.68	00000.45	0000.04	
	028	UNSP mph	*000169	000113	00012	00012	00028	00004	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
			*100.00	066.86	07.10	07.10	16.56	02.36		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
	029	0-29	*045719	042385	01074	01117	01131	00012	01103	000293	000271	00010	00007	00005	00000	00007	*000021.38	00007.29	0000.05	+ - -
			*100.00	092.70	02.34	02.44	02.47	00.02		100.00	092.49	03.41	02.38	01.70	00.00		*000019.94	00007.15	0000.05	
FRONT	030	30-49	*030460	025719	01052	01447	02206	00036	00350	000262	000226	00008	00008	00020	00000	00001	*000040.79	00019.25	0000.28	- + -
			*100.00	084.43	03.45	04.75	07.24	00.11		100.00	086.25	03.05	03.05	07.63	00.00		*000034.73	00017.98	0000.28	
	031	50+	*008846	006490	00277	00488	01458	00133	00065	000093	000070	00002	00006	00015	00000	00000	*000024.77	00016.72	0001.39	- - -
			*100.00	073.36	03.13	05.51	16.48	01.50		100.00	075.26	02.15	06.45	16.12	00.00		*000018.36	00013.85	0001.38	
	032	UNSP	*006474	005611	00210	00239	00377	00037	00006	000036	000032	00000	00003	00001	00000	00000	*000004.80	00002.30	0000.20	- - -
			*100.00	086.66	03.24	03.69	05.82	00.57		100.00	088.88	00.00	08.33	02.77	00.00		*000004.18	00002.16	0000.19	
RIGHT	033	0-29	*003482	003270	00079	00069	00064	00000	00139	000026	000026	00000	00000	00000	00000	00000	*000001.58	00000.47	0000.00	- - 0
			*100.00	093.91	02.26	01.98	01.83	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000001.49	00000.46	0000.00	
	034	30-49	*003624	003197	00112	00121	00190	00004	00023	000033	000029	00001	00002	00001	00000	00000	*000003.89	00001.76	0000.03	+ - -
			*100.00	088.21	03.09	03.33	05.24	00.11		100.00	087.87	03.03	06.06	03.03	00.00		*000003.46	00001.68	0000.03	
CAR vs. CAR	035	50+	*001219	000979	00023	00054	00145	00018	00008	000009	000008	00000	00001	00000	00000	00000	*000001.77	00001.20	0000.13	- - -
			*100.00	080.31	01.88	04.42	11.89	01.47		100.00	088.88	00.00	11.11	00.00	00.00		*000001.43	00001.04	0000.12	
	036	UNSP	*000796	000693	00026	00028	00044	00005	00000	000006	000006	00000	00000	00000	00000	00000	*000000.77	00000.36	0000.03	- - -
			*100.00	087.06	03.26	03.51	05.52	00.62		100.00	100.00	00.00	00.00	00.00	00.00		*000000.67	00000.34	0000.03	
LEFT	037	0-29	*003878	003470	00177	00115	00114	00002	00597	000020	000018	00000	00001	00001	00000	00002	*000002.10	00000.59	0000.01	- + -
			*100.00	089.47	04.56	02.96	02.93	00.05		100.00	090.00	00.00	05.00	05.00	00.00		*000001.88	00000.57	0000.01	
	038	30-49	*004165	003482	00219	00203	00249	00012	00103	000042	000040	00000	00001	00001	00000	00000	*000006.88	00002.62	0000.11	- - -
			*100.00	083.60	05.25	04.87	05.97	00.28		100.00	095.23	00.00	02.38	02.38	00.00		*000005.80	00002.48	0000.11	
	039	50+	*001782	001449	00056	00093	00151	00033	00021	000030	000026	00001	00002	00001	00000	00000	*000005.60	00003.09	0000.55	- - -
			*100.00	081.31	03.14	05.21	08.47	01.85		100.00	086.66	03.33	06.66	03.33	00.00		*000004.62	00002.81	0000.54	
	040	UNSP	*000915	000778	00044	00052	00035	00006	00000	000007	000007	00000	00000	00000	00000	00000	*000001.04	00000.31	0000.04	- - -
			*100.00	085.02	04.80	05.68	03.82	00.65		100.00	100.00	00.00	00.00	00.00	00.00		*000000.89	00000.29	0000.04	
	041	0-29	*023442	021459	01486	00273	00214	00010	02363	000189	000178	00006	00003	00002	00000	00009	*000015.98	00001.79	0000.07	- + -
			*100.00	091.54	06.33	01.16	00.91	00.04		100.00	094.17	03.17	01.58	01.05	00.00		*000014.74	00001.78	0000.07	
	042	30-49	*0[illegible]1268	029174	00704	00211	00174	00005	00876	000098	000091	00004	00002	00001	00000	00010	*000010.44	00001.69	0000.03	- - -

