Research Report 233

AUTO WEIGHT AND PUBLIC SAFETY, A STATISTICAL STUDY OF TRANSPORTATION HAZARDS

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by

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ABSTRACT

Analyses based on 1973 data from the Texas state automobile accident and registration records have been utilized in this study of the relationship between passenger car weight and occupant safety. In particular, the research showed the following: (i) the relatively higher frequency of accidents in large cars than in small cars is statistically very significant. (ii) the relatively higher frequency of accidents resulting in fatal or serious injuries in large cars than in small cars is statistically very significant. (iii) Although the occupants of small cars appear to have a higher frequency of incurring fatal or serious injuries given that an accident has occurred, such an inclination is not statistically significant. (iv) Accidents involving drunken drivers occur much more frequently in large cars than in small cars statistically to a very significant degree. Some plausible explanations for these occurrences are included in the report. Current research limitations and some suggestions for further improvement and extensions of the research are also discussed.

[~~The current~~ This study is the first phase of a larger study focusing on the relationship between autombile weight and energy savings as well as the environmental and economic effects of varying auto weight.) [2]

over

I. Introduction

The Energy Crisis has stimulated a great interest in conserving energy and in searching for new sources of energy. That the private automobile fuel consumption comprised 28 percent of the total U.S. petroleum consumption in 1972 [1] naturally attracts attention in questioning how much fuel can be saved in the private automobile sector. By using "auto weight" as a key variable, it is shown in [2] that if "auto weight" can be reduced, it is possible in the United States to actually achieve a great savings not only in fuel consumption but also in other scarce resources (such as steel, aluminum, etc.). Pollution will also be greatly reduced. Certainly, such a weight reduction will have a multifaceted effect on the economy. (For more details see [2].)

One of the major concerns to car owners besides fuel economy and price is "safety." Is it true that bigger cars are safer? An analytical evaluation of this inquiry will be of benefit to those who plan to shift from big cars to small cars. It is equally important for the public and the government to know the facts in forming their attitudes and/or regulations towards automobile size and consequently the related energy and economic policies. Such a study has not been done before, even though there is abundant literature on safety analysis (for instance [3,4] and those quoted in [3]).

The purpose of this article is to report some statistical facts on the relationship between auto weight and safety. In this report, "safety" shall denote the following: (i) the frequency of getting into an accident; (ii) the frequency of getting into an accident resulting in serious or fatal injuries to occupants; (iii) the frequency of getting into a serious or fatal accident given that an accident has occurred; and (iv) the frequency of accidents involving drunken drivers.

Subsequent to a brief introduction to the sampling data and classification in the next section, the following major findings of our research will be reported.

(i) Statistically, larger cars have a much higher frequency of getting into accidents (Section 3);

(ii) Given that an accident has occurred, it seems that smaller cars have a little higher frequency of getting into a serious or fatal accident. However, such an inclination is not statistically significant (Section 4);

(iii) Statistically, larger cars have a much higher frequency of getting into a serious injury or fatal accident (Section 5).

(iv) Statistically, larger cars have a much higher frequency of getting into an accident involving drunken drivers (Section 6).

The main limitation in this research was to obtain specific relevant and comparable data. The sampling and analysis used is by no means perfect. However, the results obtained are significant. Section 7 discusses in more detail the limitations of the current research and delineates some suggestions for further research.

2. Data Base

Since it is extremely difficult to obtain nationwide data, this research focuses on the data of the State of Texas for the year of 1973. Passenger cars are roughly classified into four classes: (i) Class 0 includes cars weighing no more than 3,000 pounds. Most subcompact and compact cars belong to this class, and these will be referred to as small cars; (ii) Class 1 includes cars weighing between 3,000 and 4,000 pounds, referred to as intermediate cars; (iii) Class 2 includes cars weighing between 4,000 and 5,000 pounds, referred to as large cars; and (iv) Class 3 includes cars weighing more than 5,000 pounds, referred to as super large cars.

