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DRIVER CHARACTERISTICS AND THEIR RELATION TO TRAFFIC CONFLICT OCCURRENCE

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Khaled M. Abdulghani

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Doctor of Philosophy degree in Civil Engineering

William C. Taylor
Major professor

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DRIVER CHARACTERISTICS AND THEIR RELATION TO TRAFFIC CONFLICT OCCURRENCE

by

Khaled M. Abdulghani

A DISSERTATION

Submitted to
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ABSTRACT

DRIVER CHARACTERISTICS AND THEIR RELATION
TO TRAFFIC CONFLICT OCCURRENCE

by

Khaled M. Abdulghani

A traffic conflict is defined as a hazardous situation in which an accident is avoided by evasive action by the driver of one of the vehicles. Research on the use of conflicts as a traffic engineering tool has been focused on attempts to correlate conflicts and accidents so that conflicts, which occur more frequently than accidents, can be used as a basis for predicting future accidents. Several stratifications and/or refinements to conflict measures have been introduced to achieve better correlation, but the use of driver characteristics has not been used in these research studies.

The objectives of this study were to determine the driver characteristics that are overrepresented in conflict involved drivers when compared to all Saudi Arabian drivers; the relationship of these characteristics to types of conflict; and the interrelationships between types of conflict and traffic control at the intersection. A final objective was to determine the possibility of predicting future conflicts by knowing the mix of driver characteristics at an urban intersection.

Conflict involved drivers observed at six different locations were found to possess similar characteristics, indicating that there is a pattern which defines hazardous drivers. Age was the single variable which explained the greatest variation in conflict involvement, but nationality, occupation, past accident experience and driver training

were also significantly correlated with conflicts. Thus, predicting future conflict by knowing the mix of driver characteristics may be possible, but larger samples and more research is needed to achieve better correlation of variables in the multiple regression model.

The relationships between driver characteristics and conflicts found in this study were similar to relationships known to exist between driver characteristics and accidents. Thus, it appears that conflicts may be used to identify hazardous intersections when past accident records are not available.

Another conclusion reached in this study was that there are significant differences in the conflict rate depending on the training received by the driver. It appears that more strict driver licensing and enforcement of traffic regulations would decrease the conflict rate, and presumably the accident rate, in Saudi Arabia.

Dedicated to my father, Rashad, and my mother, Faigah, who sacrificed their life for the education of myself and my ten brothers and sisters. My father has been continuously concerned about our education and provided the impossible to overcome the obstacles in our paths. His courage in going against the wish of the elders in sending my sister Roshdia abroad to study medicine and make her dream come true left me with great admiration. My mother's closeness to me and my brothers and sisters, and her continuous prayers that God assist us and be with us were replied. It is for her outpouring feelings and upbringing that gave us recognition among friends.

On behalf of my brothers and sisters, may I express our deep gratitude for the great price you have paid which we can never repay as long as we live.

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My brothers Sami and Essam deserve my special gratitude for their encouragement and support throughout my doctoral program.

I would like to thank all the unnamed friends who contributed morally in the development of this research.

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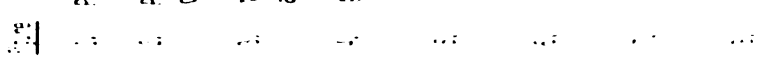

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CHAPTER 1

1.1 Introduction

The prediction of intersection accidents has long been a goal of transportation research. Much of this research has been focused on attempts to develop techniques for predicting accidents as a basis for implementing safety standards to prevent or minimize these accidents.

Traditionally, accident records have been used as a measure of the hazardousness of intersections. The fact that an accident may be the result of a driver's error, a defective vehicle, an inappropriate roadway condition, inadequate or improper traffic control devices, inadequate design, or a combination of these factors, however, makes it difficult to accurately predict future accidents based on past accidents. Also, the fact that accident records may be distorted, incorrect, not readily available or not statistically reliable, adds to the difficulty of developing adequate models from these records.

Researchers have acknowledged the need for new methods to predict the number of accidents expected at any given intersection. Most of the research work in this area has attempted to use some measure of traffic exposure as a predictive variable. The most common exposure measures have been the volume, or the volume to capacity ratio. However, neither of these measures capture the influence of geometric features on accident rates.

One of the newest methods proposed as a basis for accident prediction is the Traffic Conflict Technique. A traffic conflict is defined as a hazardous situation in which an accident is avoided by evasive

action by one or both drivers to avoid a collision. A conflict is identified by the occurrence of evasive actions (such as braking or weaving to avoid an impending accident) or a traffic violation. A traffic violation is defined in accordance with the uniform traffic code, and is considered a traffic conflict even if no other vehicle is in close proximity to the violator.

Twelve conflict types have traditionally been used at intersections and are defined as follows (53):

1. Left turn, same direction: A left turn, same direction conflict occurs when an instigating vehicle slows to make a left turn, thus placing a following, conflicted vehicle in jeopardy of a rear-end collision.

2. Right turn, same direction: A right turn, same direction conflict situation occurs when an instigating vehicle slows to make a right turn, thus placing a following, conflicted vehicle in jeopardy of a rear-end collision.

3. Slow vehicle, same direction: A slow vehicle, same direction conflict situation occurs when an instigating vehicle slows while approaching or passing through an intersection, thus placing a following vehicle in jeopardy of a rear-end collision.

4. Lane change: A lane change conflict situation occurs when an instigating vehicle changes from one lane to another, thus placing a following, conflicted vehicle in the new lane in jeopardy of a rear-end or side-swipe collision.

5. Opposing left turn: An opposing left turn conflict situation occurs when an oncoming vehicle makes a left turn, thus placing the conflicted vehicle in jeopardy of a head-on or broadside collision.

6. Right turn cross traffic, from right: A right turn cross

traffic from right situation occurs when an instigating vehicle approaching from the right makes a right turn, thus placing the conflicted vehicle in jeopardy of a broadside or rear-end collision.

7. Left turn cross traffic, from left: A left turn cross traffic from left conflict situation occurs when an instigating vehicle approaching from the left makes a left turn, thus placing a conflicted vehicle in jeopardy of a broadside or rear-end collision.

8. Left turn cross traffic, from right: A left turn cross traffic from right conflict situation occurs when an instigating vehicle approaching from the right makes a left turn, thus placing the conflicted vehicle in jeopardy of a broadside collision.

9. Thru cross traffic, from left: A thru cross traffic from left conflict situation occurs when an instigating vehicle approaching from the left crosses in front of a conflicted vehicle, thus placing it in jeopardy of a broadside collision.

10. Thru cross traffic, from right: A thru cross traffic from right conflict situation occurs when an instigating vehicle approaching from the right crosses in front of the conflicted vehicle, thus placing it in jeopardy of a broadside collision.

11. U-Turns: A U-Turn conflict situation occurs when an instigating vehicle makes a U-Turn in the vicinity of an intersection in front of a conflicted vehicle, thus placing it in jeopardy of a collision.

12. Disobeying red light or stop sign: This traffic violation occurs when an instigating vehicle violates the uniform traffic code.

Whenever a vehicle is involved in more than one observed conflict, each type of conflict is recorded for that vehicle.

For analysis purposes, the conflicts are often grouped into four

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categories:

1. Right angle conflicts: the sum of conflict counts for:
    a. Thru cross traffic, from left.
    b. Thru cross traffic, from right.
    c. Disobeying red light or stop sign.
2. Rear end conflicts: the sum of conflict counts for:
    a. Left turn, same direction.
    b. Right turn, same direction.
    c. Slow vehicle.
3. Turning conflicts: the sum of conflict counts for:
    a. Opposing left turn.
    b. Right turn cross traffic, from right.
    c. Left turn cross traffic, from left.
    d. Left turn cross traffic, from right.
    e. U-Turns.
4. Side swipe conflicts: the sum of conflicts counts for lane change conflicts.

Research on the use of this technique has attempted to correlate conflicts and accidents so conflicts, which occur more frequently than accidents, can be used as a basis for predicting future accidents. If this correlation can be verified, conflicts can be used to identify potential hazards and operational deficiencies, and to evaluate traffic improvements.

Although the traffic conflict technique has been studied for more than ten years, there are still many components that have not been thoroughly investigated. For example, insufficient research has been conducted on characteristics of conflict involved drivers (those who contribute heavily to conflicts). This research is directed toward

the study of the characteristics of conflict involved drivers, and the relationships of these characteristics to the number and type of conflicts.

Although the scope of this research does not include the testing of conflict-accident relationships, an accident is simply a conflict where the evasive action was too little or too late, and accidents and conflicts should be statistically related.

Glauz and Miglez (53) argued that most attempts to find strong correlations between conflicts and accidents have been unsuccessful for one or more of the following reasons:

1. Not all intersection accidents are reported, and the reported accidents may have happened at different times than when conflicts were measured.
2. Not all intersection accidents are the types representative of the conflicts measured.
3. Not all accident data used by previous researches was statistically repeatable.
4. Conflict definitions have not been precise enough to ensure interobserver reliability, and there have been various interpretations of these definitions.

1.2 The Problem

The objective of all highway safety programs is to reduce the number of accidents and fatalities which occur each year. Previous accident studies examined such factors as the characteristics of the roadway, the vehicle, and the environment and how each of these contribute to the occurrence of accidents. However, insufficient attention has been given to one of the basic elements of traffic accidents, the driver.

Recent studies have shown that there exists a 'pattern' among drivers involved in traffic accidents, and that certain driver characteristics are overrepresented in persons involved in accidents. Although several authors have looked at the possibility of predicting future accidents using individual characteristics, the literature contained little information on the potential for using characteristic 'patterns' as a basis for predicting future accidents.

In the literature review, no studies were found of the characteristics of conflict involved drivers or attempts to identify those characteristics that are overrepresented in conflicts.

1.3 Objectives of This Study

This study was designed to achieve the following objectives:

1. To determine driver characteristics that are overrepresented in conflict involved drivers when compared to all drivers.
2. To determine the relationship between drivers' characteristics and types of conflicts.
3. To determine the contribution of each conflict type to total conflicts at urban intersections.
4. To examine the possibility of predicting the number of conflicts and their types by knowing the mix of driver characteristics.

The importance of this research lies in the potential use of the results to establish a new basis for predicting future conflicts, and ultimately, future accidents.

CHAPTER 2

LITERATURE REVIEW

The distribution of traffic accidents in time and space, factors which contribute to or are correlated with accidents, and the potential value of traffic control devices in reducing accidents have all been the subject of extensive research. A large number of accident prediction models using various surrogate measures (mostly exposure related) have been used to explain these variations in traffic accidents. In contrast, a relatively small number of published articles have discussed the use of driver characteristics in accident prediction models even though these variables generally are strongly correlated with accident frequencies.

The literature review was conducted to determine whether sufficient evidence of a relationship between accidents and conflicts, and accidents and driver characteristics, exist. The relationships discussed by other authors was then used to develop the hypothesis to be tested in this study.

2.1 Exposure Measures

Intersection accidents account for more than 50 percent of the total accidents in many nations, which gives the 'intersection' a world wide priority in finding accident prediction procedures and remedial measures (3).

Traffic accidents are the most direct measure of safety deficiencies at intersections. However, postponing potential safety improvements until an accident history has evolved delays the implementation of accident reduction measures. The lack of reliable accident records, due to incomplete records or errors in coding either important accident

facts or the precise accident location, contributes to the insufficiencies in using accidents alone as a basis for safety improvements.

Several individuals and agencies have tried to find a solution to this problem by introducing new methods to estimate the expected number of accidents at intersections. Some of the early studies like Jorgensen (4) and Hall (5) calculated the expected number of accidents on the basis of the number of vehicle-kilometers within the intersection. However, the risk per kilometer travelled at intersections was not a satisfactory measure, since the number of accidents at intersections is dependent on more factors than volume and the width of the intersection.

This lack of success led to more sophisticated methods of predicting accidents at intersections based on a combination of measures of exposure. These studies used mathematical functions based on the stream flows passing through an intersection as the measure of exposure, and compared accident occurrences with this calculated exposure. Accidents and flows were compared for many locations and regression equations derived which correlated with the observed accident occurrences.

Thorson (8), for example, defined exposure as the sum of all vehicles entering the intersection. He theorized that the number of accidents that occurred at each intersection divided by this sum would provide a basis for comparing the hazardousness of intersections of different types. However, this too was proved to be unacceptable as it does not consider all the factors that effect accidents.