		*100.00	089.34	06.85	02.05	01.69	00.04		100.00	092.85	04.08	02.04	01.02	00.00		*000009.41	00001.67	0000.03	
REAR 043	50+	*002699	002425	00127	00061	00079	00007	00117	000044	000039	00004	00001	00000	00000	00001	*000004.47	00001.39	0000.11	+ - -
		*100.00	089.84	04.70	02.26	02.92	00.25		100.00	088.63	09.09	02.27	00.00	00.00		*000004.08	00001.36	0000.11	
044	UNSP	*002100	001942	00101	00028	00027	00002	00015	000011	000011	00000	00000	00000	00000	00000	*000000.82	00000.15	0000.00	- - 0
		*100.00	092.47	04.80	01.33	01.28	00.09		100.00	100.00	00.00	00.00	00.00	00.00		*000000.76	00000.14	0000.00	
045	0-29	*000039	000038	00000	00000	00001	00000	00002	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	097.43	00.00	00.00	02.56	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
UNSP 046	30-49	*000025	000024	00001	00000	00000	00000	00001	000001	000001	00000	00000	00000	00000	00000	*000000.04	00000.00	0000.00	- 0 0
		*100.00	096.00	04.00	00.00	00.00	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000000.03	00000.00	0000.00	
047	50+	*000032	000027	00000	00001	00004	00000	00000	000001	000001	00000	00000	00000	00000	00000	*000000.15	00000.12	0000.00	- - 0
		*100.00	084.37	00.00	03.12	12.50	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000000.13	00000.10	0000.00	
048	UNSP	*000022	000022	00000	00000	00000	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	100.00	00.00	00.00	00.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
049	0-29	*011307	010603	00216	00218	00258	00012	00274	000032	000031	00000	00000	00001	00000	00000	*000001.99	00000.76	0000.03	- + -
		*100.00	093.77	01.91	01.92	02.28	00.10		100.00	096.87	00.00	00.00	03.12	00.00		*000001.87	00000.74	0000.03	
FRONT 050	30-49	*000377	007160	00249	00338	00642	00044	00063	000041	000031	00001	00002	00006	00001	00000	*000006.21	00003.35	0000.21	+ + +
		*100.00	084.85	02.97	03.98	07.66	00.52		100.00	075.60	02.43	04.87	14.63	02.43		*000005.39	00003.09	0000.20	
051	50+	*002803	002070	00088	00170	00394	00081	00023	000012	000010	00000	00000	00002	00000	00000	*000003.13	00002.03	0000.34	- - -
		*100.00	073.84	03.11	06.06	14.05	02.88		100.00	083.33	00.00	00.00	16.66	00.00		*000002.32	00001.69	0000.33	
052	UNSP	*001270	001104	00049	00034	00079	00012	00001	000007	000006	00000	00000	00001	00000	00000	*000000.95	00000.49	0000.06	+ + -
		*100.00	086.38	03.83	02.66	06.18	00.93		100.00	085.71	00.00	00.00	14.28	00.00		*000000.82	00000.45	0000.05	
053	0-29	*001175	001165	00022	00020	00027	00001	00035	000003	000003	00000	00000	00000	00000	00000	*000000.17	00000.07	0000.00	- - 0
		*100.00	098.04	01.87	01.70	02.29	00.08		100.00	100.00	00.00	00.00	00.00	00.00		*000000.16	00000.06	0000.00	
CAR vs TRUCK RIGHT 054	30-49	*001180	001027	00023	00026	00056	00008	00012	000005	000004	00000	00000	00000	00001	00000	*000000.49	00000.28	0000.03	+ + +
		*100.00	090.08	02.01	02.28	04.91	00.70		100.00	080.00	00.00	00.00	00.00	20.00		*000000.44	00000.26	0000.02	
055	50+	*000456	000366	00021	00024	00037	00008	00002	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	080.26	04.60	05.26	08.11	01.75		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
056	UNSP	*000223	000203	00011	00000	00007	00002	00000	000001	000001	00000	00000	00000	00000	00000	*000000.08	00000.04	0000.00	- - 0
		*100.00	091.03	04.93	00.00	03.13	00.89		100.00	100.00	00.00	00.00	00.00	00.00		*000000.07	00000.03	0000.00	
057	0-29	*001151	001070	00037	00019	00025	00000	00159	000001	000001	00000	00000	00000	00000	00000	*000000.07	00000.02	0000.00	- - 0
		*100.00	092.96	03.21	01.65	02.17	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000000.06	00000.01	0000.00	
LEFT 058	30-49	*001337	001144	00050	00046	00087	00010	00026	000008	000006	00001	00000	00001	00000	00000	*000001.15	00000.57	0000.05	+ + -
		*100.00	085.56	03.73	03.44	06.50	00.74		100.00	075.00	12.50	00.00	12.50	00.00		*000000.98	00000.53	0000.04	
059	50+	*000547	000453	00021	00022	00042	00009	00010	000001	000001	00000	00000	00000	00000	00000	*000000.17	00000.09	0000.01	- - -
		*100.00	082.81	03.83	04.02	07.67	01.64		100.00	100.00	00.00	00.00	00.00	00.00		*000000.14	00000.08	0000.00	
060	UNSP	*000190	000152	00014	00009	00013	00002	00000	000001	000000	00000	00000	00001	00000	00000	*000000.20	00000.07	0000.01	+ + -
		*100.00	080.00	07.36	04.73	06.84	01.05		100.00	000.00	00.00	00.00	00.00	00.00		*000000.16	00000.06	0000.00	
061	0-29	*006843	006306	00375	00071	00088	00003	00509	000024	000022	00002	00000	00000	00000	00002	*000001.88	00000.31	0000.00	+ - 0
		*100.00	092.15	05.48	01.03	01.28	00.04		100.00	091.66	08.33	00.00	00.00	00.00		*000001.73	00000.30	0000.00	
REAR 062	30-49	*002885	002592	00168	00062	00060	00003	00145	000011	000010	00000	00000	00001	00000	00000	*000001.11	00000.23	0000.01	- + -
		*100.00	089.84	05.82	02.14	02.07	00.10		100.00	090.90	00.00	00.00	09.09	00.00		*000001.00	00000.22	0000.01	
063	50+	*000748	000675	00026	00018	00028	00001	00033	000004	000004	00000	00000	00000	00000	00000	*000000.39	00000.15	0000.00	- - 0
		*100.00	090.24	03.47	02.40	03.74	00.13		100.00	100.00	00.00	00.00	00.00	00.00		*000000.35	00000.14	0000.00	
064	UNSP	*000485	000446	00023	00003	00013	00000	00001	000001	000001	00000	00000	00000	00000	00000	*000000.08	00000.02	0000.00	- - 0