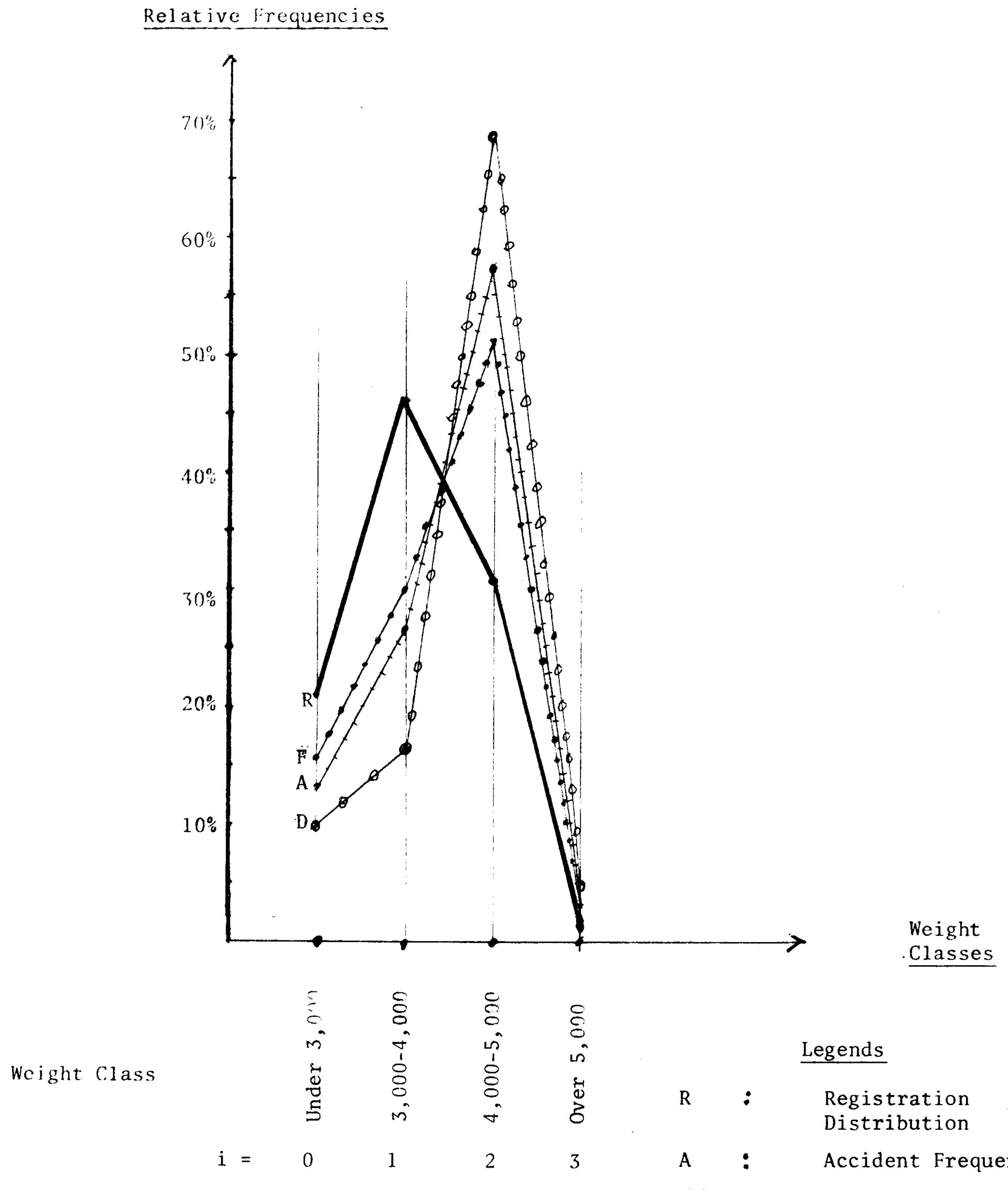
Relevant data were obtained from two sources. The Texas Highway Department supplied the percentile distribution of the passenger cars registered in Texas for the year 1973 according to auto weight (which is the shipping weight plus 100 pounds for gas, oil, water, etc.). These data were converted to the percentile distribution according to the weight classes described above. The distribution is given in Column 2 of Table 1.

The Texas Department of Public Safety supplied us with the records of motor vehicle traffic accidents for the year of 1973. Samples were randomly selected from the department's input and types of accidents were recorded. This yields Columns 3 to 5 of Table 1. Since the TDPS records only register type and make (no weight) of the cars involved in the accident, data were taken from Consumer Reports for the "curb weight" (which includes the weight of fuel, oil and water, thus comparable to the registration weight of the Texas Highway Department) of each model car for the classification (see Section 7 for further comment). The detail of such a classification is given in Appendix 1.

Table 1

i	(1) Weight Classes	(2) Registration Distribution	(3) Accidents (Sampled)	(4) Serious Injuries or Fatal Accidents (Sampled)	(5) Accidents Involving Drunken Drivers
0	Under 3,000 lbs.	21.04%	162 cars (13.46%)	24 cars (16.22%)	13 cars (9.92%)
1	3,000-4,000 lbs.	46.13%	318 cars (26.40%)	45 cars (30.41%)	22 cars (16.79%)
2	4,000-5,000 lbs.	31.13%	689 cars (57.23%)	76 cars (51.35%)	90 cars (68.70%)
3	Over 5,000 lbs.	1.70%	35 cars (2.91%)	3 cars (2.03%)	6 cars (4.58%)
	Total	100% (5,517,916 cars registered)	1,204 cars (100%)	148 cars (100.01%)	131 cars (99.99%)

Table 1 is self-explanatory. For instance, the first element of Column 3 reflects the fact that 162 automobiles involved in accidents weighed less than 3000 lbs., from a sample of 1204 cars involved in accidents. The percentages in Columns 3 to 5 are with respect to Column totals. Note that the percentage gives the relative frequency of each class of cars having the specified types of accidents, i.e., 13.46% = 100% · (162/1204). Using these percentages in Columns 2 to 5 the relative frequencies of each type of accident in Figure 1 can be obtained (plotted against weight class). These data provide the basis for this study of the relationship between occupant safety and auto weight.



Legends

R : Registration Distribution

A : Accident Frequency

F : Serious Injury or Fatal Accident

D : Accident Involving Drunken Drivers

Figure 1

RELATIVE FREQUENCY OF EACH TYPE OF ACCIDENT FOR EACH WEIGHT CLASS

3. Auto Weight and Accident Frequency

It is evident from Figure 1 that the accident frequency curve lies below that of the registration distribution when the auto weight is under 4,000 pounds, and the reverse case occurs when auto weight exceeds 4,000 pounds. To polarize this effect the research investigators used:

A/R = (Accident Frequency in %) / (Registration Distribution in %) (1)

to measure the relationship between auto weight and accident frequency. Thus,

$$A_i/R_i = \left(\frac{\text{Accident Frequency in the ith class}}{1{,}204}\right) / \text{(Registration Frequency in \% for the ith class)}$$

$$= \text{(Accident Frequency in the ith class)} / 1.204 \times \text{(Registration Frequency in \% for the ith class)}$$

$$= \text{(Accident Frequency in the ith class)} / \text{(Expected Accident Frequency for the ith class if Accident Occurring is Proportional to Registration Distribution Frequency)} \tag{2}$$

Dividing Column 3 by Column 2 results in A_i/R_i as in Figure 2.

As indicated in Eq. (2), if auto weight has no effect on accident frequency and the accident frequency is proportional to registration distribution, then A_i/R_i will be the ratio of the <u>sampled</u> accident frequency with respect to <u>expected</u> accident frequency. If auto weight has no relationship to accident frequency, one would expect to have A_i/R_i close to 1 or 100%. Figure 2 indicates that this ratio is much lower than 100% for smaller cars (under 4,000 pounds) and much higher than 100% for larger cars (over 4,000 pounds). Is this due merely to the randomness of the samples? Or is there any intrinsical relation between auto weight and accident frequency?