Several researchers defined exposure as a probability distribution based on the number of opportunities of being involved in an accident at the intersection. Mathewson and Brenner (6) and Breuning and Bone (7) were among the first to point out the difference between exposure on a road situation, which is related to distance travelled, and

exposure at intersections, which is related to the maneuvers through the intersection. They suggest that an exposure index at intersections should take into account the flows on each crossing, merging, or diverging path.

These studies led to several measures of exposure being used to predict collisions at intersections. The following paragraphs summarize briefly what has been accomplished with these models; the traffic conflict technique will be discussed in more detail later in this chapter.

Early research on exposure was reported by Feuchtinger (13), Raff (14), Thorson (8), and Breuning and Bone (7). Each found that the number of accidents per vehicle was lower for locations with a high measure of exposure than for locations with a low measure of exposure. In each of these studies, however, measures of exposure were found by observing traffic at different locations rather than by taking observations at one location over different time periods. Thus, this phenomenon may be explained by the fact that locations with higher flows generally are built to higher design levels than those with lower flows. Thus none of these studies can claim to have shown conclusively the effect of flow on the ratio of accidents per vehicle.

McDonald (15) and Thorson (8) found that accident risks do not vary much between heavily travelled intersections, even though the flows varied widely. For the intersections they studied, there does not seem to be a strong case for the use of the sum of entering traffic as a measure of exposure.

Grossman (10) calculated the number of locations where one traffic stream crossed another traffic stream in an intersection, added the flows for each stream, and summed this over all locations and used it as the measure of exposure. This measure was used to compare different

intersection layouts. However, these models have not calibrated well with accident experience, indicating that not all traffic stream crossings are equally hazardous.

A second group of researchers used the product of conflicting flows as a measure of exposure. This measure takes into account the number of times vehicles from different directions wish to occupy the same area of road space simultaneously. Surti (11) proposed using this product from a number of points (depending on type of intersection) where potential collisions may take place as a basis for an accident exposure indes. The essential parameters for this model are: number of conflict points, ADT, and time. Time is a measure of the period of exposure to conflict and can be arbitrary since it only has a relative value. The purpose of Surti's work was to determine an "exposure index" for each of the conflict points to develop a general equation for the entire intersection.

Surti (16) followed his initial work by using the same points concept and adding merging maneuvers to test the model. He considered, however, the same likelihood of accidents for different maneuvers.

Chapman (17) agreed with the use of the product rather than the sum of flows as an exposure measure, but added that the square root of the product may be a better predictor of accident occurrences. McDonald (15) was among the leading researchers to use the square root of the product of flows as a measure of exposure. He studied intersections between a divided highway and a cross street and obtained a relation between the number of accidents per year 'A_v', the average daily traffic entering from the divided highway 'V_d', and the cross street traffic 'V_c':

$$A = .000783\ V_d^{.455}\ V_c^{.633}$$

Thrope (21), in an investigation of accident rates at signalized intersections, related the number of accidents to the square root of the product of entering traffic, but did not justify the use of such a measure for signalized intersections, where the two traffic streams are separated by time.

Webb (20) developed graphs (for urban, semi-urban, and rural sites) for signalized intersections, showing the average expected number of accidents per year according to a non-linear function of the average daily main road and minor road traffic. This study, like those of Raff (14) and others, was based on single data points from many locations rather than many data points for a single location. Thus the cause-effect relationship cannot be determined.

Gwynn (12) conducted one of the most comprehensive studies of the relationship between accident rates (or involvement) and hourly volumes. Although this was a highway (not an urban intersection) study, it demonstrated that accident rates and traffic volumes do not parallel each other. This may be related to the fact that there is a tendency for a disproportionately high accident rate to occur during the hours with the lowest volumes (early morning hours). This is followed by a decrease in accident rate with an intermediate traffic flow, an increase in accidents with an increase in volume up to a point of congestion, and then the accident rate again falls off, even though the volume of traffic continues to increase. This study illustrated the fact that a stable relationship between exposure and accidents probably does not exist unless other conditions are eliminated from the analysis

(such as a high number of drivers under the influence of alcohol between midnight and 5:00 a.m., congested traffic). Thus, it is not surprising that attempts to develop accident predictive models based on exposure measures have not been successful.

2.2 Accident Patterns

Intersection accident patterns have proven to be very stable over time and in many different traffic situations. Intersection accidents account for a high and relatively constant percentage of total accidents in many nations. Smeed (3) reported that in Great Britain over 50% of all injury accidents in 1970 occurred in urban intersections. In France, intersection accidents accounted for more than 45% of total injury accidents in 1972; in Denmark 38% in 1973; in Ireland 44% in 1973; in Holland 44% in 1971; and in the United States an average of 41% of all reported accidents between 1971 and 1979 occurred at intersections.

Accident statistics published by the National Safety Council show little variation in the number of accidents when classified by type of collision over a period of ten years (see Table 1). The statistics also show a constant pattern in the type of accidents, with angle accidents having the highest frequency, followed by rear-end accidents and left turn accidents.

The effect of intersection geometry on accidents has also been studied extensively. In one two-year study to find relationships between motor vehicle accidents and the geometric and traffic features of highway intersections, Stanford Research Institute analyzed 558 intersections (57). The results were similar to the National Safety Council statistics as they found that angle accident rates are the highest for all types of intersections followed by rear-end accidents and weaving

and turning accidents. Table 2 presents the percentages of collisions by type for different geometrics and traffic control at intersections. Thus, if a particular intersection is experiencing an abnormal accident history, some other factors must be contributing to these accidents.

2.3 Driver Characteristics

There have been fewer studies reported on the relationship between accidents and the driver. Yet the characteristics of drivers, their capabilities and their driving skills are important factors that affect accidents. The National Safety Council concluded that an average of 88 percent of all accidents at urban intersections were a result of improper driving (58). Table 3 presents the percentages of different faulty driving techniques that caused accidents over a ten year period compiled by the National Safety Council.

In an attempt to find an easily measurable, yet reliable, surrogate measure of an accident prone driver, Spicer (26) examined the difference in car following behavior (as measured by the time gap between vehicles) between drivers with accident records and the general driving public. This study concluded that the smaller the following gap, the higher the probability of prior involvement in accidents. In the same study, Spicer also analyzed the relationship between intersection accidents and drivers age. He concluded that a crossing maneuver involving a young driver on the major road and an older driver on the minor road is more likely to result in accidents than any other combination of age groups.

Siebrecht, Schumacher, and Lauer (22) made a comparison of two samples of drivers. The first was taken in 1950 and the second three years later from the vehicle license files in Iowa. A follow-up mail survey was sent to all individuals in the samples. The survey included

Type of Accident / Year	1970[1]	1971[1]	1972[1]	1973	1974	1975	1976	1977	1978	1979	Average $\bar{x}$	Variance

TABLE 1. Two Motor Vehicle Accidents at Urban Intersections

Type of Accident \ year		1970[1]	1971[1]	1972[1]	1973	1974	1975	1976	1977	1978	1979	Average %	Variance
Total - Urban Intersections % of All Urban Accidents		36.5	36.5	36.5	41.9	38.2	40.0	45.7	44.1	43.1	40.8	41.3	3.1
Entering at Angle		17.4	17.4	17.4	18.3	20.2	23.1	22.5	22.3	21.2	19.7	20.6	2.1
Entering Same Direction	Both Going Straight	3.0	3.0	3.0	4.1	2.7	2.4	2.8	2.6	2.5	2.2	2.8	.58
	One Turn, One Straight	3.5	3.5	3.5	3.4	3.5	3.3	3.7	3.7	3.5	3.2	3.5	.18
	One Stopped	5.1	5.1	5.1	7.4	4.8	7.3	8.3	7.5	6.5	5.2	6.5	1.3
	All Others	0.9	0.9	0.9	1.3	0.6	0.8	0.9	1.0	1.3	1.4	1.0	.28
Enter. Oppo-site direc.	Both Going Straight	1.1	1.1	1.1	2.5	1.9	0.5	0.5	0.5	0.4	0.4	.98	.80
	One Left, One Straight	5.1	5.1	5.1	5.2	5.1	4.1	4.7	4.6	4.6	4.3	4.7	.40
	All Others	0.4	0.4	0.4	0.8	1.3	1.4	1.7	1.7	2.0	2.9	1.5	.76

Source: Accident Facts, National Safety Council Based on State Traffic Authorities Reports

[1] The figures given in 1970, 1971, 1972 show no variations which introduces the probability of being biased. Only one of these figures is included in the average and variance calculation which reduces the sample to 8.

TABLE 2. Percentage Accident Rate by Type of Collision and Intersection Type

Collision Type	All Intersections	Signal	Stop	Cross	Tee
Right Angle	24	34.6	20.0	29.7	12.4
Turning	4	2.6	4.2	2.2	4.7
Rear End	15.4	22.8	14.1	14.6	17.6
Head On	2.6	2.3	1.0	2.2	1.6
Sideswipe	8.4	10.2	3.7	10.3	6.7
Others (Driveway, Pedestrian, etc.)	45.6	27.5	57	41	57

Source: Stanford Research Institute (57).
Transferred from bar graphs.

TABLE 3. Percentages of Faulty Driving Techniques

Kind of Improper Driving	70	71	72	73	74	75	76	77	78	79
Total Improper Driving	93.8	93.6	85.8	86.9	87.1	91.1	86.6	82.0	86.6	86.8
Disregarded Signal	4.6	4.0	3.7	3.9	3.8	5.8	6.1	4.6	4.3	4.5
Drove Left of Center	3.0	2.4	2.3	2.5	2.4	3.0	2.8	2.2	2.6	2.7
Followed Too Closely	12.8	13.2	14.3	14.0	14.0	15.0	12.1	8.8	10.3	9.3
Made Improper Turn	4.1	4.8	4.1	4.6	4.7	5.4	4.9	4.0	4.6	5.0

Source: Accident Facts, National Safety Council. Based on State Traffic Authorities Reports.

data on the methods of learning to drive, mileage driven yearly, educational level, and other information. The authors concluded:

1. Violations and accidents are closely correlated and records of violations give a fair index of potential accidents.
2. About one person in four has an accident record and the same ratio holds true for violations.
3. A higher percentage of accidents involve men under 30 than other age groups.
4. The hypothesis that accidents are distributed equally among age groups is rejected.

Lynn (23) indicated that there is evidence to support the fact that accidents do not occur completely by chance but rather according to a demographic pattern. For example, in 1970, males between the age of 20 and 24 comprised 10.1% of all males in Virginia and 5% of the total population of the state. However, this demographic group comprised 20.7% of all male accident fatalities during the same year. Lynn gave other examples and concluded that certain demographic variables can be used to predict accident patterns.

Waller and Koch (27) evaluated accident data and types of driving exposure in terms of sociodemographic variables. They found that more highly educated individuals drive more than those with less education but there was no significant difference in the accident rate.

Plez and Schuman (28) found that among young drivers, those who were alienated from the educational system (dropouts, poor grades) had more accidents and incurred more violations.

Baker (29) found that more males and more young drivers were at fault in fatal accidents and that lower economic class drivers were also

more often at fault.

McGuire (59) compiled data on 2,799 drivers in an attempt to identify personal characteristics of drivers that possessed a causal relationship to accident-producing behavior. The study reported a multiple correlation between characteristics of drivers and accidents, with the highest observed simple R values corresponding to age (.38), occupation (.38), and income (.30), among 29 other tested variables.

All of these studies indicate that there are dirver characteristics related to accidents which if known in advance, could be used in accident prediction models. However, many of these characteristics can only be determined through interviews with drivers involved in accidents or stopped at a survey station. Unless the distribution of these characteristics can be determined, it is not possible to determine the relative hazardness of intersections.

2.4 Traffic Conflicts

Traffic conflict analysis has been proposed as a method of addressing these concerns. Because traffic conflicts are measured on-site, variations due to different driver characteristics or changing volumes can be captured in the data. The adoption of this technique, however, has been limited by the lack of research indicating that these conflicts are strongly related to accidents.

The traffic conflict technique was developed by Perkins and Harris (30) to be used as a dynamic tool in evaluating accident potential and operational deficiencies of intersections. Using this technique, it was hypothesized that intersections could be evaluated with no accident data. Instead, the safety evaluation would be based on the observed conflict frequencies at the intersection.