MULTIPLE VEHICLE CRASHES

No.	Group																		
		*100.00	091.95	04.74	00.61	02.68	00.00		100.00	100.00	00.00	00.00	00.00	00.00		*000000.07	00000.01	0000.00	
065	0-29	*000048	000047	00000	00000	00001	00000	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	097.91	00.00	00.00	02.08	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
UNS P 066	30-49	*000069	000066	00001	00001	00001	00000	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	095.65	01.44	01.44	01.44	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
067	50+	*000061	000060	00000	00001	00000	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	098.36	00.00	01.63	00.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
068	UNSP	*000020	000017	00000	00000	00003	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	085.00	00.00	00.00	15.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
FRONT 069	0-29	*004446	003964	00168	00120	00193	00001	00569	000023	000022	00000	00000	00001	00000	00002	*000002.49	00001.00	0000.00	- 0 0
		*100.00	089.15	03.77	02.69	04.34	00.02		100.00	095.65	00.00	00.00	04.34	00.00		*000002.23	00000.96	0000.00	
070	30-49	*003147	002507	00132	00190	00306	00012	00000	000017	000014	00002	00000	00001	00000	00000	*000003.45	00001.71	0000.06	- - -
		*100.00	079.66	04.19	06.03	09.72	00.38		100.00	082.35	11.76	00.00	05.88	00.00		*000002.76	00001.54	0000.06	
071	50+	*001128	000774	00045	00077	00213	00019	00000	000007	000005	00001	00000	00001	00000	00000	*000002.19	00001.43	0000.11	- - -
		*100.00	068.61	03.98	06.82	19.88	01.68		100.00	071.42	14.28	00.00	14.28	00.00		*000001.51	00001.14	0000.10	
072	UNSP	*001320	001065	00054	00061	00132	00008	00011	000006	000005	00000	00000	00001	00000	00001	*000001.15	00000.63	0000.03	- + -
		*100.00	080.68	04.09	04.62	10.00	00.60		100.00	083.33	00.00	00.00	16.66	00.00		*000000.93	00000.56	0000.02	
073	0-29	*000367	000284	00017	00031	00034	00001	00070	000003	000001	00000	00001	00001	00000	00000	*000000.67	00000.28	0000.00	+ + 0
		*100.00	077.38	04.63	08.44	09.26	00.27		100.00	033.33	00.00	33.33	33.33	00.00		*000000.52	00000.25	0000.00	
RIGHT 074	30-49	*000132	000107	00009	00005	00011	00000	00000	000003	000002	00001	00000	00000	00000	00000	*000000.56	00000.24	0000.00	+ - 0
		*100.00	081.06	06.81	03.78	08.33	00.00		100.00	066.66	33.33	00.00	00.00	00.00		*000000.46	00000.22	0000.00	
075	50+	*000058	000045	00002	00001	00008	00002	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	077.58	03.44	01.72	13.79	03.44		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
076	UNSP	*000072	000053	00003	00004	00010	00002	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	073.61	04.16	05.55	13.88	02.77		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
077	0-29	*000465	000393	00022	00025	00023	00002	00216	000001	000001	00000	00000	00000	00000	00001	*000000.15	00000.05	0000.00	- - 0
		*100.00	084.51	04.73	05.37	04.94	00.43		100.00	100.00	00.00	00.00	00.00	00.00		*000000.12	00000.04	0000.00	
LEFT 078	30-49	*000266	000217	00011	00008	00029	00001	00001	000001	000001	00000	00000	00000	00000	00000	*000000.18	00000.11	0000.00	- - 0
		*100.00	081.57	04.13	03.00	10.90	00.37		100.00	100.00	00.00	00.00	00.00	00.00		*000000.14	00000.09	0000.00	
079	50+	*000103	000082	00002	00005	00011	00003	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	079.61	01.94	04.85	10.67	02.91		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
080	UNSP	*000087	000067	00004	00005	00010	00001	00002	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	077.01	04.59	05.74	11.49	01.14		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
081	0-29	*007930	006878	00732	00167	00149	00004	01352	000046	000039	00005	00001	00001	00000	00012	*000006.10	00000.88	0000.02	+ + -
		*100.00	086.73	09.23	02.10	01.87	00.05		100.00	084.78	10.86	02.17	02.17	00.00		*000005.32	00000.86	0000.02	
REAR 082	30-49	*000721	000624	00045	00024	00028	00000	00003	000007	000006	00000	00000	00001	00000	00000	*000000.94	00000.27	0000.00	+ + 0
		*100.00	086.54	06.24	03.32	03.88	00.00		100.00	085.71	00.00	00.00	14.28	00.00		*000000.82	00000.26	0000.00	
083	50+	*000233	000193	00010	00007	00022	00001	00000	000003	000003	00000	00000	00000	00000	00000	*000000.51	00000.29	0000.01	- - -
		*100.00	082.83	04.29	03.00	09.44	00.42		100.00	100.00	00.00	00.00	00.00	00.00		*000000.42	00000.26	0000.01	
084	UNSP	*000384	000323	00033	00005	00020	00003	00004	000001	000001	00000	00000	00000	00000	00000	*000000.15	00000.05	0000.00	- - 0
		*100.00	084.11	08.59	01.30	05.20	00.78		100.00	100.00	00.00	00.00	00.00	00.00		*000000.12	00000.04	0000.00	
085	0-29	*000020	000016	00000	00002	00002	00000	00034	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0
		*100.00	080.00	00.00	10.00	10.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
086	30-49	*000020	000017	00001	00000	00002	00000	00032	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0 0 0