Suppose that auto weight has no effect on the accident frequency. Then it is known (for instance see Chapter 5 of [5]) that

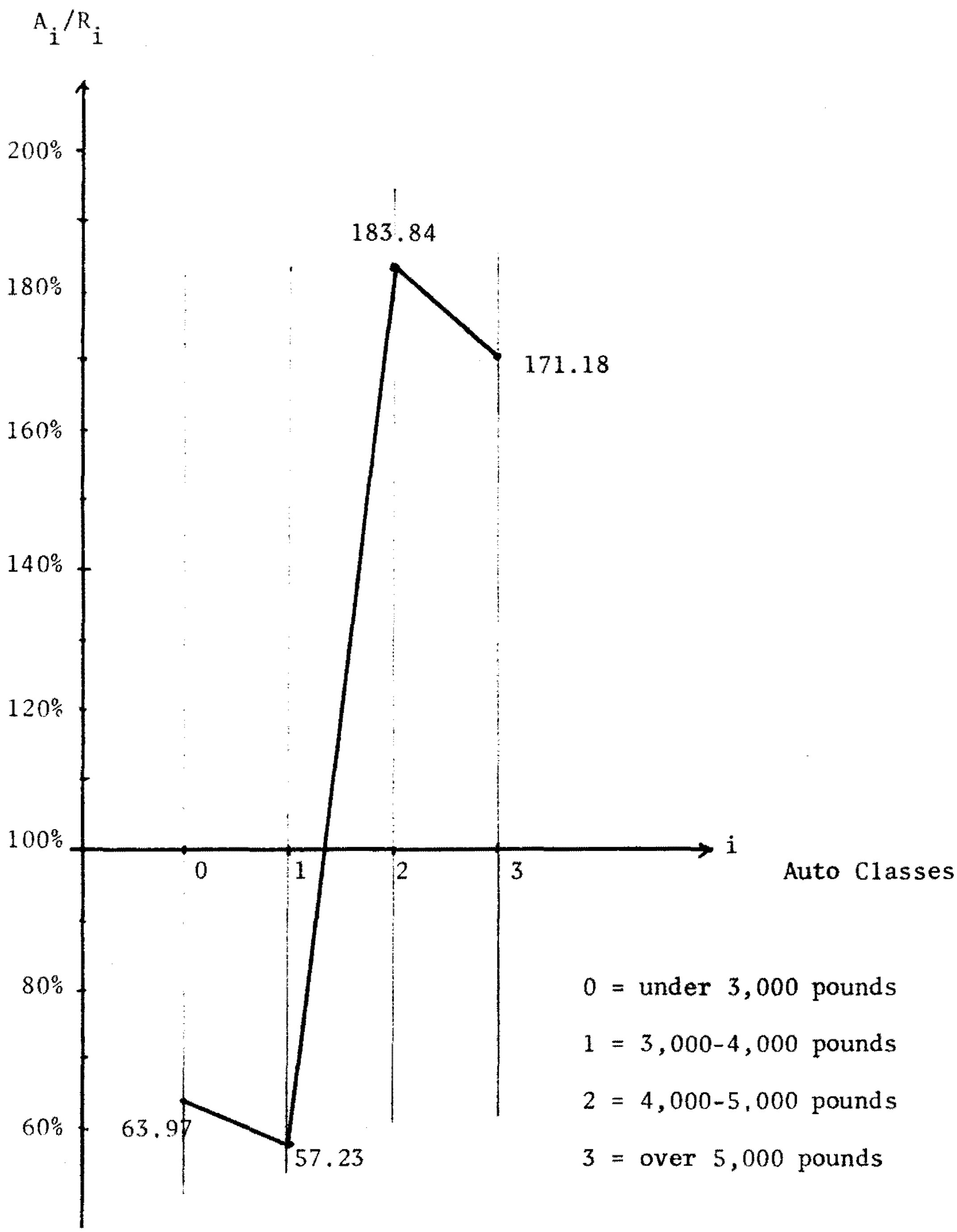


Figure 2

RELATIONSHIP BETWEEN OBSERVED ACCIDENT FREQUENCY AND EXPECTED ACCIDENT FREQUENCY FOR EACH WEIGHT CLASS

$$X^2 = \sum_{i=0}^{3} \text{(observed freq. - expected freq.)}^2/\text{expected frequency} \qquad (3)$$

is distributed approximately as $X^2(3)$ (i.e., X^2 with 3 degrees of freedom) when the sample size is large. Using Columns 2 and 3 of Table 1 and Eq. (3), we obtain Table 2, which contains computations for carrying out the X^2 test.

Table 2

(1) Auto Classes	(2) Observed Accident Frequency (O_i)	(3) Registration Distribution	(4) Expected Accident Frequency (E_i)	(5) $\frac{(O_i - E_i)^2}{E_i}$
Under 3,000 lbs.	162	21.04%	253.32	32.92
3,000-4,000 lbs.	318	46.13%	555.41	101.48
4,000-5,000 lbs.	689	31.13%	374.81	263.38
Over 5,000 lbs.	35	1.70%	20.47	10.32
Total	1,204	100%	1,204.01	408.10

In Table 2, Columns 2 and 3 correspond to Columns 3 and 2 of Table 1. Column 4 of Table 2 is obtained by multiplying Column 3 by 1,204 (the total sample size) and Column 5 is derived from Columns 2 and 4 by the formula indicated in Column 5.