Since this initial paper on the traffic conflict technique, researchers have directed their studies in two main areas:

1. Studies concerned with finding relationships between accidents and conflicts.
2. Studies using the technique to identify potential hazards and operational deficiencies at intersections, and to substantiate the value of operational traffic improvements by measuring a reduction in conflict frequency or rate.

The Federal Highway Administration (FHWA), in cooperation with the State Highway Departments of Washington, Ohio and Virginia, evaluated the traffic conflict technique in an effort to find statistical relationships between accidents and conflicts. Their objectives were also to field test the technique to determine if conflict data provided information advantageous to pinpointing the need for safety improvements at intersections. The studies concluded the following (31):

1. The hypothesis that conflicts and accidents are associated is accepted.
2. Safety deficiencies at intersections can be described more quickly and reliably by using the traffic conflict technique than by conventional methods.
3. The traffic conflict technique costs less than conventional methods for finding intersection deficiencies and operational problems, and is also useful in analyzing spot improvements (before/after studies).

Paddock and Spence (32) developed prediction equations to estimate the number of accidents expected over a two year period using conflicts (and additional parameters) as components of these equations. Equations (1) and (2) were developed from their data for signalized and

non-signalized intersections respectively:

$$AP2Y = 1.1653 + 11.6345\,(ADT) - .0503\,(CPT) - .0321\,(RROPP) + .0387\,(OCPO2) + 0.285\,(TTOPP) - .02255\,(OPOPP) \quad (1)$$

$$AP2Y = 0.36 + ADT\,(22.3568 + 17.773\,(SPLIT) - 36.7045\,(ADT)^{\frac{1}{2}} - 1.6785\,(SPLIT)^2 + 18.2544\,(ADT) - .0264\,(OPOPP) + .8385\,(OPCON) \quad (2)$$

where

AP2Y = Accidents predicted in 2 years

ADT = Average Daily Traffic in 10,000's

SPLIT = Ratio of the sum of the cross volume to the approach volume

CPT = Total of conflicts/10 opportunities

OPOPP = Opposing conflict opportunities (opportunity is a term used to denote traffic volume)

RROPP = Rear-end conflict opportunities

OPCON = Opposing conflicts

TTOPP = Total conflict opportunities

OCPO2 = Square of opposing conflicts/10 opportunities

The regression equations had a prediction error for all points (611 locations, 220 signalized, and 391 nonsignalized intersections) of ± 4.2 accidents/year at a 95% confidence level.

Glennon (33) pointed out that these equations are based more on traffic volume counts (ADT, SPLIT, OPOPP, RROPP, AND TTOPP) than the conflict counts OPCON, OCPO2 and CPT). In fact, in equation (1), the number of accidents is negatively correlated with conflicts (CPT and OCPO2). Thus, the use of these regression equations adds little to the exposure based models discussed earlier.

All studies of conflict rates did not reach the same conclusion. Cooper (37) and Glennon (33) found that conflicts are very much volume dependent and could not account for differences in accidents when corrected for exposure. They argued that studies which concluded strong association between accidents and conflicts are either brief and not statistically reliable, or have disregarded important parameters that may explain the association (such as site parameters).

Not all conflicts are, in fact, near accidents. Drivers vary in their response to other vehicles, some braking when it would not be necessary to avoid a collision, for example. In an attempt to gain reliability, Spicer (34,35,36) classified conflicts by severity (routine, moderate, and severe) and attempted to find relationships between severe conflicts and intersection accidents. He concluded that using only severe conflicts improves the prediction equation. However, accidents at only six intersections were included in this analysis.

Hayward (53) used Time Measured to Collision (TMTC) as another method of identifying conflicts. TMTC is defined as "the time required for two vehicle to collide if they continue at their present speeds on the same path." This too improves the reliability of prediction equations be reducing the variation due to a driver related response in the equation.

A second type of research used the Traffic Conflict Technique to identify potential hazards and operational deficiencies of highways and intersections. Findings from these studies were used to justify and substantiate the value of many types of operational traffic improvements. This use seems to have had more success with the Traffic Conflict Technique.

Among the reports indicating successful use of the Traffic Conflict

Technique in practice are:

1. Before and after improvement studies (38,40,41,42),
2. Construction zones (43),
3. Freeway acceleration lanes (44),
4. Freeway lane drops (45),
5. Freeway weave areas (46),
6. Intersection improvements (42,41,39,40,47,48),
7. Interchanges (49),
8. Oversize loads (50),
9. Pedestrians (51),
10. Signing and traffic signals (38,39,48,43,40,52).

The conclusion of all these studies was that traffic conflict frequencies or rates are sensitive to changes in geometry or traffic control measures. Thus, traffic conflicts appear to possess one of the properties necessary for a valid surrogate measure - that they respond to changes in the independent variable being tested. The remaining question is whether the conflict response maps reliably into an accident response, and thus can be used to make an accurate prediction of future accidents.

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CHAPTER 3

METHODOLOGY

As the literature review indicated, many past studies have suggested a statistical relationship between a change in the number of conflicts and accidents. In addition, research (59) (22) has identified the existence of an overrepresentation of certain characteristics among drivers involved in accidents. Therefore, it is a reasonable hypothesis that there also exists a relationship between conflict involvement and driver characteristics. This hypothesis was tested by studying the characteristics of conflict involved drivers and comparing these with the general driving public to see if they are significantly different.

3.1 Location

The experiment was conducted in the Eastern province of Saudi Arabia in the city of Dammam. Dammam is about 18 kilometers from Dhahran, the home of the University of Petroleum and Minerals.

This location was chosen based on the following considerations:

1. The University's interest in this type of research and their willingness to fund the data collection phase.
2. The cooperative attitude of the Dammam police agency.
3. The availability of facilities and students to assist in the data collection activities.

3.2 Choice of Intersections

Due to the extensive construction and development program in Saudi Arabia, many of Dammam's streets were under construction. The task of

locating suitable sites to undertake the experiment was a difficult one. One day was spent touring the city, and nineteen intersections suitable for the experiment were identified. Five of those were signalized and fourteen were controlled by stop signs.

The city was then divided into three radial sections extending from the central business district. Two intersections were chosen randomly from each of the three sections, to serve as data collection sites. One of those was disqualified after the second visit and a similar intersection in the same sector was substituted for that intersections.

The intersections chosen had no obstructions to the traffic stream for at least 300 feet from the center. They all were properly signed, paved, and painted. The signalized intersections were lighted at night, and there were no observed driver distractions.

The Average Daily Traffic (ADT) at these intersections ranged from 2000 to 26000. The two signalized intersections had ADT's of 21000 and 26000, with the unsignalized intersections carrying lower volumes.

3.3 Observer Training

Special attention was given to the training of conflict observers for the data collection phase. Fifteen candidates were selected as possible conflict observers, and all were required to attend four training sessions designed to provide them with an overall understanding of traffic law, traffic safety, and traffic conflict techniques. The sessions consisted of movies, slides, video tapes and lectures. At the end of the last session, the candidates were taken to different intersections and each was asked to conduct volume counting, interviewing, and conflict observations.

Three of the fifteen participants were chosen as conflict observers,

with the others assigned to volume counts or interviews.

The choice of conflict observers was based on:

1. Their background in traffic engineering. (Two were seniors, one a graduate student, all majoring in Transportation.)
2. Their attendance and participation in all of the training sessions.
3. Their understanding of the definition of traffic conflicts, and their ability to distinguish conflicts in the field.

3.4 Experimental Design

Each intersection was observed for three consecutive working days during which two different samples were collected.

1. Intersection population sample (subsequently referred to as sample 1).

   The first day of observation at each intersection was used to collect data to identify the characteristics of the general driver population using the intersection. Three interviewers were stationed about 200 feet upstream from intersections on each approach, and for a period of twenty minutes, every tenth vehicle was stopped and the driver interviewed. The interviewers then relocated on a second approach, and the process was repeated until samples from all intersection approaches were collected.

2. Conflict involved drivers sample (subsequently referred to as sample 2).

   The second and third days were used to collect data on conflict involved drivers. Conflict observers identified those vehicles that caused a particular conflict, and then signalled conflict type and make and color of that vehicle to interviewers who

stopped and interviewed the driver. Table 8 gives the number of samples collected at each intersection.

3.5 Schedule of Activities

The data collection phase of this project took three weeks. The first week was devoted to training participants and selecting adequate sites, and the following two weeks were devoted to data collection.

A total of six hours of three consecutive working days were required to collect both the data for sample 1 and sample 2 at each intersection. The first two hours of the first day were used to collect the general driving population sample of each intersection with a twenty minute period designated to collect data for each approach. The same two hour period of the following two days was used to collect data on conflict involved drivers.

A minimum of seven participants for each observation period were needed to collect the required data. The participants included one conflict observer, one volume observer, three interviewers, and the two policemen.

Data collection on conflict involved drivers was designed so that data on each traffic movement is collected one time (for twenty minutes) during the total four-hour period of two consecutive days. This was accomplished by first stationing the conflict observer on the south approach and the interviewer on the north approach. The conflict observer would record all conflicts on the south approach and identify for the interviewer the subset of those drivers traveling north. After twenty minutes, the interviewer was relocated on the west approach, where the subset of conflict involved drivers turning left from the south approach were interviewed. Finally the interviewer was moved to

the east approach to obtain the last data set. In the second hour of observation, the conflict observer relocated to the north approach and the process was repeated. The east and west approach were then used in the data collection phase on the second day of data collection for sample 2.

This accounted for all traffic movements with the use of only two police officers. Simultaneous collection of all movements was not possible because the use of communications devices by individuals other than policemen is banned in Saudi Arabia.

CHAPTER 4

DATA ANALYSIS

4.1 Observer Reliability

Observer reliability is essential to this experiment, since the samples are relatively small, and some analyses required the aggregation of data from different observers. To determine whether data from the various observers could be combined, a test was designed to determine if observations made by different observers were significantly different.

Two observers simultaneously recorded conflicts on eleven different occasions. In seven cases observers one and two recorded simultaneous data, and in four cases the observers were numbers one and three (see Table 4).

The Pearson's x^2 test for goodness of fit was used to determine whether the resulting conflict counts were observer dependent. This test is used to study data which can be grouped into multiple categories across at least two dimensions. The categorization can be either scaler or vector level (contingency tables or cross tabulations), and is used to determine whether the categories are independent or whether certain levels of categories tend to be associated.

An r x c contingency table with columns $\sum_{1}^{r} A$, rows $\sum_{1}^{c} B$, and cell frequency n is used to test the independance of A and B by calculating the value of x^2 (60, 61):

$$x^2 = \sum_{\substack{\text{all} \\ \text{rc cells}}} \frac{(n_{ij} - E_{ij})^2}{E_{ij}}$$

where:

n_{ij} = frequency of observations in cell A_iB_j

E_{ij} = expected frequency of A_i B_j = $\frac{n_{io} \times n_{oj}}{N}$ if the characteristics are independent

n_{io} = ith row total, or frequency of A_j

n_{oj} = jth column total, frequency of B_j

$n = \sum n_{io} = \sum n_{oj}$

The null hypothesis of independance is rejected at a specified level of significance (α), if the calculated x_c^2 is greater than the upper tail of a x_T^2 distribution with degrees of freedom = (r-1)(c-1).

The null hypothesis for observer reliability was; H_o: there is no difference in conflict counts by type of conflict between observers. The null hypothesis was accepted at the α = .1 level of significance, and thus data from different observers could be combined for further analysis (Tables 5 and 6).

4.2 Representation of Driver Characteristics

Since data on the characteristics of conflict involved drivers (sample 2) and the data on characteristics of the general driving public (sample 1) were collected on different days, an analysis was conducted to test the assumption that "drivers passing through an intersection at a specific hour during working days possess similar characteristics to drivers passing through that intersection at the same hour of other working days."

Intersection populations were sampled for each signalized intersection on the first and third working day during the specified hours of data collection. The null hypothesis that there is no difference between characteristics of the population during these days was tested.

TABLE 4. Observed conflict counts.