Note	No.	Group																				
			*100.00	085.00	05.00	00.00	10.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
UNSP	087	50+	*000014	000012	00000	00000	00002	00000	00013	000000	000000	00000	00000	00000	00000	00001	*000000.00	00000.00	0000.00	0	0	0
			*100.00	085.71	00.00	00.00	14.28	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	088	UNSP	*000037	000011	00007	00003	00010	00006	02127	000000	000000	00000	00000	00000	00000	00019	*000000.00	00000.00	0000.00	0	0	0
			*100.00	029.72	18.91	08.10	27.02	16.21		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	089	0-29	*002815	002321	00080	00171	00236	00007	00138	000012	000011	00001	00000	00000	00000	00001	*000002.10	00001.03	0000.02	-	-	-
			*100.00	082.45	02.84	06.07	08.38	00.24		100.00	091.66	08.33	00.00	00.00	00.00		*000001.73	00000.94	0000.02			
FRONT	090	30-49	*001917	001347	00072	00163	00311	00024	00002	000003	000002	00000	00001	00000	00000	00000	*000000.89	00000.52	0000.03	+	-	-
			*100.00	070.26	03.75	08.50	16.22	01.25		100.00	066.66	00.00	33.33	00.00	00.00		*000000.62	00000.42	0000.02			
	091	50+	*000708	000496	00017	00047	00124	00024	00000	000003	000003	00000	00000	00000	00000	00000	*000000.89	00000.62	0000.10	-	-	-
			*100.00	070.05	02.40	06.63	17.51	03.38		100.00	100.00	00.00	00.00	00.00	00.00		*000000.62	00000.49	0000.09			
	092	UNSP	*000467	000324	00014	00042	00073	00014	00005	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	069.37	02.99	08.99	15.63	02.99		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	093	0-29	*000472	000399	00015	00014	00037	00007	00027	000001	000001	00000	00000	00000	00000	00000	*000000.15	00000.09	0000.01	-	-	-
			*100.00	084.53	03.17	02.96	07.83	01.48		100.00	100.00	00.00	00.00	00.00	00.00		*000000.12	00000.08	0000.00			
RIGHT	094	30-49	*000191	000154	00005	00009	00019	00004	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	080.62	02.61	04.71	09.94	02.09		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
OTHER CRASHES	095	50+	*000066	000048	00002	00005	00010	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	072.72	03.03	07.57	15.15	01.51		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	096	UNSP	*000063	000044	00000	00004	00014	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	069.84	00.00	06.34	22.22	01.58		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	097	0-29	*000510	000392	00016	00030	00064	00008	00073	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	076.86	03.13	05.88	12.54	01.56		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
LEFT	098	30-49	*000229	000166	00011	00015	00033	00004	00002	000001	000001	00000	00000	00000	00000	00000	*000000.27	00000.16	0000.01	-	-	-
			*100.00	072.48	04.80	06.55	14.41	01.74		100.00	100.00	00.00	00.00	00.00	00.00		*000000.19	00000.13	0000.00			
	099	50+	*000053	000041	00002	00000	00009	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	077.35	03.77	00.00	16.98	01.88		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	100	UNSP	*000077	000050	00007	00005	00011	00004	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	064.93	09.09	06.49	14.28	05.19		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	101	0-29	*001848	001625	00090	00066	00063	00004	00215	000004	000004	00000	00000	00000	00000	00001	*000000.48	00000.14	0000.00	-	-	0
			*100.00	087.93	04.87	03.57	03.40	00.21		100.00	100.00	00.00	00.00	00.00	00.00		*000000.42	00000.13	0000.00			
REAR	102	30-49	*000397	000349	00009	00021	00017	00001	00003	000001	000001	00000	00000	00000	00000	00000	*000000.12	00000.04	0000.00	-	-	0
			*100.00	087.90	02.26	05.28	04.28	00.25		100.00	100.00	00.00	00.00	00.00	00.00		*000000.10	00000.03	0000.00			
	103	50+	*000128	000111	00003	00003	00009	00002	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	086.71	02.34	02.34	07.03	01.56		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	104	UNSP	*000158	000134	00008	00007	00007	00002	00003	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	084.81	05.06	04.43	04.43	01.26		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	105	0-29	*000045	000039	00000	00001	00003	00002	00001	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	086.66	00.00	02.22	06.66	04.44		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
UNSP	106	30-49	*000040	000033	00002	00001	00003	00001	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	082.50	05.00	02.50	07.50	02.50		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	107	50+	*000015	000011	00000	00001	00003	00000	00000	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0
			*100.00	073.33	00.00	06.66	20.00	00.00		000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00			
	108	UNSP	*000032	000030	00000	00002	00000	00000	00006	000000	000000	00000	00000	00000	00000	00000	*000000.00	00000.00	0000.00	0	0	0

	*100.00	093.75	00.00	06.25	00.00	00.00		*	000.00	000.00	00.00	00.00	00.00	00.00		*000000.00	00000.00	0000.00	
TOTALS	*270697	226947	11027	11474	19900	01349	12260	*	001813	001552	00065	00074	00116	00006	00071	*000299.14	00145.70	0008.80	
	*100.00	083.83	04.07	04.23	07.35	00.49		*	100.00	085.60	03.58	04.08	06.39	00.33		*000232.67	00124.03	0008.51	UNECU

+019 017 003
044 043 037
Z045 048 068

SUMMARY TABLE

		REFERENCE NO.	%		TEST GROUP %	NO.		CHI-SQUARE	
1. CAR OFF ROAD	*	045007	016.62	*	016.76	000304	*		*
2. CAR VS FIX OB	*	001635	000.60	*	000.49	000009	*	0130.091	*
3. CAR VS OB	*	001744	000.64	*	000.22	000004	*		*
4. CAR VS CAR	*	149987	055.40	*	066.24	001201	*		*
5. CAR VS TRUCK	*	041143	015.19	*	008.38	000152	*		*
6. MULT. VEHICLE	*	020950	007.73	*	006.50	000118	*		*
7. OTHER	*	010231	003.77	*	001.37	000025	*		*
TOTALS	*	270697	100.00	*	100.00	001813	*		*
8. FRONT	*	132587	048.97	*	047.26	000857	*		*
9. RIGHT	*	013648	005.04	*	004.96	000090	*		*
10. LEFT	*	015829	005.84	*	006.23	000113	*	0004.600	*
11. REAR	*	061393	022.67	*	024.54	000445	*		*
12. UNSPECIFIED	*	047240	017.45	*	016.98	000308	*		*
TOTALS	*	270697	100.00	*	100.00	001813	*		*
13. 0-29 MPH	*	120796	044.62	*	038.44	000697	*		*
14. 30-49 MPH	*	085500	031.58	*	034.52	000626	*	0045.958	*
15. 50+ MPH	*	043692	016.14	*	020.57	000373	*		*
16. UNSPECIFIED	*	020709	007.65	*	006.45	000117	*		*
TOTALS	*	270697	100.00	*	100.00	001813	*		*