From Table 2, the value of X^2 derived from Eq. (3) is 408.10. Note, however, that from Table C of [6], $X^2(3)$ has only a 0.001 chance of exceeding 16.3, which is much smaller than 408.10. Thus the hypothesis that there is no association between auto weight and reported accident frequency must be rejected. It can be concluded that larger cars have a much higher frequency of getting into accidents as indicated in Figure 2. (This does not imply that the auto weight is the only factor influencing accidents.)

Why do larger cars have a higher frequency of getting into accidents? The following are some plausible explanations. Physically, larger cars have less room to maneuver in a fixed lane width on highways or in a fixed space size in a parking lot. A slight error in judgment by the driver may take the auto out of its lane and cause an accident. Besides, the field of vision in larger cars may be more obstructed than in smaller cars. This again may cause more accidents. [redacted]

Figure 2 shows that Class 1 cars have a slightly lower A_i/R_i ratio than that of Class 0 cars. This may be due to the randomness of the sampling. It could also be attributed to the nature of the classification, because quite a few cars whose weights are around 3,000 pounds (such as Valiant, Maverick, Mercury, Comet, etc.) have been classified into Class 0 (see Appendix 1). This makes the A_i/R_i ratio a little higher for Class 0 than it probably should be. (See further discussion in Section 7.) A similar comment holds for Sections 5 and 6. We shall not discuss it again.

4. Auto Weight and Serious Injury or Fatal Accidents Given An Accident Occurred

This section looks into the relationship between auto weight and serious injury or fatal accidents (SIFA) given that an accident has occurred. Note that in Figure 1, the SIFA curve is on the top of the curve of accident frequency when auto weight is smaller than 4,000 pounds, and the reverse case happens when auto weight exceeds 4,000 pounds. To polarize the effect, the investigators used:

$$F_i/A_i = \text{(SIFA Frequency in \% for class i)} \Big/ \text{(Accident Frequency in \% for class i)} \qquad (4)$$

to measure the relationship between auto weight and SIFA frequency given that an accident has occurred. Note that as in Eq. (2), one can easily show that if auto weight has no effect and SIFA frequency is proportional to accident frequency then F_i/A_i gives the ratio of observed sample SIFA frequency to expected SIFA frequency (i.e., $148 \cdot A_i$). Data from Columns 3 and 4 in Table 1 were used to obtain F_i/A_i for each auto class. The result is depicted in Figure 3.

Figure 3 shows that F_i/A_i is larger than 1 for "small" cars (class 0 and 1) and smaller than 1 for "large cars (class 2 and 3). Furthermore F_i/A_i becomes smaller as auto weight becomes larger. Is this due to randomness of the sample selection? Or is there an intrinsical relationship between auto weight and SIFA given that an accident has occurred? Again, as in Section 3, suppose that auto weight has no effect on the SIFA frequency given that an accident has occurred. Then X^2 defined in Eq. (3) will be approximately distributed as $X^2(3)$. Such a computation for X^2 is given in Table 3.