Conflict Type	Approach / Observer No.	Intersection 1 2nd Sample, 3rd Day Time (3-5 PM)						Intersection 1 2nd Sample, 5th Day Time (3-5 PM)								Intersection 2 2nd Sample, 5th Day Time (5-7 PM)							
		West		East		South		South		East		North		West		East		North		West		South	
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	1	3	1	3	1	3	1
Left turn, same direction		0	0	1	2	1	2	2	2	0	0	3	1	0	1	5	5	2	3	6	3	1	1
Right turn, same direction		0	0	0	0	0	0	2	5	7	6	0	1	5	5	7	7	5	8	0	0	8	8
Slow vehicle		4	3	3	3	4	2	3	3	3	5	1	3	7	8	7	7	8	5	5	6	2	1
Lane change		4	2	9	9	4	3	6	4	8	8	7	5	8	7	7	7	8	8	5	7	8	8
Opposing left turn		0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Right turn from right		0	0	0	1	1	1	3	3	1	1	3	3	0	4	0	0	0	0	2	2	0	0
Left turn from left		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Cross traffic from left		1	1	0	0	0	0	0	0	1	1	0	0	3	0	2	2	7	0	1	2	2	3
Cross traffic from right		0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	2	0
U-Turn		0	0	0	0	0	0	2	2	4	3	1	1	8	6	5	5	3	4	5	4	5	4
Disobeying signal or sign		1	1	1	1	1	1	3	2	2	3	4	3	3	4	4	4	1	2	0	4	5	8
Column Total		10	9	15	16	11	10	23	22	26	28	22	18	36	35	29	29	34	31	28	29	33	34

TABLE 5. Conflict observation, reliability test for observers 1 and 2.

Conflict Type	Total Observer Counts (Seven simultaneous counts) 1	2	Total rows
Right Angle	21 (20.36)	19 (19.64)	40
Rear End	46 (49.87	52 (48.13)	98
Turning	30 (30.02)	29 (28.96)	59
Side Swipe	46 (42.75)	38 (41.25)	84
Total Columns	143	138	281

Hypothesis:

H_o: The frequencies counted by observers 1 and 2 are similar for each type of conflict. x^2_c calculated: $1.16 < x^2_T$ distribution = 7.81 at 3 d.f.: accept H_o.

TABLE 6. Conflict observation, reliability test for observers 1 and 3.

Conflict Type	Total Observer Counts (Four simultaneous counts) 1	3	Total rows
Right Angle	26 (26.20)	26 (25.80)	52
Rear End	54 (55.42)	56 (54.58)	110
Turning	23 (22.17)	21 (21.83)	44
Side Swipe	30 (29.22)	28 (28.78)	58
Total Columns	133	131	264

Hypothesis:

H_o: The frequencies counted by observers 1 and 3 are similar for each type of conflict. x^2_c calculated = .181 < 7.81 at 3 d.f.: accept H_o.

A x^2-test was run to test for differences between population characteristics on the first day, and population characteristics on the third day of data collected for the same intersection. The sample sizes were ($n_1 = 99$, $n_2 = 27$) for population samples on the first and third day respectively. Results of this test are summarized in Table 8, which indicates that there is no significant difference between drivers of the first and third day when age, nationality, trip purpose, occupation, and income are tested. The null hypothesis for these characteristics is not rejected at $\alpha = .1$.

When the driver characteristics "miles driven per year" and "number of accidents in the last two years" were tested, they were found to be significantly different at the $\alpha = .1$ level. About 58% of the drivers on the first day drove < 13000 miles per year compared to 30% of the drivers on the third day, and three times as many drivers have had two or more accidents in the past two years on the third day than on the first. This implies that there is more variance in these characteristics than in the others tested, or that a different group of drivers use the road on different days.

4.3 Characteristics of Hazardous Drivers

Nineteen characteristics of both conflict involved drivers, and the general driving public were collected in the field (see Appendix A). The average driver is 29 years old, with an income of about $1100 U.S. a month. Almost sixteen percent of the drivers did not possess a valid driver's license. One of every three drivers had been involved in at least one accident in the last two years, and one of every two drivers had been involved in at least one accident since he started driving. Sixty percent of the drivers had completed a driving training course.

TABLE 7. Chi-square test of population assumption.

Characteristics of drivers	x_T $\alpha = .1$	x_c
Age	2.706	.122
Nationality	2.706	2.015
Trip purpose	4.605	4.278
Occupation	4.605	1.717
Miles driven/year	2.706	5.562*
Number of accidents in past 2 years	2.605	9.349
Income	4.605	2.271

* H_0 is rejected for underlined characteristic.

H_0: There is no difference between characteristics of drivers on different days of observation.

TABLE 8. Sample sizes for studied intersection, number of drivers interviewed in each sample for each intersection.

Intersection	Sample 1 (Intersection population sample)	Sample 2 (Conflict involved driver sample)	Double conflict involved drivers
1 Signalized	56	66	--
2 Signalized	70	64	--
3 Unsignalized	19	41	34
4 Unsignalized	20	23	8
5 Unsignalized	24	51	28
6 Unsignalized	23	51	10
Total			
All intersections	212	296	--
Signalized	126	130	--
Unsignalized	86	166	80

About 40% of all drivers were professionals, followed by students (36%) and all other occupations (24%). Two of every three drivers were Saudi Arabian nationals.

Determination of characteristics of conflict involved drivers

In order to identify the characteristics of conflict involved drivers, it was hypothesized that conflict involved drivers possess different characteristics from that of the general driving public. The testing of this hypothesis was done in two steps:

1. By comparing the intersection population sample to that of conflict involved drivers.
2. Statistically testing the significance of the characteristics that appeared to be different from step 1.

The following paragraphs will discuss the findings of step 1, while section 4.4 will discuss the findings of step 2.

The characteristics of conflict involved drivers (sample 2) were compared to those of the general driving public (sample 1) at both signalized and non-signalized intersections (Table 14), to determine whether hazardous drivers can be identified by these characteristics.

Driver characteristics overrepresented in the conflict sample at both signalized and non-signalized intersections include the age groups < 25, the age group > 46, Middle Eastern (but non-Saudi) nationality, occupation listed as a salesman, craftsman, student, or professional driver, has completed 9 years of schooling, drives an average of 11,000 miles per year, has had two or more accidents in the past two years, and has attended a local driver training school.

On the other hand, safe drivers (those underrepresented in the conflict samples) are of the age group (26-45), of Saudi or Western

nationality, have a professional occupation, college education, have had no accidents in the past two years, an income of $1800 U.S. a month, and had driving training outside the Kingdom.

Several plots (1-5) were used to show the representations of different age groups in conflict involvement, in order to determine whether a certain age group contributes more to conflicts than other age groups. The graphs show that drivers of age group ($\leq$ 25 years of age) are overrepresented in conflict involvement, and that drivers of age group (> 45 years of age) were slightly overrepresented in conflict involvement.

These observations support the hypothesis that there is a positive relationship between conflicts and accidents, as young drivers and drivers with an accident history were significantly more likely to be represented in the conflict sample than in the sample of the general public (see Fig. 6).

4.4 Test for Driver Characteristics that Explain Conflict Involvement

Since most characteristics of the general driving public are not significantly different across test sites and samples, these data were pooled, and x^2 tests conducted to determine whether the differences in characteristics identified in the previous section are statistically significant.

The frequency with which characteristics occur in the general population were compared to the frequency with which these same characteristics occur in drivers involved in conflicts. This comparison was conducted for data from all intersections, data from signalized intersections only, and data from unsignalized intersections only.

The sample size for each intersection is given in Table 9, and the

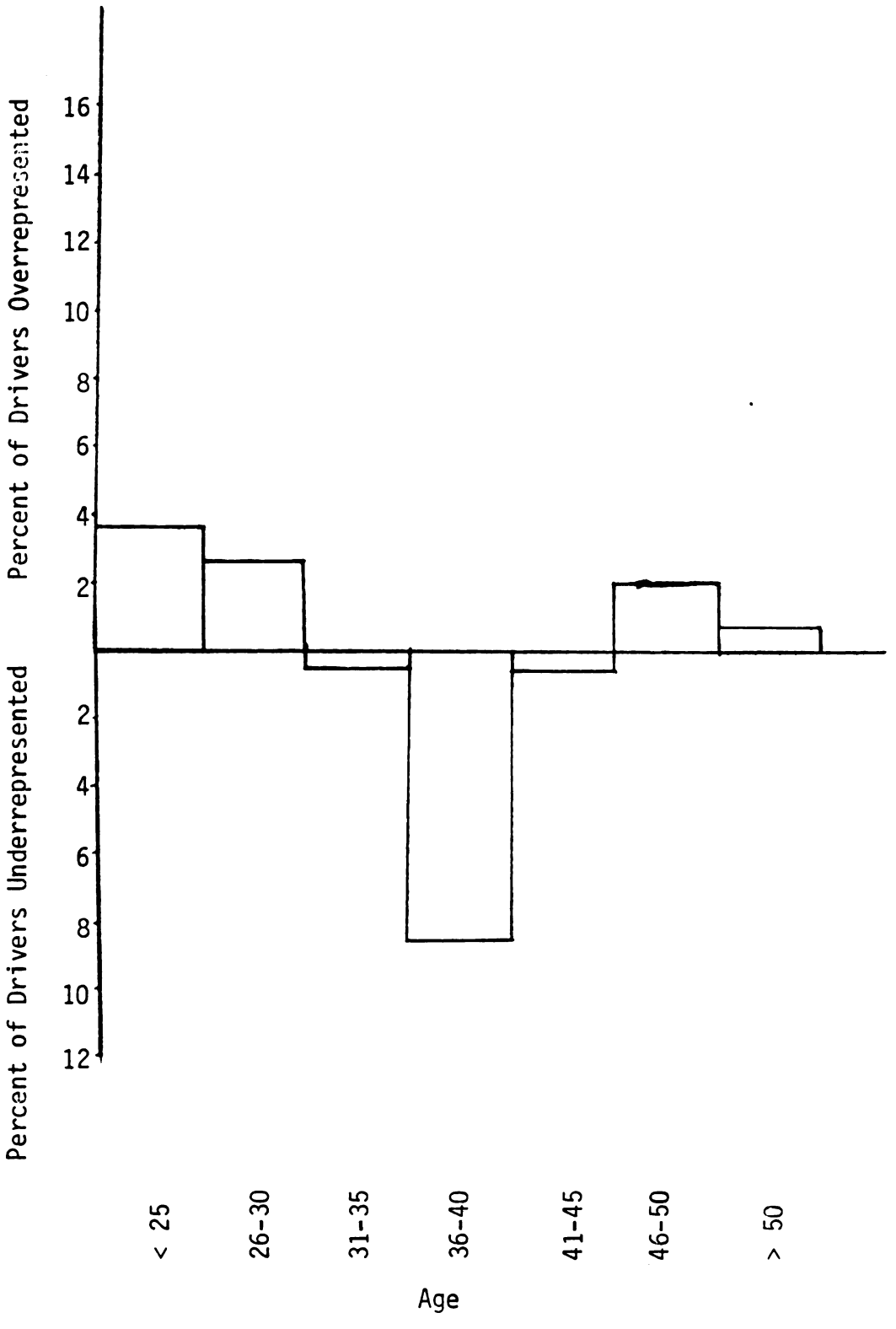

Fig. 1. Representation of driver age in conflict involvement.