CHI SQUARES FROM MASTER MATRIX

INJURIES = 0006.252

A+KILLED = 0004.528 = $\frac{[122 - 145.70]^2}{124.03}$

KILLED = 0000.921

SUMMARY LINES

CUMULATIVE ROW NO.	TOT - UN	NOT INJ	C INJ	B INJ	A INJ	KILLED	UNSPEC	TOT - UN	NOT INJ	C INJ	B INJ	A INJ	KILLED	UNSPEC	E INJ	E A+K	E K	O-E IA+KK
001	*045007	029532	02100	04140	08625	00610	00254*	000304	000211	00014	00029	00046	00004	00001*	000106.40	00064.26	0004.43	
	*100.00	065.61	04.66	09.19	19.16	01.35	*	100.00	069.40	04.60	09.53	15.13	01.31	*	000068.77	00050.20	0004.34	
002	*001635	001222	00046	00109	00232	00026	00007*	000009	000005	00000	00002	00002	00000	00000*	000002.38	00001.48	0000.13	
	*100.00	074.74	02.81	06.66	14.18	01.59	*	100.00	055.55	00.00	22.22	22.22	00.00	*	000001.64	00001.16	0000.11	
003	*001744	001199	00069	00200	00258	00018	00003*	000004	000002	00001	00001	00000	00000	00000*	000001.34	00000.70	0000.05	
	*100.00	068.75	03.95	11.46	14.79	01.03	*	100.00	050.00	25.00	25.00	00.00	00.00	*	000000.88	00000.57	0000.04	
004	*149987	132634	05768	04600	06663	00322	05789*	001201	001080	00036	00037	00048	00000	00030*	000147.27	00061.10	0003.03	
	*100.00	088.43	03.84	03.06	04.44	00.21	*	100.00	089.92	02.99	03.08	03.99	00.00	*	000126.60	00055.86	0002.99	
005	*041143	036614	01394	01078	01861	00196	01295*	000152	000131	00004	00002	00013	00002	00002*	000018.07	00008.48	0000.75	
	*100.00	088.99	03.38	02.62	04.52	00.47	*	100.00	086.18	02.63	01.31	08.55	01.31	*	000015.46	00007.67	0000.68	
006	*020950	017632	01297	00740	01215	00066	04435*	000118	000100	00009	00002	00007	00000	00036*	000018.54	00006.94	0000.23	
	*100.00	084.16	06.19	03.53	05.79	00.31	*	100.00	084.74	07.62	01.69	05.93	00.00	*	000015.35	00006.22	0000.21	
007	*010231	008114	00353	00607	01046	00111	00477*	000025	000023	00001	00001	00000	00000	00002*	000004.90	00002.60	0000.17	
	*100.00	079.30	03.45	05.93	10.22	01.08	*	100.00	092.00	04.00	04.00	00.00	00.00	*	000003.80	00002.22	0000.13	
008	*132587	114902	03837	05010	08342	00496	02617*	000857	000745	00025	00029	00057	00001	00012*	000119.71	00060.74	0003.04	
	*100.00	086.66	02.89	03.77	06.29	00.37	*	100.00	086.93	02.91	03.38	06.65	00.11	*	000099.69	00054.44	0002.93	

009	*013648	012062	00371	00423	00727	00065	00318*	000090	000081	00002	00004	00002	00001	00000*	000010.13	00004.79	0000.23
	*100.00	088.37	02.71	03.09	05.32	00.47	*	100.00	090.00	0[illegible].22	04.44	02.22	01.11		*000008.82	00004.42	0000.20
010	*015829	013460	00696	00659	00914	00100	01211*	000113	000102	00002	00004	00005	00000	00003*	000017.81	00007.68	0000.79
	*100.00	085.03	04.39	04.16	05.77	00.63	*	100.00	090.26	01.76	03.53	04.42	00.00		*000014.98	00007.09	0000.74
011	*061393	055366	03943	01030	01005	00049	05643*	000445	000411	00021	00007	00006	00000	00035*	000043.53	00007.40	0000.25
	*100.00	090.18	06.42	01.67	01.63	00.07	*	100.00	092.35	04.71	01.57	01.34	00.00		*000039.39	00007.20	0000.25
012	*047240	031157	02140	04352	08912	00639	02471*	000308	000213	00015	00030	00046	00004	00021*	000107.72	00064.95	0004.48
	*100.00	065.95	04.61	09.21	18.86	01.35	*	100.00	069.15	04.87	09.74	14.93	01.29		*000069.62	00050.75	0004.38
013	*120796	109641	04830	02920	03316	00089	07985*	000697	000640	00025	00016	00016	00000	00037*	000061.98	00017.64	0000.24
	*100.00	090.76	03.99	02.41	02.74	00.07	*	100.00	091.82	03.58	02.29	02.29	00.00		*000055.82	00016.32	0000.23
014	*095500	070339	03637	04356	06915	00253	01653*	000626	000535	00025	00024	00040	00002	00011*	000104.67	00047.46	0001.30
	*100.00	082.26	04.25	05.09	08.08	00.29	*	100.00	085.46	03.99	03.83	06.38	00.31		*000085.41	00042.95	0001.25
015	*043692	030811	01697	03197	07339	00648	00292*	000373	000282	00014	00025	00048	00004	00002*	000104.42	00064.13	0005.04
	*100.00	070.51	03.88	07.31	16.79	01.48	*	100.00	075.60	03.75	06.70	12.86	01.07		*000072.66	00051.91	0004.93
016	*020709	016156	00863	01001	02330	00359	02330*	000117	000095	00001	00009	00012	00000	00021*	000027.83	00016.91	0002.21
	*100.00	078.01	04.16	04.83	11.25	01.73	*	100.00	081.19	00.85	07.69	10.25	00.00		*000018.61	00012.72	0002.09

[redacted]

APPENDIX 7: Summary Tables

CAR GROUP 1 Pontiac (Bonneville, etc.)