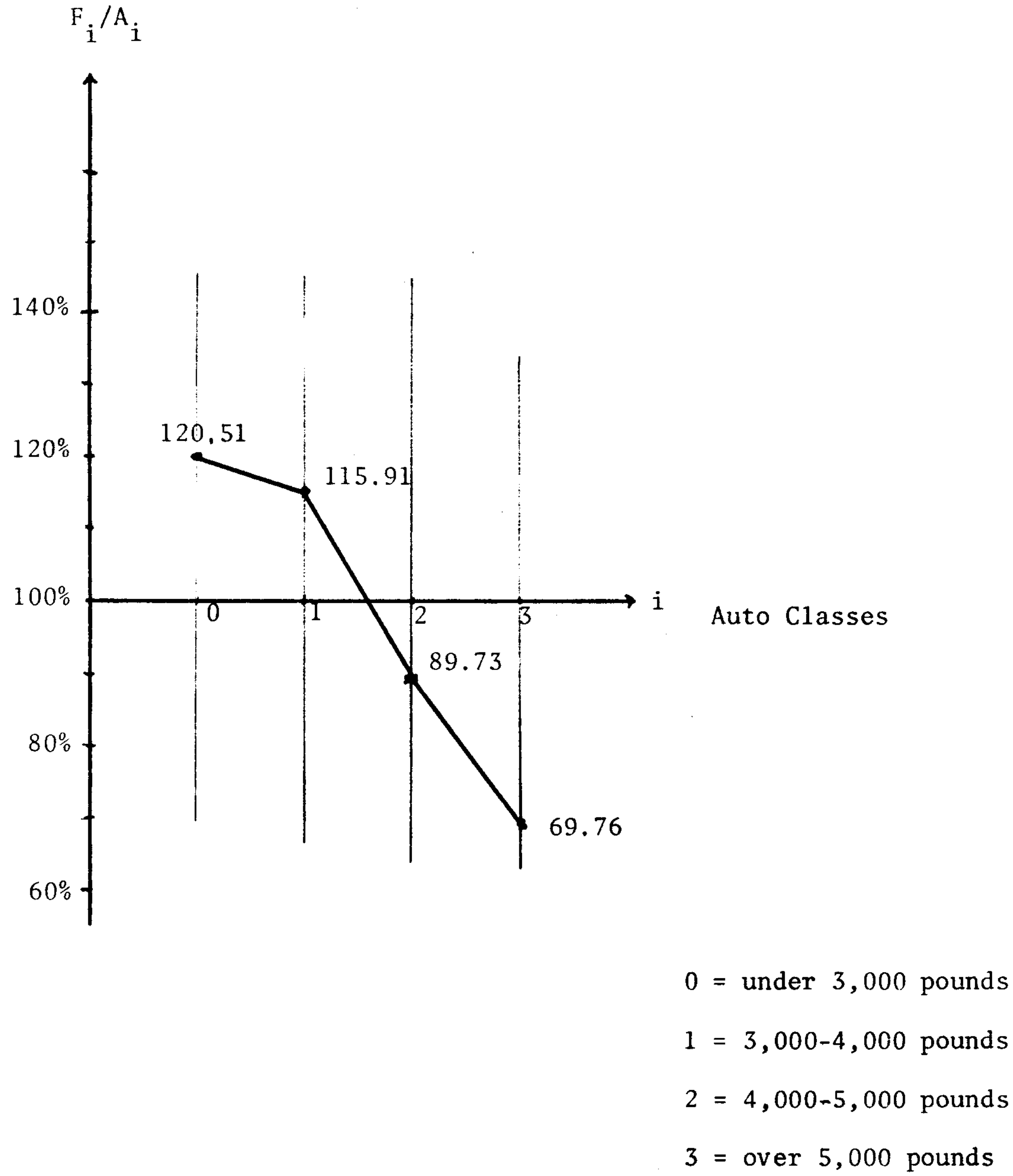


Figure 3

RELATIONSHIP BETWEEN OBSERVED SIFA FREQUENCY AND EXPECTED SIFA FREQUENCY FOR EACH WEIGHT CLASS, GIVEN THAT AN ACCIDENT HAS OCCURRED

Table 3

(1) Auto Classes	(2) Observed SIFA Frequency (O_i)	(3) Accident Frequency	(4) Expected SIFA Frequency (E_i)	(5) $\frac{(O_i-E_i)^2}{E_i}$
Under 3,000 lbs.	24	13.46%	19.92	0.84
3,000-4,000 lbs.	45	26.40%	39.07	0.90
4,000-5,000 lbs.	76	57.23%	84.70	0.89
Over 5,000 lbs.	3	2.91%	4.31	0.40
Total	148	100%	148	3.03

Note that Columns 2 and 3 of Table 3 come from Columns 4 and 3 of Table 1 respectively. Column 4 of Table 3 is obtained by multiplying Column 3 by 148, the total for column 2. Recall that we use a large sample size of 1,204 (Column 3, Table 1) to register accident frequency. It can be regarded as a very good extimate for (population) accident frequency. Column 5 of Table 3 is clearly from Columns 2 and 4 by the formula indicated on the top of Column 5.

From Table 3 it can be seen that X^2 corresponding to Eq. (3) has a value of 3.03. Table C of [6] shows that more than 30 percent of $X^2(3)$ will exceed 3.67. Since 3.03 is less than 3.67, one cannot statistically reject the hypothesis that given that an accident occurred, SIFA frequency is proportional to that of accident frequency. Consequently, it can be concluded that the sampling does not show to a statistically significant degree that given an accident, smaller cars have a higher frequency of serious injury or fatal accidents.

The above finding is somewhat contrary to what could be expected. The following is a plausible explanation. It is true that when a large car collides with a small car, the latter is subject to a higher chance for SIFA and the larger car is safer. However, when a large car collides with a large car, the odds may become even and both cars may be subject to a high chance for SIFA. For example, consider a car in class 2 (i.e., 4,000-5,000 pounds) which collides with another car. From Table 1, if an accident occurs randomly with another car, one would expect the Class 2 car to collide with a car in Class 0 with a 0.1346 chance; with a car in Class 1 with a 0.264 chance; with a car in Class 2 with a 0.5723 chance and with a car in Class 3 with a 0.0291 chance. Thus it has about a 60 percent chance of colliding with a car no smaller than itself. With this kind of reasoning, one might think that larger cars are perhaps safer in an accident, but the odds (or edge) may not be very significant.

5. Auto Weight and Serious Injury or Fatal Accidents

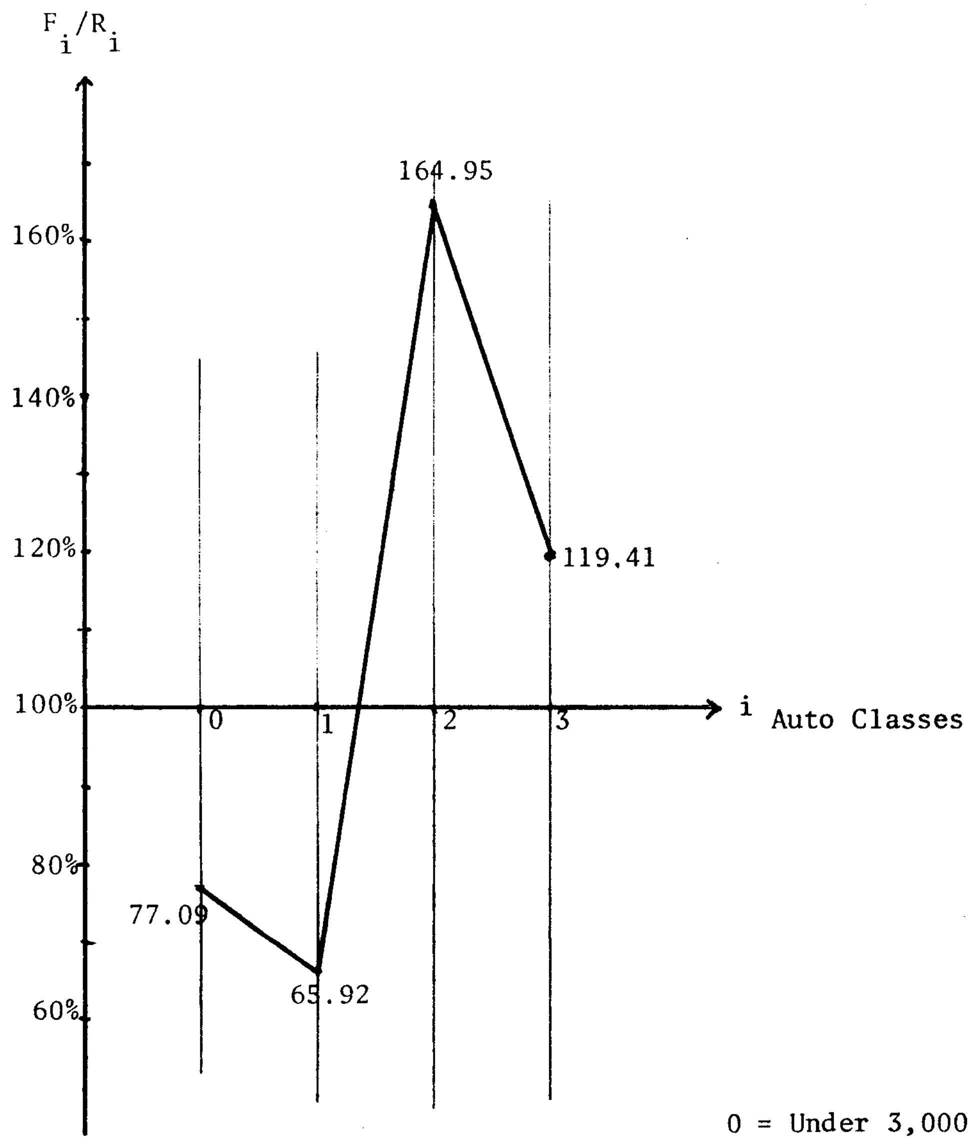
This section examines the relationship between auto weight and frequency of SIFA. Relative frequencies of SIFA will be compared with the registration distribution.