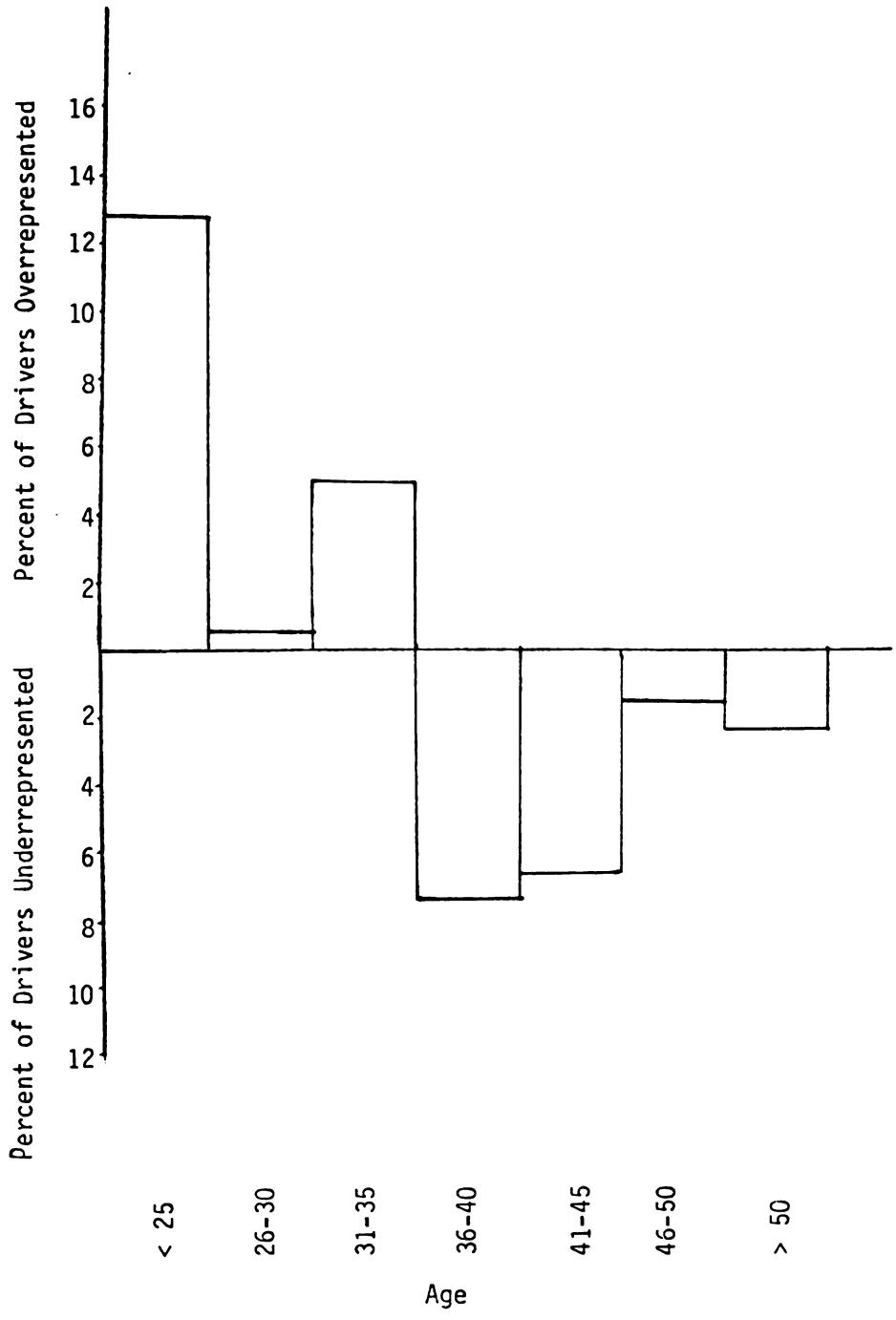

Fig. 2. Representation of driver age in turning conflict sample.

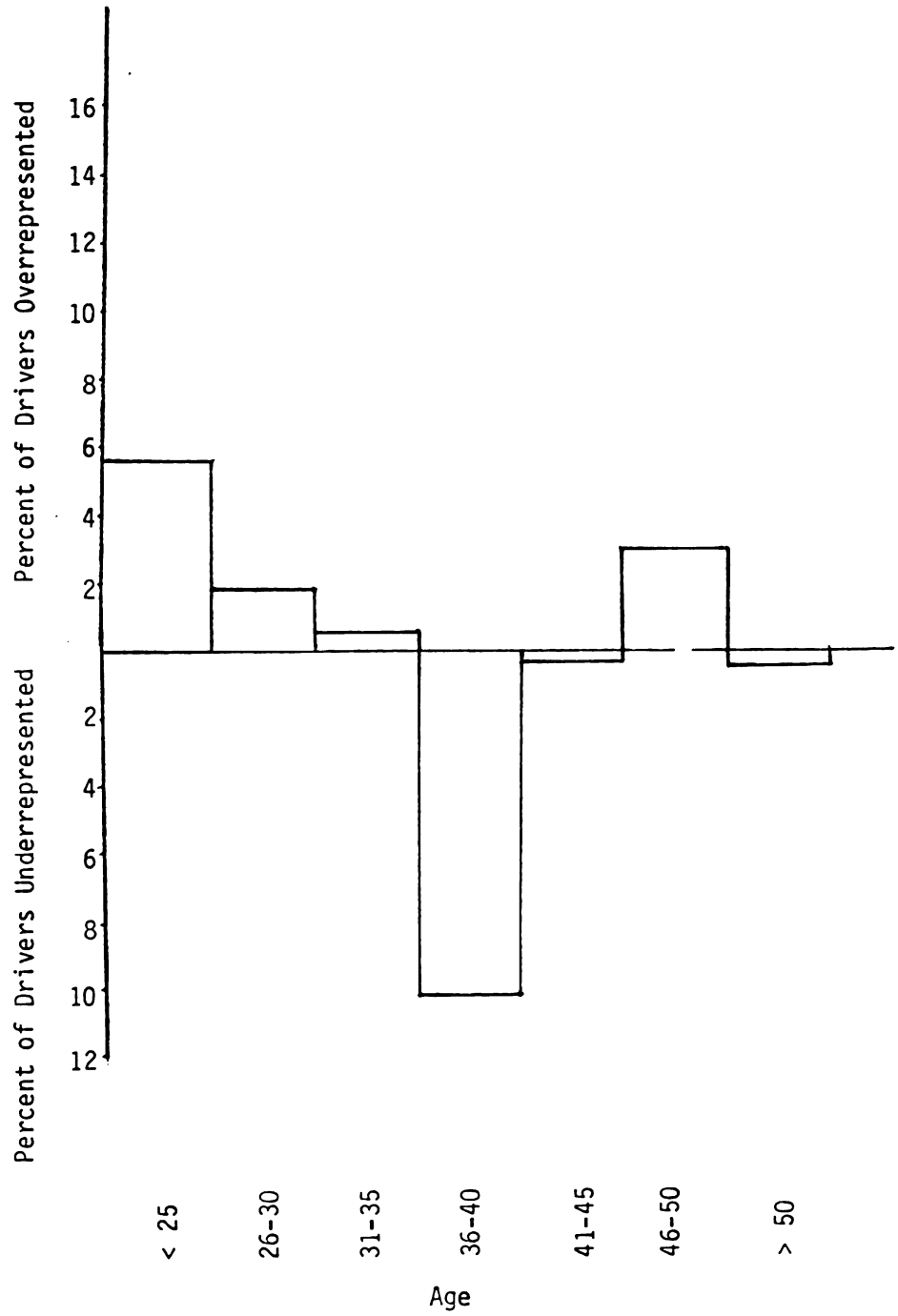

Fig. 3. Representation of driver age in right angle conflict sample.

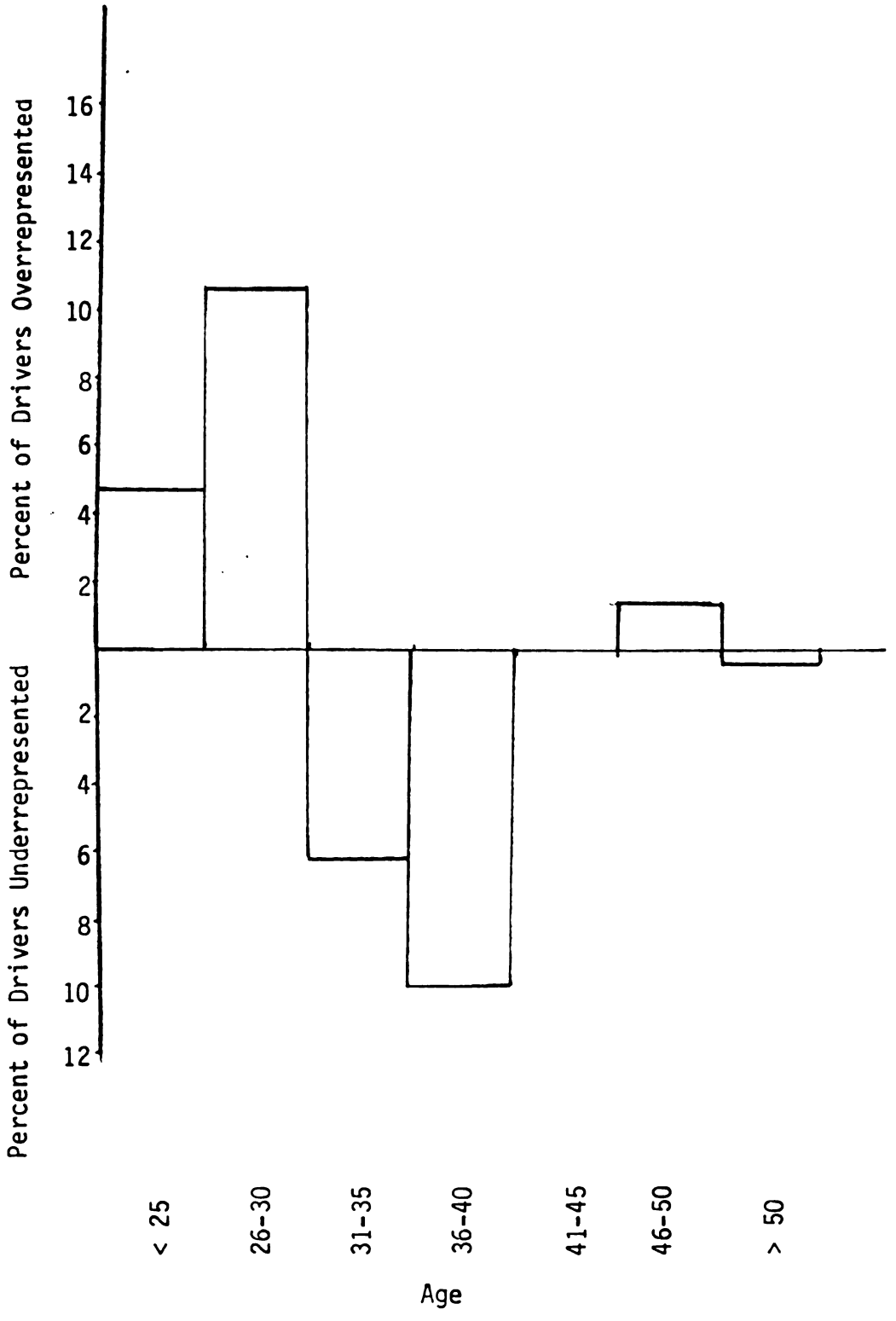

Fig. 4. Representation of driver age in side swipe conflict sample.