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	X^2	Observed	Expected	Index	X^2
60	259	37	39.15	95	0.15	16	18.26	88	0.33
61	224	28	34.89	80	1.753	14	16.43	85	0.426
62	318	44	48.92	90	0.628	14	23.35	60	4.386
63	73								
64	62								
65	318	41	47.07	87	0.991	19	21.23	89	0.275
66	291	33	44.05	75	3.551	13	20.45	64	3.230
67	143	15	20.88	72	2.101	6	8.99	67	1.171
68	115	11	16.74	66	2.496	2	7.43	<50	4.740
ALL									

CAR GROUP 2 Pontiac (Catalina, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	329	54	54.81	99	0.015	23	26.77	86	0.635
61	247	36	42.90	84	1.466	21	21.09	100	0.000
62	307	44	47.67	92	0.363	23	22.60	102	0.008
63	113	14	15.97	88	0.31	6	7.06	85	0.19
64	66								
65	460	57	72.99	78	4.492	26	34.91	74	2.684
66	347	39	50.70	77	3.380	22	23.18	95	0.069
67	244	35	38.48	91	0.402	15	18.62	81	0.832
68	188	19	28.72	66	4.182	6	13.41	<50	4.833
ALL									

CAR GROUP 3 Pontiac (Tempest, Le Mans, etc.)

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	X^2	Observed	Expected	Index	X^2
60									
61	18								
62	31								
63	22								
64	31								
65	625	111	103.66	107	0.681	53	49.55	98	0.288
66	372	56	57.08	106	0.026	25	26.70	94	0.127
67	218	32	31.94	100	0.000	14	14.40	97	0.013
68	173	22	25.52	86	0.618	8	11.55	69	1.295
ALL									

CAR GROUP 4 Pontiac GTO

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60									
61									
62									
63									
64									
65									
66	379	50	67.59	74	6.112	30	34.02	88	0.577
67	174	30	30.10	100	0.00	17	15.09	113	0.294
68	139	22	27.18	81	1.369	14	14.53	96	0.024
ALL									

CAR GROUP 5 Pontiac Firebird

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	103	21	18.32	115	0.532	8	9.47	84	0.282

CAR GROUP 6 Standard Chevrolet

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	3041	421	489.69	86	12.266	212	236.46	90	2.943
61	2377	354	382.33	93	2.677	181	183.92	98	0.054
62	3162	492	523.26	94	2.395	249	255.15	98	0.173
63	3207	444	520.33	85	14.296	228	250.18	91	2.294
64	2961	446	478.79	93	2.867	202	230.70	88	4.171
65	2188	328	355.48	92	2.724	150	171.52	87	3.167
66	1355	199	226.35	88	4.297	92	111.18	83	3.927
67	1072	150	160.15	94	0.807	62	74.16	84	2.311
68	789	101	120.97	83	4.201	43	56.84	76	3.959
ALL									

CAR GROUP 7 Chevrolet Chevelle

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64	760	137	123.84	111	1.801	65	59.64	109	0.567
65	718	106	119.41	89	1.966	54	57.92	93	0.316
66	1127	227	215.93	105	0.765	117	112.99	104	0.171
67	801	143	147.74	97	0.204	65	75.97	86	1.923
68	664	107	125.16	85	3.570	50	64.95	77	4.197
ALL									

CAR GROUP 8 Chevrolet Chevy II

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62	543	108	86.56	125	6.813	63	41.57	152	12.984
63	638	112	100.19	112	1.778	46	46.97	98	0.023
64	231	50	39.07	128	4.019	24	19.10	126	1.511
65	179	49	27.84	176	20.932	25	13.21	189	12.682
66	351	66	65.53	101	0.004	37	33.30	111	0.500
67	166	29	28.26	103	0.025	14	13.69	102	0.008
68	153	28	27.47	102	0.013	19	14.15	134	2.043
ALL	2261	442	374.92	118	15.21	228	181.99	125	13.74

CAR GROUP 8 Chevy II

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
62-67	2108	414	347.45	119	16.60	209	167.84	125	12.03
68	153	28	27.47	102	0.013	19	14.15	134	2.043

CAR GROUP 9 Chevrolet Corvair

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	365	107	66.59	161	32.916	64	33.52	191	33.394
61	505	130	91.48	142	21.645	67	45.52	147	12.141
62	181	52	33.65	155	13.577	33	16.78	197	19.161
63	532	119	101.11	118	4.302	57	52.07	109	0.819
64	377	87	65.12	134	9.655	39	31.33	124	2.235
65	395	72	61.37	117	2.376	31	28.14	110	0.345
66	174	34	28.04	121	1.642	18	13.01	138	2.273
67	24								
68	10								
ALL	2563	609	452.87	134	70.626	314	223.38	141	43.373

CAR GROUP 9 Corvair

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60-63	1583	408	292.83	139	61.029	222	147.89	150	44.84
64	377	87	65.12	134	9.655	39	31.33	124	2.235
65-68	603	114	93.67	122	5.69	53	42.89	124	2.835

CAR GROUP 10 Chevrolet Corvette

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	5								
61	9								
62	21								
63	20								
64	23								
65	33								
66	47								
67	22								
68	8								
ALL	188	38	40.49	94	0.216	24	22.13	108	0.198

CAR GROUP 11   Chevrolet Camaro

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	690	125	130.56	96	0.320	72	67.54	107	0.357

CAR GROUP 12 Buick (Electra, etc.)