Suppose that auto weight has no effect on SIFA frequency and SIFA frequency is proportional to the registration distribution. Then the measure (as derived in Section 3)

$$F_i/R_i = \text{(SIFA Frequency in \% for class i)/(Registration Frequency in \% for class i)} \qquad (5)$$

will give the ratio of observed sample SIFA frequency to expected SIFA frequency (i.e., $148 \cdot R_i$). From Columns 2 and 4 of Table 1 F_i/R_i can be computed. The results are depicted in Figure 4.

Figure 4 shows that F_i/R_i is much smaller than 1 for "small" cars (Classes 0 and 1) and much larger than 1 for "large" cars (Classes 2 and 3). Is this due to the randomness of the sample selection? Or is there an intrinsical relationship between auto weight and SIFA frequency? Again, similar to Section 3, assume that auto weight has no effect on the SIFA frequency. Then X^2 defined in Eq. (3) will be approximately distributed as $X^2(3)$. A computation for such a X^2 test is given by Table 4.



0 = Under 3,000 pounds

1 = 3,000-4,000 pounds

2 = 4,000-5,000 pounds

3 = Over 5,000 pounds

Figure 4

RELATIONSHIP BETWEEN OBSERVED SIFA FREQUENCY AND EXPECTED SIFA FREQUENCY FOR EACH WEIGHT CLASS

Table 4

(1) Auto Classes	(2) Observed SIFA Frequency (O_i)	(3) Registration Distribution	(4) Expected SIFA Frequency (E_i)	(5) $\frac{(O_i-E_i)^2}{E_i}$
Under 3,000 lbs.	24	21.04%	31.14	1.64
3,000-4,000 lbs.	45	46.13	68.27	7.93
4,000-5,000 lbs.	76	31.13	46.07	19.44
Over 5,000 lbs.	3	1.70	2.52	0.09
Total	148	100%	148.00	29.10

Note that Columns 2 and 3 of Table 4 correspond to Columns 4 and 2 of Table 1 respectively. In Table 4, Column 4 is obtained by multiplying Column 3 by 148, the total for Column 2, and Column 5 is computed from Columns 2 and 4 by the formula indicated in Column 5.

From Table 4 the value of X^2 corresponding to Eq. (3) is 29.10. By Table C of [6], note that $X^2(3)$ has only 0.001 chance to exceed 16.3 which is much smaller than 29.10. Thus, one must reject the hypothesis that auto weight has no effect on SIFA frequency and conclude that larger cars have a much higher frequency of getting into serious injury or fatal accidents than do smaller cars.

Why do larger cars have a higher frequency of getting into SIFA? The following is a plausible explanation.

Note that a SIFA requires that an accident happen which results in a serious injury or death to an occupant. That is, a SIFA requires that two conditions be met: (i) an accident occurs and (ii) the accident result in a serious injury or death. A well-known law of probability theory states:

$$\text{Prob[SIFA occurs]} = \text{Prob[Accident occurs]} \cdot \text{Prob[SIFA occurs} \mid \text{Accident occurs]} \quad (6)$$

From Eq. (6) and the results of Sections 3 and 4, note that since larger cars have a much higher probability of getting into accidents, even if Prob[SIFA|Accident] for larger cars may be slightly lower than that of smaller cars (recall that in

Section 4 the samples do not show statistical significance), the combined probability according to Eq. (6) for a larger car of getting into a SIFA is much higher than that of a smaller car.

Before concluding this section, perhaps it is a good idea to call the reader's attention to distinguishing Prob [SIFA occurs] from Prob[SIFA occurs| Accident occurs]. It seems that Prob[SIFA occurs] is a better measurement for safety than that of Prob[SIFA occurs| Accident occurs]. However, the latter has been used to a great extent for safety measurement.

6. Auto Weight and Accidents Involving Drunken Drivers

Drunken drivers have caused a great deal of highway safety problems. This section studies the relationship between auto weight and accidents involving drunken drivers (AIDD). Relative frequencies of AIDD will be compared with the registration distribution.

Suppose that auto weight has no effect on AIDD frequency and that the latter is proportional to the registration distribution. Then the measure

$$D_i/R_i = \left(\begin{array}{l}\text{AIDD Frequency in \%} \\ \text{for Class i}\end{array}\right) \Big/ \left(\begin{array}{l}\text{Registration Frequency in \%} \\ \text{for Class i}\end{array}\right) \quad (7)$$

(as derived in Section 3) will give the ratio of observed sample AIDD frequency to expected AIDD frequency (i.e., $131 \cdot D_i$). D_i/R_i is computed from Columns 2 and 5 of Table 1 and the results are depicted as in Figure 5.