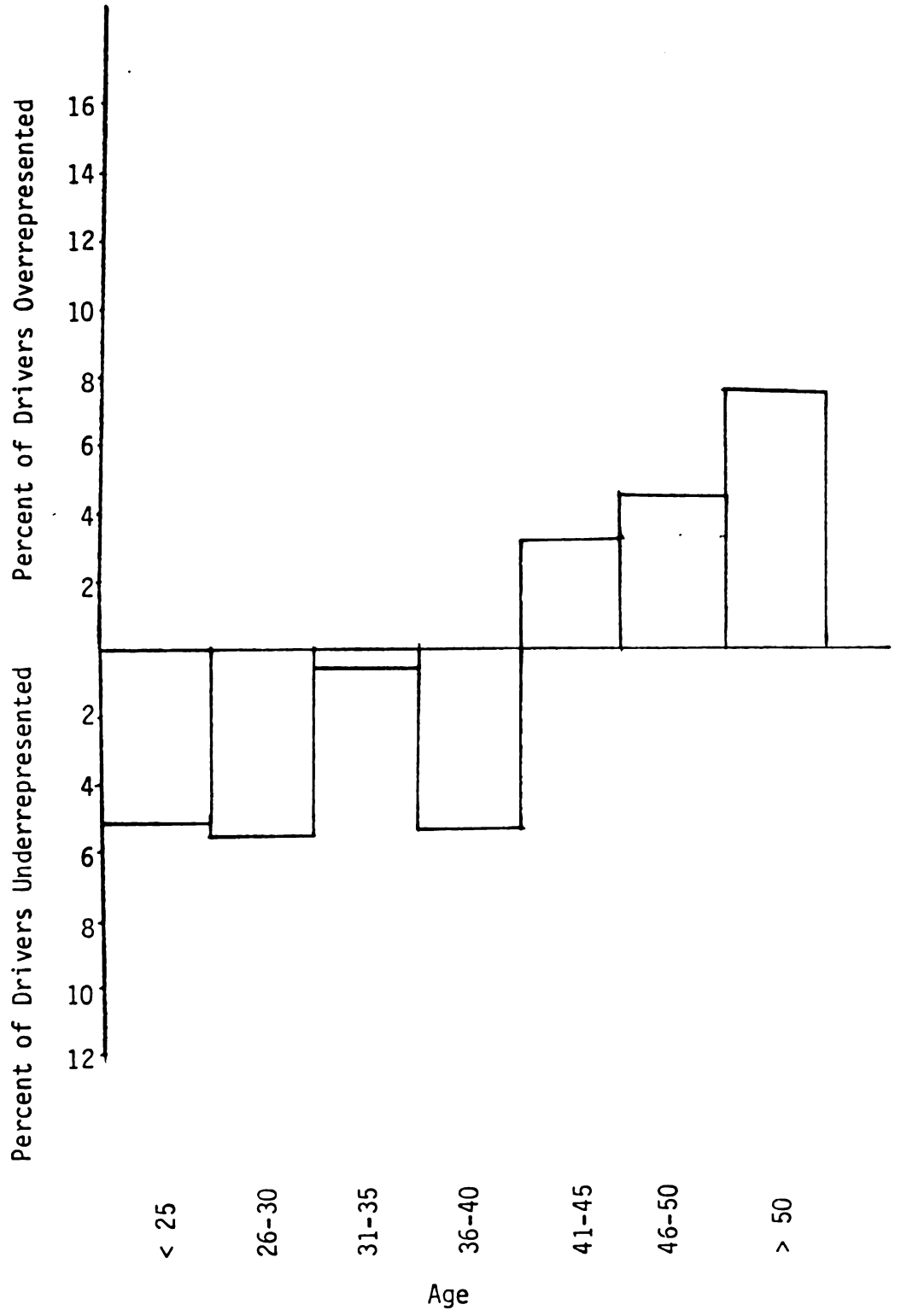

Fig. 5. Representation of driver age in rear end conflict sample.

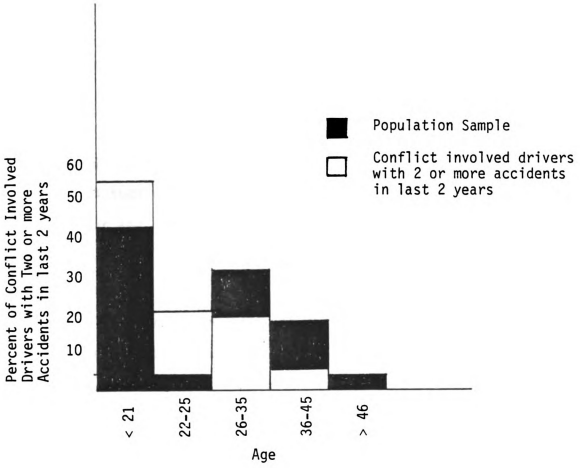

Fig. 6. Age of conflict involved drivers with 2 or more accidents.

test results are shown in Tables 9, 10 and 11.

These results indicate that there are significant differences in the characteristics of conflict involved drivers and the general driving public.

When all intersection data was combined, the null hypothesis of no difference was rejected (at $\alpha = .1$) for only nationality and driving schools (Table 9). When using only signalized intersection data, the null hypothesis was rejected (at $\alpha = .1$) for age, nationality, occupation, driving schools, miles driven per year and income (Table 10). These results suggest that there are differences between the general driving public and conflict involved drivers at signalized intersections. Some of these characteristics may be useful in predicting accidents at signalized intersections.

When using only unsignalized intersection data, the null hypothesis of no difference was rejected (at $\alpha = .1$) only for driving schools (Table 11).

The fact that the null hypothesis is not rejected for nearly all tested characteristics at unsignalized intersection is due (in part) to the fact that nearly all drivers are conflict involved drivers. This is true because a violation of a traffic control device is considered a conflict, and nearly all drivers failed to observe the stop signs at these intersections. (An average of 80% of all conflicts observed at unsignalized intersections were right angle conflicts, which include control device violations.)

In an effort to more clearly identify conflict involvement at unsignalized intersections, the test was repeated with Sample 2 including only those drivers involved in at least two conflicts. Using these data, the null hypothesis was rejected (at $\alpha = .1$) for age, occupation,

educational level, and number of accidents in the past two years (Table 12).

These results indicate that including violations as a conflict simply tends to mask real differences between hazardous drivers and the general driving public. At signalized intersections, like unsignalized intersections, those drivers involved in conflicts have significantly different characteristics than the general driving public.

The age of drivers was found to be significantly different at $\alpha = .1$, at both types of intersections. Thus, age appears to be the variable with the greatest explanatory power among the nineteen characteristics tested.

This result is consistent with findings by Lynn (23) in which he concluded that age is the variable which best explains differences in accident involvement, and McGuire (59) who reported that age had the highest simple R value (.38) among all characteristics correlated with accident involvement.

Drivers of age groups (< 18, 19-25, and > 46) were overrepresented in conflict involvement at both intersection types. The highest increase in representation found was for age group < 18 among all age groups. The age group (26-45) was underrepresented in conflict involvement at both types of intersections. Drivers with a middle eastern nationality (but non-Saudi), those with two or more accidents in the past two years, students with 9 years of education or less, and drivers with an occupation as salesman, craftsman, or professional driver were also overrepresented at both intersection types.

On the other hand, drivers with a professional occupation, those from a high income group, and drivers with no previous accident history were underrepresented at both intersection types.

TABLE 9. Chi-square test for driver characteristics in Sample 1 vs. Sample 2 using all intersections.

Characteristics of Drivers	X^2_T at $\alpha = .1$	X^2_C
Age	6.251	4.605
Nationality	7.779	12.013
Occupation	10.645	8.200
Educational level	7.779	6.076
Driving schools	4.605	11.938
Miles driven/year	4.605	1.993
Number of accidents in past 2 years	6.251	1.112
Income	4.605	3.217
Drivers license availability	4.605	.649

H_o: There is no difference between characteristics of population drivers and conflict involved drivers at all intersections combined.

TABLE 10. Chi-square test for driver characteristics in Sample 1 vs. Sample 2 (signalized intersections only).

Characteristics of Drivers	X^2_T at $\alpha = .1$	X^2_C
Age	6.251	7.802
Nationality	6.251	12.463
Occupation	9.236	18.109
Educational level	7.779	3.490
Driving schools	4.605	6.174
Miles driven/year	4.605	5.568
Number of accidents in past 2 years	4.605	.523
Income	4.605	5.450
Drivers license availability	2.706	2.203

H_o: There is no difference between characteristics of intersection population drivers and conflict involved drivers at signalized intersections.

TABLE 11. Chi-square test for driver characteristics in Sample 1 vs. Sample 2 (unsignalized intersections only).

Characteristics of Drivers	X^2_T at $\alpha = .1$	X^2_C
Age	6.251	.750
Nationality	6.251	.384
Educational level	7.779	1.405
Driving schools	4.605	12.636
Miles driven/year	4.605	1.590
Number of accidents in past 2 years	4.605	1.619
Income	4.605	1.997

H_o: There is no difference between characteristics of intersection population drivers and conflict involved drivers at unsignalized intersections.

TABLE 12. Chi-square test for driver characteristics in Sample 1 vs. Sample 2 (unsignalized intersections, drivers with two conflicts only).

Characteristics of Drivers	X^2_T at $\alpha = .1$	X^2_C
Age	4.605	6.212
Nationality	4.605	1.562
Occupation	6.251	6.088
Educational level	6.251	18.359
Miles driven/year	4.605	.264
Number of accidents in past 2 years	4.605	12.530
Income	4.605	2.207

H_o: There is no difference between characteristics of intersection population drivers and drivers involved in two conflicts at unsignalized intersections.

TABLE 13. Percentage increase or decrease in representations of conflict involved drivers over intersection population sample.

Characteristic	percent over or under in representation	
	Signalized Intersection	Unsignalized (drivers with 2 conflicts only)
Age:		
< 18	+ 23%	+ 95%
19-25	+ 28%	+ 1%
26-45	- 26%	- 21%
> 46	+150%	N.T.*
Nationality:		
Saudi	+ 1%	- 6%
Middle Eastern	+ 70%	+ 39%
Far Eastern	+ 38%	- 18%
Others	- 73%	N.T.
Occupation:		
Salesman	+ 53%	+ 43%
Teacher	- 17%	+ 43%
Professional	- 49%	0
Craftsman	+ 40%	+ 46%
Student	+ 94%	+ 50%
Professional Driver	+ 82%	N.T.
Educational level:		
None	+ 18%	- 47%
Preparatory	+ 17%	- 47%
Intermediate	+ 23%	+ 28%
High School	- 9%	+ 74%
College	- 34%	- 61%
Driving Schools:		
No	- 5%	
Dallah	+ 34%	N.T.
Others	- 51%	
Miles Driven/Year:		
< 9000 miles	- 33%	+ 2%
9000-13000 miles	+ 55%	+ 12%
> 13,000 miles	+ 6%	- 7%
Number of Accidents Past 2 Years:		
None	- 3%	- 23%
One	+ 4%	- 7%
Two or more	+ 31%	+150%
Monthly Income ($):		
< 900	+ 45%	- 20%
900-1800	- 10%	+ 26%
> 1800	- 29%	- 13%

* N.T. Not tested because of low frequencies of occurrences.

4.5 Evidence of Patterns Among Conflict Involved Drivers

Data from conflict involved drivers were separated by intersection for each of the signalized intersections, and the distribution of these characteristics were compared with the characteristics found when data from all unsignalized intersections for drivers with two conflicts were combined.

Pearson's goodness of fit test was used to test the null hypothesis of no difference among conflict involved driver's characteristics. The results are given in Table 14 and 15, which indicate that conflict involved drivers possess similar characteristics at all intersections.

It may be concluded that a 'pattern' does exist among conflict involved drivers, and that this pattern may be useful in predicting future involvement in conflicts, and ultimately in accidents.

It is suspected that the reason certain characteristics (occupation, educational level, and income) were accepted in the first test (Table 14) and rejected in the second (Table 15) was due to the large number of young conflict involved drivers (high school students) without driver's license traveling through some of the 'back streets' away from police detection.

4.6 Conflicts by Type

The literature (32,34,35) contains several articles that suggest a better correlation exists between accidents and specific types of conflicts than between accidents and total conflicts. Thus, an analysis was performed to determine whether specific conflict types are prevalent among conflict involved drivers. The null hypothesis of no difference between characteristics of drivers involved in a specific conflict type and the general driver population was tested. The result

TABLE 14. Chi-square test for conflict involved drivers (Intersection 1 vs. Intersection 2 signalized).

Characteristic	X_T^2 $\alpha = .1$	X_C^2
Age	4.605	2.453
Nationality	4.605	5.161
Occupation	7.779	4.959
Educational level	7.779	.766
Driving schools	4.605	2.039
Miles driven/year	4.605	1.810
Number of accidents in last 2 years	4.605	4.107
Income	4.605	3.286
Driver's license availability	2.706	1.431

H_o: There is no difference between conflict involved driver characteristics.

TABLE 15. Chi-square test for conflict involved drivers (Intersection 1 vs. Intersection 2 vs. all unsignalized intersections with drivers of 2 conflicts).

Characteristics	X_T^2 $\alpha = .1$	X_C^2
Age	7.779	4.586
Nationality	7.779	7.192
Occupation	13.362	24.656
Educational level	13.362	23.807
Driving schools	7.779	2.381
Miles driven/year	7.779	7.733
Number of accidents in past 2 years	7.779	13.290
Income	7.779	5.710
Driver's license availability	4.605	32.599

H_o: There is no difference between conflicted involved driver characteristics.

of this analysis is provided in Table 18.

Since no single characteristic is significantly overrepresented in drivers involved in all types of conflicts, predicting type of conflict using driver characteristics did not appear feasible. In contrast to the literature, total conflicts were more highly related to characteristics than were conflict types.

One possible explanation for these results would be that the variance between days or locations in the dependent variable (conflict type) was large, and thus combining these data masked any true relationship. To determine whether this is true, a series of chi-square tests were conducted to see if the variance by day or location was significant. The specific tests conducted were:

1. H_0: conflict type frequencies are similar at each unsignalized intersection.
2. H_0: conflict type frequencies are similar for each day of conflict observation at unsignalized intersections.
3. H_0: conflict type frequencies are similar at each signalized intersection.
4. H_0: conflict type frequencies are similar for each day of conflict observation at signalized intersections.