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	79								
61	68								
62	18								
63	83								
64	100	10	13.38	75	1.05	4	5.55	72	0.51
65	215	25	32.03	78	1.95	10	15.23	66	2.118
66	176	22	24.82	89	0.401	10	11.18	89	0.15
67	135	5	18.62	< 50	12.475	1	8.18	< 50	7.439
68	105	16	15.75	102	0.005	5	7.23	69	0.834
ALL									

CAR GROUP 13 Buick (LeSabre, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	359	58	54.96	106	0.216	22	26.02	85	0.738
61	248	34	36.68	93	0.248	17	16.67	102	0.007
62	39								
63	351	48	50.91	94	0.208	18	22.87	79	1.213
64	367	57	54.29	105	0.173	17	24.85	68	2.942
65	188	27	26.26	103	0.026	14	11.34	123	0.742
66	204	22	26.79	82	1.058	11	11.60	95	0.036
67	129	15	19.08	79	1.10	4	8.95	<50	3.215
68	98								
ALL									

CAR GROUP 14 Buick (Special, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61	132	25	20.18	124	1.483	13	9.18	142	1.910
62	36								
63	248	39	35.35	110	0.470	18	15.61	115	0.423
64	274	33	39.08	84	1.184	15	16.95	88	0.263
65	260	38	39.54	96	0.076	17	18.45	92	0.135
66	274	40	39.63	101	0.004	20	17.80	112	0.316
67	163	24	24.27	99	0.003	11	10.74	102	0.007
68	154	19	22.51	84	0.692	8	9.95	80	0.450
ALL									

CAR GROUP 17 Oldsmobile (98, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60	104	12	14.41	83	0.510	10	6.51	154	2.263
61	59								
62	97								
63	103	10	14.85	67	2.010	5	6.60	76	0.463
64	68								
65	119	14	17.36	81	0.824	7	7.83	89	0.104
66	102	11	16.39	67	2.303	1	7.62	<50	6.934
67	54								
68	60								
ALL									

CAR GROUP 18 — Oldsmobile (88, etc.)

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	571	91	87.75	104	0.153	39	41.07	95	0.122
61	339	49	55.31	89	0.938	29	26.97	108	0.182
62	569	65	89.09	73	8.330	22	42.23	52	11.412
63	505	68	79.56	85	2.155	41	37.95	108	0.288
64	443	54	69.59	78	4.492	32	32.97	97	0.033
65	398	49	63.16	78	4.087	22	29.98	73	2.504
66	207	26	30.54	85	0.856	7	13.80	51	3.972
67	141	17	19.12	89	0.287	5	8.43	59	1.616
68	118	17	16.17	105	0.053	9	7.28	124	0.483
ALL									

CAR GROUP 19 Oldsmobile (F-85, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60									
61	120	27	18.76	144	4.672	12	8.75	137	1.444
62	176	34	28.04	121	1.63	18	13.22	136	2.06
63	173	28	27.25	103	0.026	12	12.63	95	0.037
64	248	39	37.48	104	0.078	15	16.89	89	0.251
65	342	42	55.43	76	4.209	22	26.75	82	1.003
66	414	67	65.54	102	0.041	33	30.99	106	0.155
67	237	27	38.16	71	4.268	10	18.44	54	4.677
68	166	19	22.82	83	0.806	8	10.19	79	0.558
ALL									

CAR GROUP 22 Standard Plymouth

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	373	64	60.07	107	0.334	33	29.27	113	0.567
61	314	43	47.51	91	0.547	25	22.76	110	0.260
62	298	37	45.74	81	2.144	20	21.27	94	0.090
63	576	80	87.99	91	0.922	32	41.77	77	2.673
64	752	111	123.24	90	1.579	46	59.68	77	3.727
65	871	122	139.39	88	2.791	58	66.51	87	1.287
66	678	98	109.09	90	1.444	58	53.23	109	0.503
67	375	47	57.00	82	2.222	18	26.14	69	2.965
68	348	42	51.88	81	2.372	24	24.17	99	0.001
ALL									

CAR GROUP 23 Plymouth (Belvedere-Sattelite, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64									
65	408	65	67.88	96	0.159	33	33.16	100	0.000
66	543	90	93.20	97	0.145	49	46.28	106	0.192
67	246	44	40.41	109	0.417	23	19.80	116	0.620
68	375	62	73.09	85	2.296	34	38.22	89	0.571
ALL									

CAR GROUP 24 Plymouth Valiant

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	191	33	28.13	117	1.07	13	12.52	104	0.02
61	187	47	29.63	159	13.03	20	13.71	146	3.39
62	177	27	25.75	105	0.075	12	11.11	108	0.083
63	256	48	36.38	132	4.635	19	16.06	118	0.625
64	345	73	55.96	130	6.732	40	25.98	154	9.008
65	217	44	32.97	133	4.733	26	15.59	167	8.259
66	143	38	22.54	169	13.65	17	10.61	160	4.572
67	53								
68	23								
ALL	1595*	319	243.75	131	29.294	149	111.54	134	14.561

*The summary or "ALL" row includes several drivers in 1969 model cars.

CAR GROUP 24 Valiant

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60-66	1516	310	231.36	134	34.10	147	105.58	139	19.17
67-68	76								

CAR GROUP 26 Dodge (Monaco, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	24								
61	20								
62	53								
63	142	23	21.57	107	0.121	15	9.91	151	3.144
64	287	50	44.07	113	1.015	24	20.34	118	0.778
65	199	40	28.75	139	5.493	16	13.07	122	0.762
66	108	15	14.58	103	0.014	6	6.16	97	0.004
67	71								
68	54								
ALL									

CAR GROUP 27 Dodge (Seneca, "440", etc.)