In Figure 5 note that D_i/R_i is much smaller than 1 for "small" cars (Classes 0 and 1) and much larger than 1 for "large" cars (Classes 2 and 3). Is this due to randomness in the sample selection? Or is there an intrinsical relationship between auto weight and AIDD? Again similar to Section 3, assume that auto weight has no relation to AIDD frequency. Then X^2 defined in Eq. (3) will be approximately distributed as $X^2(3)$. A computation for such a X^2 is given in Table 5.

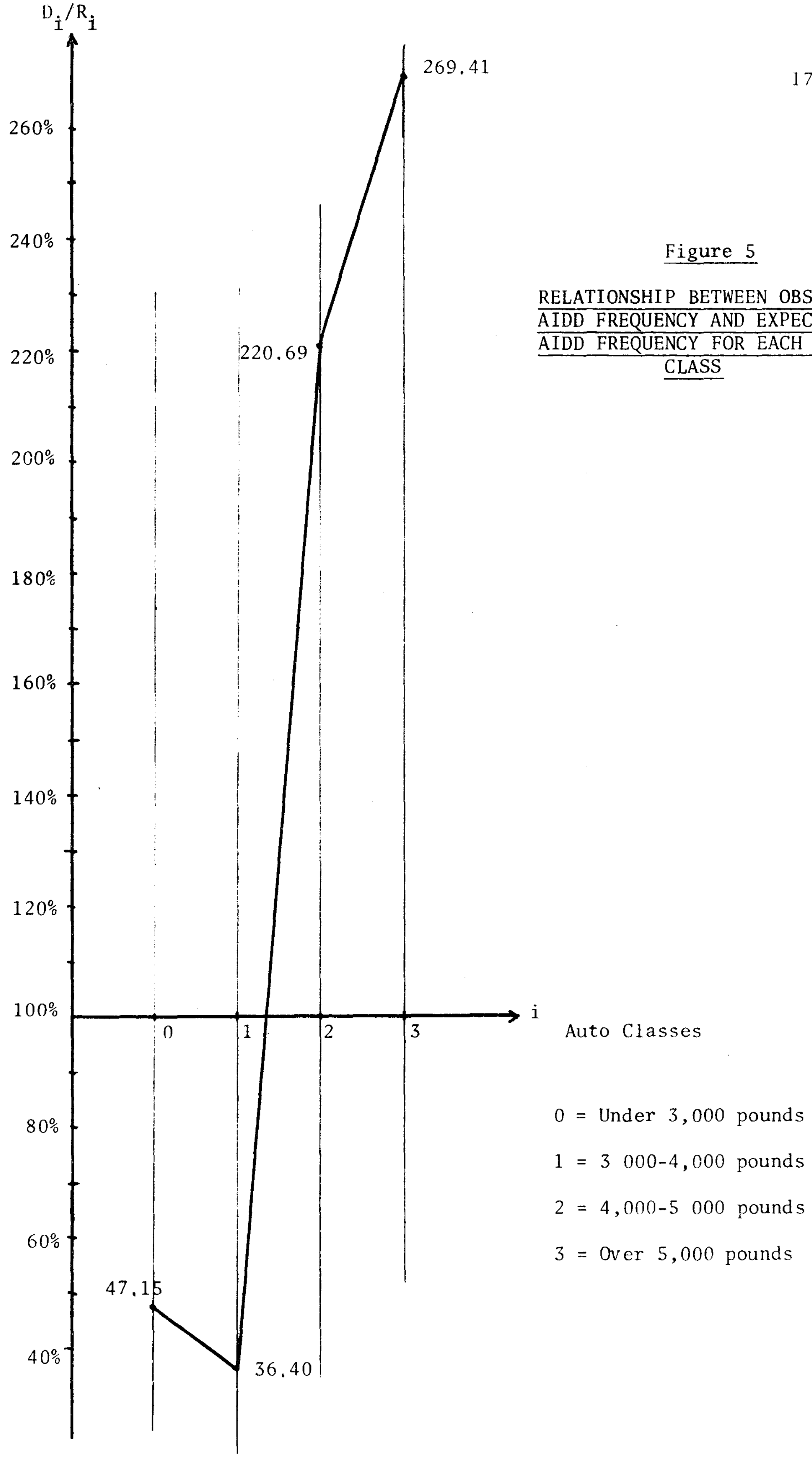


Figure 5

RELATIONSHIP BETWEEN OBSERVED AIDD FREQUENCY AND EXPECTED AIDD FREQUENCY FOR EACH WEIGHT CLASS

Table 5

(1) Auto Classes	(2) Observed AIDD Frequency (O_i)	(3) Registration Distribution	(4) Expected AIDD Frequency (E_i)	(5) $\frac{(O_i-E_i)^2}{E_i}$
Under 3,000 lbs.	13	21.04%	27.56	7.69
3,000-4,000 lbs.	22	46.13	60.43	24.44
4,000-5,000 lbs.	90	31.13	40.78	59.41
Over 5,000 lbs.	6	1.70	2.23	6.39
Total	131	100%	131.00	97.93

Note that Columns 2 and 3 of Table 5 correspond to Columns 5 and 2 of Table 1 respectively. Column 4 of Table 5 is obtained by multiplying Column 3 by 131, and Column 5 is computed from Columns 2 and 4 by the formula indicated in Column 5.

From Table 5, the value of X^2 corresponding to Eq. (3) is 97.93. From Table C of [6], note that $X^2(3)$ has only a 0.001 chance of exceeding 16.3 which is much smaller than 97.93. Thus one must reject the hypothesis that auto weight has no relation with AIDD frequency and conclude that large cars have a much higher frequency of getting into AIDD than small cars have.