In tests 1 and 2 frequencies of conflict type were found to be similar on all days at all unsignalized intersections. Thus prediction of conflict type at these intersections cannot be improved by analyzing each data set separately. In tests 3 and 4 frequencies of conflict types at signalized intersections were found to differ significantly with the observation period and the intersection, indicating that separating the data may be helpful in determining the relationship between driver characteristics and conflict types.

TABLE 16. Frequencies of conflicts by type for unsignalized intersections (drivers involved in two conflicts only).

Conflict Type	Frequency	Percent of Total
Right angle	48	60
Turning	11	13.7
Rear End	9	11.2
Side Swipe	12	15.0
	80	100

TABLE 17. Frequencies of conflicts by type for signalized intersections

Conflict Type	Frequency	Percent of Total
Right angle	14	11.2
Turning	23	18.4
Rear End	40	32.0
Side Swipe	48	38.4
	125	100

TABLE 18. Characteristics of conflict involved drivers that explain types of conflict.

Conflict Type	Characteristics Found Significant at $\alpha = .1$		
	Signalized	Unsignalized	All Intersections
Right angle	Nationality	Income	Nationality, number of accidents last 2 years
Turning	Age	None	None
Rear end	Occupation, educational level	None	Educational level
Side Swipe	Occupation, miles	None	Number of accidents last 2 years, miles driven per eyar

A test to determine whether subsets of driver characteristics are related to the distribution of conflict involvement by type for each of the signalized intersections was conducted. Each characteristic that explained conflict involvement (as shown in Table 10) was tested using a multiplier to maintain the proportionality of the test.

$$n_{oj} = \frac{n}{n_j}$$

n = total conflict frequency observed

n_j = total column frequency of characteristic subset

n_{oj} = new cell frequency of that subset

Several subsets of characteristics were found to have a significant relationship to type of conflict. The significant variables are drivers of age group < 20, and with a Saudi nationality. As in previous tests, age and nationality proved to be important variables in explaining the variation in conflicts.

4.7 The Model

One of the principal objectives of this study was to determine whether models could be developed to predict the conflict rate at intersections, based on driver characteristics. The fact that a 'pattern' of conflict involved driver characteristics, defined in (4.5), exists indicates that some characteristics of conflict involved drivers are consistently related to the conflict rate. It is, therefore, hypothesized that the overrepresentation of these characteristics can be used in the model to predict conflicts.

Multiple linear regression was used in this study to relate

dependent variables to one or more independent variables by means of a linear relationship. One of the methods used in multiple regression is step wise regression where an independent variable is added or removed from the equation to achieve the highest coefficient of determination with the fewest number of independent variables. The model tested was of the form:

$$Y_k = a_{000} + a_{11k} X_{11k} + \cdots + a_{14k} X_{14k}$$

where:

$$X_{ijk} = \frac{\text{\% of conflict involvement (pattern) for characteristic i subset j intersection k}}{\text{\% of general driving public for characteristic i subset j intersection k}}$$

$$Y_k = \text{conflict rate/ 1000 vehicles} = \left(\frac{\text{Total conflict count for each approach}}{\frac{\text{Corresponding Volume (20 min.)}}{n}}\right)(1000)$$

n = number of observations

corresponding volume = 20 minute volume for that approach

The driver characteristic most clearly related to conflicts, age, was used as the first independent variable in the model tested.

The multiple linear regression models developed as a result are

$$Y_k = 508.9 - 242.9\ X_{12k} \qquad (1)$$

X_{13} corresponds to age group (19-25)

$$Y_k = 925.2 - 95.8\ X_{11} - 149.3\ X_{12} - 349.5\ X_{13} \qquad (2)$$

X_{11} corresponds to age group $\leq$ 18 and > 46 years of age

X_{13} corresponds to age group 26-45

In all cases, the 't' test indicated that the coefficients were not significantly different from zero.

The coefficient of determination R^2 was .32 (32% of variations explained by regression) with an F significance of .244 for the first model, and R^2 = .58 for an F significance of .558 for the second model.

All coefficients of the independent variables were negative with the lowest coefficient (95.8) corresponding to age group (< 18 and > 46) and the highest coefficient corresponds to age group (26-45). Because the sum of the percentages of all age groups amounts to 100%, the lowest negative coefficient represent that subset of the age that makes the greatest contribution to the conflict rate.

Thus, a well defined and statistically reliable linear relationship between conflict rates and age does not exist in this data even though the x^2 test indicated that there was a relationship between these variables. The number of data points was too small to test non-linear regression analysis, or to stratify the data into multiple regions for separate linear analysis.

To illustrate the empirical relationship between these variables, a plot of the conflict index, which is defined as the ratio of the percentage of conflict involved drivers of a certain characteristic to the percentage of the same characteristic of the general public, and driver's age is shown in Fig. 7. The graph suggests two linear relationships, with the conflict index decreasing with age for ages 16-40 and then increasing with age after age 40. More data would be required to test the statistical reliability of each of these relationships, but this explains why the x^2 test was significant and the linear regression not

strong.

The conflict index plotted against age for both drivers who had been involved in at least one accident in the past two years, and drivers with no accident in this time period is shown in Fig. 8. Drivers with no accident history exhibited the same general pattern as all drivers. However, drivers with one or more accidents in the past two years exhibited a similar relationship for the under 40 age group, but the conflict index did not increase with age beyond this point.

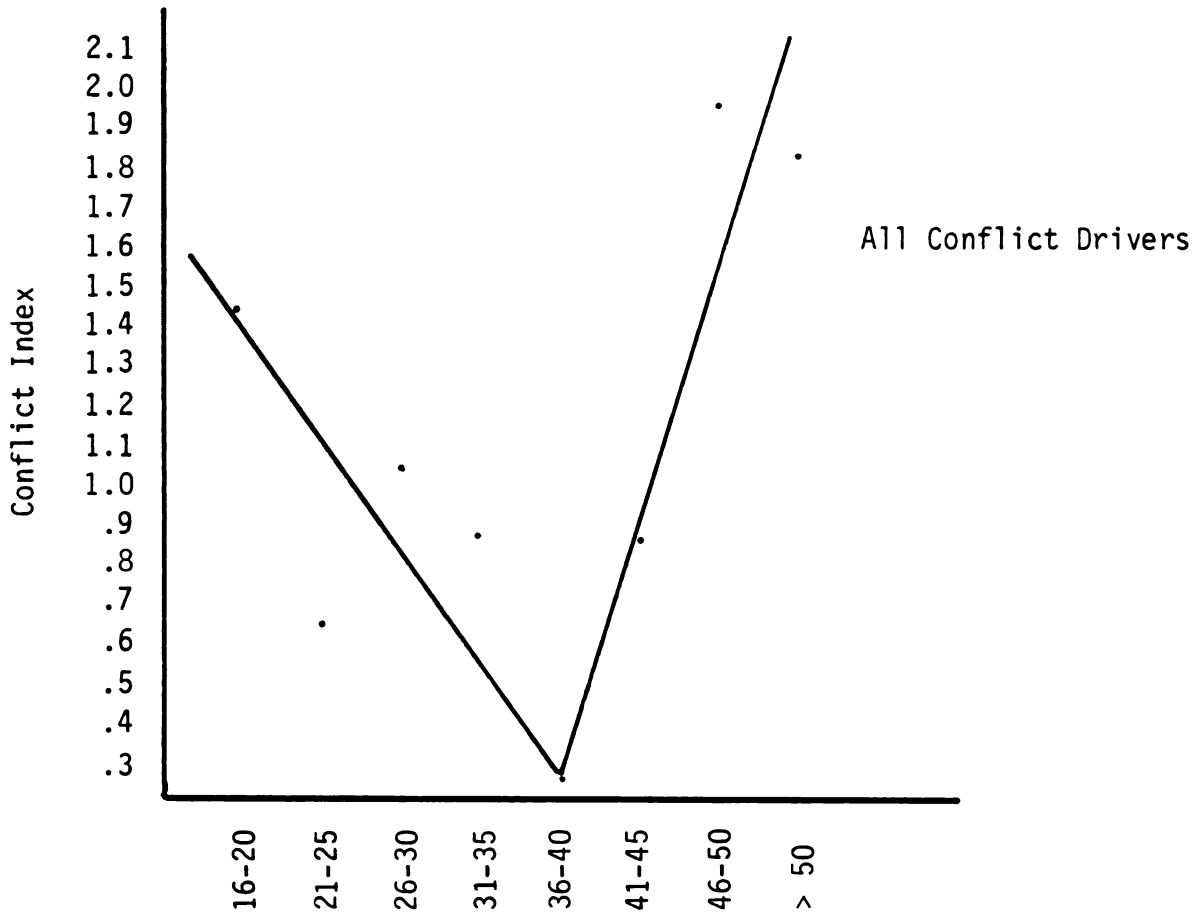

Fig. 7. Conflict index by age of all conflict involved drivers.

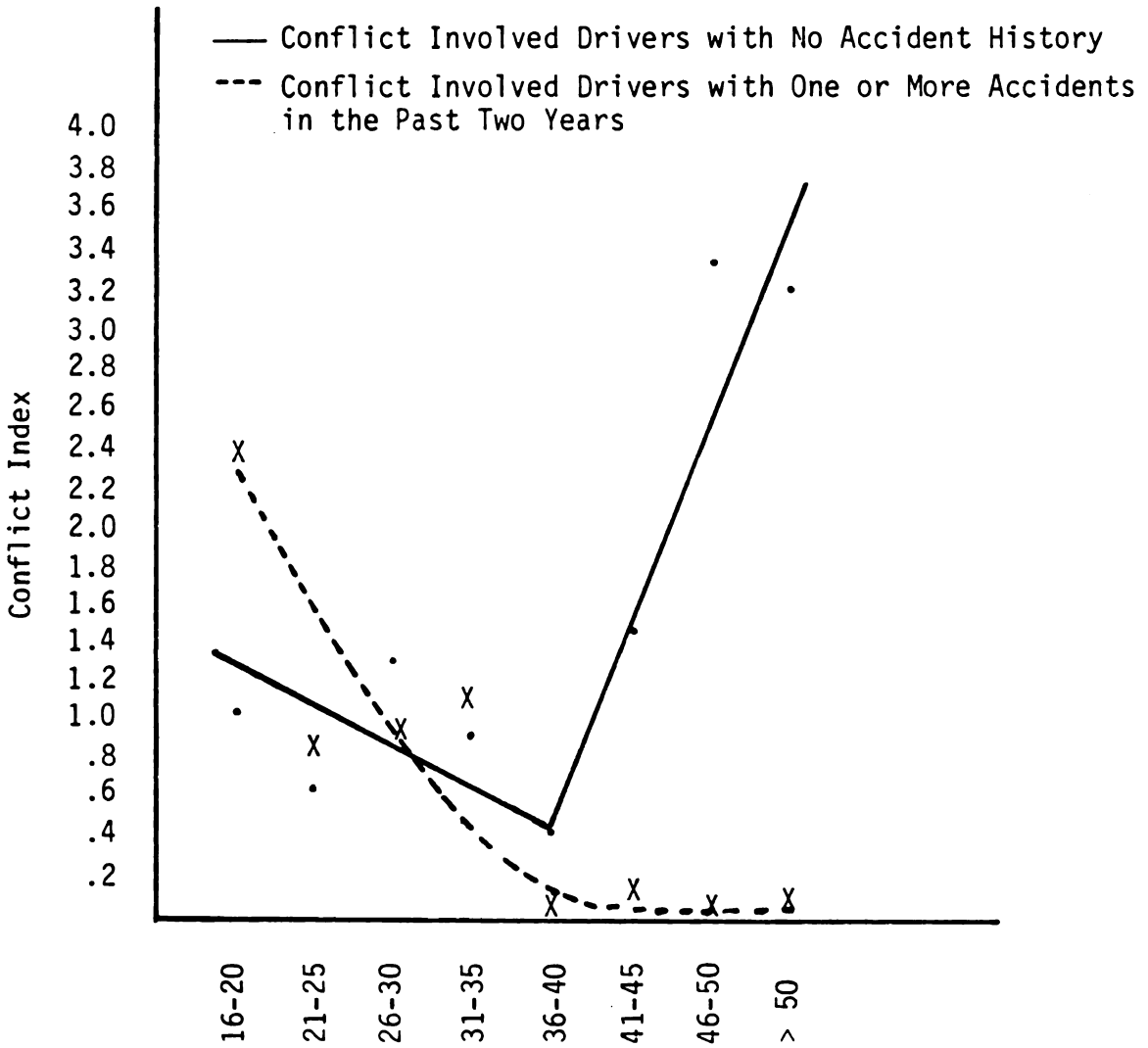

Fig. 8. Conflict index by age of conflict involved drivers with and without an accident history.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the data collected and analyzed in this study, the following conclusions were reached:

1. The most hazardous driver is in the age group 25, has not completed more than 9 years of schooling, has been involved in two or more accidents in the past two years, works as a salesman, craftsman, professional driver, or a student. His income is of a lower income group, and he drives an average of 11,000 miles per year.