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60	355	53	56.39	94	0.265	29	27.34	106	0.120
61	260	39	41.02	95	0.129	14	19.91	70	2.102
62	117	22	18.95	116	0.643	12	9.20	130	1.035
63	190	30	32.70	92	0.293	16	16.35	98	0.009
64	192	30	28.24	106	0.138	13	12.70	102	0.008
65									
66									
67									
68									
ALL									

CAR GROUP 28 Dodge (Dart, Coronet, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60									
61									
62	72								
63	184	27	25.62	105	0.093	12	11.42	105	0.034
64	200	32	29.01	110	0.386	20	12.67	158	4.938
65	597	78	87.72	89	1.355	29	40.31	72	3.691
66	467	81	72.71	111	1.210	37	34.22	108	0.266
67	224	31	35.22	88	0.650	18	16.79	107	0.104
68	215	32	34.27	93	0.195	15	16.31	92	0.126
ALL									

CAR GROUP 32 Standard Ford

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	1813	261	299.14	87	6.252	122	145.70	84	4.528
61	1929	337	332.28	101	0.087	178	166.02	107	1.020
62	1956	315	346.17	91	3.698	164	175.23	94	0.857
63	2660	427	454.04	94	2.084	219	225.29	97	0.205
64	2798	433	473.65	91	4.504	232	233.36	99	0.009
65	2781	466	479.39	97	0.485	237	238.93	99	0.018
66	2342	364	393.19	93	2.799	176	194.31	91	2.029
67	1097	158	176.54	89	2.497	77	84.96	91	0.876
68	534	65	82.55	79	4.784	34	38.81	88	0.707
ALL									

CAR GROUP 33 Ford Fairlane

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY X^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY X^2
60									
61									
62	585	115	94.48	122	5.742	59	45.15	131	5.017
63	782	164	127.23	129	13.699	85	61.19	139	10.908
64	577	102	93.45	109	1.009	54	45.07	120	2.087
65	565	82	92.66	88	1.592	51	44.66	114	1.071
66	991	178	175.26	102	0.056	98	88.32	111	1.269
67	451	74	79.53	93	0.510	31	39.71	78	2.298
68	607	87	110.00	79	6.448	35	54.99	64	8.801
ALL									

CAR GROUP 34 Ford Falcon

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY X^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY X^2
60	594	122	97.28	125	8.135	55	47.22	116	1.511
61	746	144	117.19	123	7.812	76	56.12	135	8.189
62	643	135	101.56	133	14.158	55	48.44	114	1.047
63	676	147	114.33	129	12.177	77	56.15	137	9.175
64	596	121	104.64	116	3.370	60	52.21	115	1.386
65	493	98	83.14	118	3.480	52	41.32	126	3.297
66	335	54	54.77	99	0.014	28	26.48	106	0.103
67	110	25	18.76	133	2.730	11	9.51	116	0.281
68	72								
ALL	4268*	861	705.02	122	44.010	424	344.67	123	21.147

*The summary or "ALL" row includes several drivers in 1969 model cars.

CAR GROUP 34 Falcon

Model Year	Sample Size (N)	ALL INJURY				SERIOUS AND FATAL INJURY			
		Observed	Expected	Index	x^2	Observed	Expected	Index	x^2
60-65	3748	767	618.14	124	46.50	375	301.46	124	21.20
66-68	517	93	84.54	110	1.10	48	41.25	116	1.32

CAR GROUP 36 Ford Mustang

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	4304*	749	763.69	98	0.375	357	384.09	93	2.292

*The summary or "ALL" row includes several drivers in 1969 model cars.

CAR GROUP 37 Mercury (Monterey, etc.)

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60	160	24	23.31	103	0.026	9	10.77	84	0.348
61	176	22	26.25	83	0.866	12	12.23	98	0.005
62	269	37	43.14	86	1.123	19	20.84	91	0.192
63	165	21	24.66	85	0.689	11	11.27	98	0.007
64	165	26	28.17	92	0.221	10	14.07	71	1.435
65	206	25	32.25	78	2.122	18	15.02	120	0.711
66	192	27	28.84	94	0.150	13	13.27	98	0.006
67	52								
68	48								
ALL									

CAR GROUP 40 Mercury Cougar

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	210	33	36.55	90	0.459	14	17.97	78	1.067

CAR GROUP 50 — Volkswagen Type I-- Beetle

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60	284	73	46.90	156	18.970	36	21.80	165	11.012
61	324	79	54.80	144	14.084	33	26.33	125	2.021
62	338	106	61.33	173	43.200	50	30.08	166	15.746
63	503	116	87.98	132	11.797	55	42.56	129	4.337
64	563	132	101.43	130	12.270	67	50.05	134	6.878
65	749	185	137.24	135	22.145	101	68.47	148	18.454
66	699	177	128.92	137	23.987	93	64.43	144	15.188
67	404	102	69.19	147	20.681	46	33.68	137	5.438
68	331	76	55.68	136	9.729	35	27.24	128	2.639
ALL	4209*	1050	747.57	140	159.067	517	367.75	141	70.682

*The summary or "ALL" row includes several drivers in 1969 model cars.

CAR GROUP 50

Volkswagen Type I -- Beetle

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60-67	3864	970	687.79	141	153.81	481	337.40	143	73.13
68	331	76	55.68	136	9.729	35	27.24	128	2.639

CAR GROUP 51 — Volkswagen Type II -- Bus

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	176*	50	29.34	170	19.18	32	14.10	>200	27.29

*The summary or "ALL" row includes several drivers in 1969 model cars.

CAR GROUP 52 — Volkswagen Type III -- Fastback

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	250	58	43.43	134	6.46	28	21.27	132	2.55

CAR GROUP 53 Volvo

Model Year	Sample Size (N)	ALL INJURY Observed	ALL INJURY Expected	ALL INJURY Index	ALL INJURY x^2	SERIOUS AND FATAL INJURY Observed	SERIOUS AND FATAL INJURY Expected	SERIOUS AND FATAL INJURY Index	SERIOUS AND FATAL INJURY x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	173	30	[illegible]	114	0.653	17	11.98	[illegible]	2.490

CAR GROUP 54 MG

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60									
61									
62									
63									
64									
65									
66									
67									
68									
ALL	419	108	68.45	158	29.777	67	33.48	200	39.919

CAR GROUP 55   Renault

Model Year	Sample Size (N)	ALL INJURY Observed	Expected	Index	x^2	SERIOUS AND FATAL INJURY Observed	Expected	Index	x^2
60									
61									
[illegible]									
63									
64									
65									
66									
67									
68									
[illegible]	384	133	[illegible]	185	70.23	52	35.77	[illegible]	8.84