[redacted].

7. Conclusion

The relationship between auto weight and safety has been discussed above. As previously stated, the research is by no means perfect. Some limitations of the research shall be outlined and these will in turn give some suggestions for further extension.

First, because of great difficulty in collecting data and because of time limitations, the relationship between auto weight and safety only for the year 1973 is studied. Is there any trend effect or cyclical effect in the relationship? Especially after the speed limitation of 55 miles per hour, is there any change in the relationship? A further study is needed to answer such questions.

Secondly, the data were obtained from two sources, and in order to compare the data, the "curb weight" of Consumer Reports was employed in conjunction with the "registration weight" used by the Texas Highway Department. There may be some discrepancy between the two weight measurements, even though it is probably very small. Furthermore, auto weight tends to vary from year to year even within the same make and model. In fact, depending on engine size and optional equipment, the weight of the same make and model of car in any year may vary within a considerable range. This again will cause some discrepancy in our classification. Hopefully, such discrepancies are each cancelled out by the randomness of the sampling.

Finally, the results reported herein should not be interpreted purely as "cause" and "end" relations, because there are a variety of factors such as speed, driving distance, observing traffic laws, alertness, etc., which are significant factors in accidents. Recall that the relationships reported are aggregated ones. They may be regarded as phenomena which result from a variety of factors. A further study of the relationships between the accidents frequencies and the causing factors is certainly important.

Acknowledgement

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Appendix 1 -- Auto Weight Classification

Class 0 (under 3,000 pounds)

Alfa Romeo
Austin Healey
Austin Metropolitan
Austin Not Listed & Unknown
Chevrolet Vega
Datsun
Fiat
Ford Anglia
Ford Cobra
Ford Cortina
Ford Falcon
Ford Maverick
Ford Pinto
Hillman
Honda
Mercury Comet
MG Midget
MG Not Listed & Unknown

Appendix 1 (continued)

Opel Kadette
Opel Rekord
Opel Not Listed & Unknown
Peugeot
Plymouth Valiant
Porsche
Renault
SAAB
Simca
Sunbean
Toyota Corona
Toyota Not Listed & Unknown
Triumph
Vauxhaul
Volkswagen Karmann-Ghia
Volkswagen (Bug)
Volkswagen Not Listed & Unknown
Volvo

<u>Class 1</u> (3,000-4,000 pounds)

Chevrolet Camaro
Chevrolet Chevelle
Chevrolet Chevy II
Chevrolet Corvair
Chevrolet Monte Carlo
Chevrolet Nova
Citroen
Dodge Charger
Dodge Coronet
Dodge Dart
Dodge Demon
Dodge Swinger
Dodge Not Listed & Unknown
Ford Mustang
Ford Torino
Mercury Cougar
Mercury Montego
Oldsmobile Cutlass
Plymouth Barracuda
Plymouth Duster
Plymouth Satellite
Plymouth Not Listed & Unknown
Pontiac Firebird
Rambler Ambassador
Rambler American
Rambler AMX
Rambler Javelin
Rambler Rebel
Rambler Not Listed & Unknown
Rover (Land-Rover)

Appendix 1 (continued)

Class 2 (4,000-5,000 pounds)

Buick LeSabre
Buick Riviera
Buick Skylark
Buick Special
Buick Wildcat
Buick Not Listed & Unknown
Checker
Chevrolet Bel Air
Chevrolet Biscayne
Chevrolet Caprice
Chevrolet Corvette, Chevrolet Impala
Chevrolet Not Listed & Unknown
Chrysler Newport
Chrysler New Yorker
Chrysler Saratoga
Chrysler 300
Chrysler Windsor
Chrysler Not Listed & Unknown
Dodge Monaco
Dodge Polara
Ford Custom
Ford Fairlane
Ford Futura
Ford Galaxie
Ford LTD
Ford Thunderbird
Ford Not Listed & Unknown
Mercedes-Benz
Mercury Marquis
Mercury Montclair
Mercury Monterey
Mercury Parklane
Mercury Not Listed & Unknown
Oldsmobile Delta 88
Oldsmobile Delmont 88
Oldsmobile F-85
Oldsmobile 442
Oldsmobile 98
Oldsmobile Starfire
Oldsmobile Toronado
Oldsmobile Not Listed & Unknown
Plymouth Belvedere
Plymouth Fury
Plymouth GTX
Pontiac Bonneville
Pontiac Catalina
Pontiac Executive (Starchief)
Pontiac Grand Prix
Pontiac GTO
Pontiac LeMans
Pontiac Tempest
Pontiac Not Listed & Unknown

Appendix 1 (continued)

Class 3 (over 5,000 pounds)

Bentley
Bridgestone
Cadillac Calais
Cadillac DeVille
Cadillac Fleetwood
Cadillac Not Listed & Unknown
Chrysler Imperial
Lincoln Continental
Lincoln Not Listed & Unknown
Rolls-Royce

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

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13. ABSTRACT

Analyses based on 1973 data from the Texas state automobile accident and registration records have been utilized in this study of the relationship between passenger car weight and occupant safety. In particular, the research showed the following: (i) the relatively higher frequency of accidents in large cars than in small cars is statistically very significant. (ii) the relatively higher frequency of accidents resulting in fatal or serious injuries in large cars than in small cars is statistically very significant. (iii) Although the occupants of small cars appear to have a higher frequency of incurring fatal or serious injuries given that an accident has occurred, such an inclination is not statistically significant. (iv) Accidents involving drunken drivers occur much more frequently in large cars than in small cars statistically to a very significant degree. Some plausible explanations for these occurrences are included in the report. Current research limitations and some suggestions for further improvement and extensions of the research are also discussed.

The current study is the first phase of a larger study focusing on the relationship between automobile weight and energy savings as well as the environmental and economic effects of varying auto weight.

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