2. Drivers with prior involvement in accidents were involved in more conflicts than drivers with no accident history.

3. Age was found to be the single most explanatory variable of conflict involvement. Age and occupation form the best multiple regression model among all tested characteristics.

4. Uniformity of conflict involved driver characteristics was found to improve when intersection type is considered. There was no significant difference between the characteristics of the general driving public and conflict involved driver for combined data from all intersections. However, differences were identified when the data was segregated by type of intersection control.

5. Characteristics of conflict involved drivers were found to be similar at all intersections, and the potential of using this pattern is promising in predicting future conflict occurrence and ultimately future accidents.

6. No single driver characteristic has a distribution matching the distribution of type of conflict occurrence. However, combinations

of individual characteristics (young Saudi drivers) correlates well with the occurrence of conflict types at signalized intersections.

7. Drivers licensed by local driving schools were involved in more conflicts than drivers without driving training or with training from schools outside the Kingdom.

8. The multiple regression model results indicate that a simple linear relationship between conflict rate and driver's age does not exist. However, when the relationship was presented vectorially two different relationships were observed; one for the age group 16-40 and a second one for the age group 40 and over. More data is needed to construct and test these relationships in a model.

5.2 Discussion and Recommendations

The traffic conflict technique was determined to be a promising technique for identifying characteristics of hazardous drivers at urban intersections in Saudi Arabia. The relationship between the characteristics of hazardous drivers and conflicts was found to be analogous to that between driver characteristics and accidents. This strengthens the arguments for using conflicts as a surrogate safety measure whenever accident history is not developed or not available, such as in the case of Saudi Arabia.

The similarities in the observed characteristics of conflict involved drivers at different locations provides the basis for the identification of a driver profile (or pattern) necessary for predicting future conflict rates. Based on the data collected in this study, it appears that the prediction process should be carried out separately for signalized and unsignalized intersections.

Young drivers were found to be overrepresented in conflict

involvement as well as drivers with one or more accidents in the past two years. One of every two drivers interviewed 18 years of age or younger, was involved in one or more accidents in the past two years. This group of drivers is considered a high risk group, and issuance of special driving permits, which is allowed for drivers below 18 years of age (the legal driving age), should be reviewed. These young drivers tended to traverse back streets away from police detection. It is recommended that local police introduce more patrol surveillance to cover remote roads, and better enforcement action be promptly and strictly applied to traffic violators to reduce the risk of accidents.

Local driving schools have not been effective in minimizing the risk of involvement in conflicts. These schools should be evaluated and upgraded to achieve greater effectiveness in driver training.

The establishment of an accident location system should be initiated in Saudi Arabia to provide a data base for research, improvement, and development programs.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Russan, Sabey B., "Accident and Traffic Conflicts at Junctions,: TRRL Report LR 514.

2. Waller, P. F., and G. G. Koch, "Characteristics of North Carolina Drivers," Highway Safety Research Center, Univeristy of North Carolina, Chapel Hill, N.C. (December 1971).

3. Smead, R. J., "The Statistics of Road Accidents," 3rd Int. Symposium on Urban Traffic Safety, October, Budapest, 1972.

4. Jorgenson, N. O., "The Statistical Detection of Accident Black Spots," 11th Int. Study Weak in Traffic Engineering and Safety, Brussels, 1972.

5. Hall, P. A., "The Identification of High Accident Locations," 11th Int. Study Week in Traffic Engineering and Safety, Brussels, 1972.

6. Mattewson, J., and Brenner, R., Indexes of Motor Vehicle Accident Liklihood, Highway Research Board Bulletin 161, 1957.

7. Breunning, S. M., and Bone, A. J., Interchange Accident Exposure, Highway Research Board, Bulletin 240, 44-52, 1959.

8. Thorson, O., "Traffic Accidents and Road Layout," The Technical University of Denmark, Copenhagen, Denmark, 1967.

9. Smith, W. L., Probability Study of Accident Locations in Kansas City, Missouri, Traffic Engineering 40 (7), 42-49, 1970.

10. Gorssman, L., Accident Exposure Index, Highway Research Board Proc. 33, 129, 19, 54.

11. Sutri, V. H., "Accident Exposure for At-Grade Intersections," Traffic Engineering, December 1965.

12. Gwynn, D. W., "Relationship of Accident Rates and Accident Involvements with Hourly Volumes," Traffic Quarterly, July 1967.

13. Feuchtinger (1949) Road Junctions and Trans. Die Bautechnik (Germany).

14. Raff, M. S. (1953) Interstate Highway Accident Study, HRB Bulletin 74, 18-45.

15. McDonald, J. W., Relation Between Number of Accidents and Traffic Volumes at Divided Highway Intersections, HRB Bulletin 74, 7-17, 1953.

16. Surti, V. H., Accident Exposure and Intersection Safety for At-Grade, Unsignalized Intersections, HRB 286, 81-95.

17. Chapman, R. A., Traffic Collision Exposure, New Zealand Roading Symp., 184-198, 1967.

18. Tanner, J. C., 1958, Accidents at Rural Three-Way Junctions, J. of Instn. Highway Engineers, 2(11), 56-67.

19. Colgate, M. and Tanner, J. C. (1967), Accidents at Rural Three-Way Junctions, Road Research Laboratory Report, LR-87, Crowthorne, England.

20. Webb, G. M., 1955, The Relation Between Accidents and Traffic Volumes at Signalized Intersections, Proc. Inst. of Traffic Engr., 149-160.

21. Thrope, J. D., 1964, Calculating Relative Involvement Rates in Accidents Without Determining Exposure ARRB Aust. Road Res. 2(1), 26-36.

22. Seibrecht, E. B., Schumacher, C. F., Lauer, A. R., "Accident Characteristics of Drivers at Various Age Levels," Iowa State College, Traffic Safety, December 1959.

23. Lynn, C. W., "Psychological and Sociodemographic Characteristics of Accident Involved Drivers," Highway Safety, Virginia.

24. Betz, M. H., and Bauman, R. D., "Driver Characteristics at Intersections," HRR, 195.

25. Faulkner, C. R., 1968, "Accident Debris and Reported Accidents at Roundabouts," TRRL Report LR 202, Crowthorne, England.

26. Spicer, B. R., "A Traffic Conflict Study at an Intersection on the Andoversford By-Pass," Transport and Road Research Laboratory, TRRL Report LR 520, 1972.

27. Waller, P. F., Koch, G. G., "Characteristics of North Carolina Drivers," Highway Safety Research Center, University of North Carolina, Chapel Hill, N.C., December 1971.

28. Pelz, D., Schuman, S., "Drinking, Hostility, and Alienation in the Driving of Young Men," A paper delivered to the Third Annual Alcoholism Conference, NIAAA, Washington, June 1973.

29. Baker, W. T., "Evaluating the Traffic Conflict Technique," FHWA.

30. Perkins, S. R., Harris, J. I., "Traffic Conflict Characteristics - Accident Potential at Intersections," GMR, December 1967.

31. Baker, W. T., "Evaluating the Traffic Conflict Technique," FHWA.

32. Paddock, R. D., Spence, D. E., "The Conflict Technique: An Accident Prediction Method," Ohio DOT, August 1973.

33. Glennon, J. C., "Critique of the Traffic Conflicts Technique," TRR #630, 1977.

34. Spicer, B. R., "A Traffic Conflict Study at an Intersection on the Andoversford By-Pass," Transport and Road Research Laboratory, TRRL Report LR 520, 1972.

35. Spicer, B. R., "A Study of Traffic Conflict at the Intersection Transport and Road Research Laboratory," TRRL, Department of the Environment, Crowthorne, Berkshire, 1973.

36. Spicer, B. R., "A Pilot Study of TC at a Dual Carriage-Way Intersection," Road Research Laboratory, TRRL Report LR 410, 1971.

37. Cooper, P. J., "Predicting Intersection Accidents," Ministry of Transport, Canada Road and Motor Vehicle Traffic Safety Branch, September, 1973.

38. Pugh, David, "Relevance of Conflict Studies to Safety Improvements at Intersections," Washington DOT, 1977.

39. Pugh, D. E., Haplin, T. J., "Traffic Conflict in Washington State," Washington State DOT, April 18, 1975.

40. Al-Ashini, Nasa, "Alternative Methods of Examining Correlation of Conflicts with Accidents," Michigan DOT Traffic Engineering, October, 1976.

41. Parker, M. R., Jr., "Right-Turn-on-red," Virginia Highway at Transportation Research Council, September, 1975.

42. Blunden, W. R., Munro, R. D., "Report on the Study of Traffic Conflicts and Accident Exposure," Australian DOT, June 1976.

43. Seymour, W. M., Deen, R. C., Havens, J. H., "Traffic Control for Maintenance of High-Speed Highways," Research Report 380, Kentucky DOT, December 1973.

44. Cima, B. T., "An Evaluation of Freeway Merging Safety as Influenced by Ramp Metering Control," TRR 30, 1977.

45. Pigman, J. G., Agent, K. R., "Raised Pavement Markings as a Traffic Control Measure at Lane Drop," Public Roads, Vol. 39, No. 1, June 1975.

46. Pigman, J. G., Seymour, W. M., Agent, K. R., Cornell, D. L., "An Operational Analysis of the I-69, I-65 and I-71 Route Junction at Louisville," Kentucky DOT, April 1972.

47. Zegeer, C. V., "Effectiveness of Green-Extension of Systems at High Speed Intersections," Kentucky DOT, Divisions of Highways, May 1977.

49. Clyde, M. N., Paper presented at Traffic Conflicts Seminar, March 20-21, 1974, Michigan DOT.

50. Parker, M. R., Jr., "Use of TCT to Assess the Hazards of Transporting Oversize Loads," Virginia Highway and Transportation Research Council, December 1977.

51. Guttinger, V. A., "Conflict Observation Technique of the Work Done and On-Going Research in Holland," Holland 1977.

52. Paddock, R. D., "The Conflict Technique Procedures Manual," Ohio DOT, July 1975.

53. Blanz, W. D., and Migletz, D. J., "Application and Traffic Conflict Analysis at Intersections," Midwest Research Institute, October 1979.

54. Clayton, M. E., Deen, R. C., "Evaluation of Urban Intersections Using TC Measures," Kentuck DOT, August 1971.

55. Hayward, J. C., "New-Miss Determination Throng Use of a Scale of Danger," Pennsylvania Transportation and Traffic Safety Center, HRB Record #384.

56. Lightburn, A., and Howarth, C., A Study of Observer Variability and Reliability in the Detection and Grading of Traffic Conflict, 2nd International Traffic Conflict Workshop.

57. "Motor Vehicle Accidents in Relation to Geometric and Traffic Features of Highway Intersections," Stanford Research Institute.

58. National Safety Council, "Accident Facts," 1970-1979.

59. McGuire, F. L., "The Understanding and Prediction of Accident-Producing Behavior," North Carolina Symposium on Highway Safety, Chapel Hill, N.C., 1969.

60. Nie, Hull, Jenkins, Steinbrenner, and Bent, "Statistical Package for Social Sciences," McGraw-Hill, 1970.

APPENDIX A

Driver Interview Form for Both Sample 1 and 2

بسم الله الرحمن الرحيم
جامعة البترول والمعادن

معلومات خاصة تستخدم لغرض البحث العلمي فقط.

Confidential information used only for Scientific research

كم عمرك من العمر
How old are you?

ما هي جنسيتك ( ) سعودي ( ) غير سعودي ( ) أحدد ( )
What is your Nationality? Saudi Non-Saudi (Specify)

الى أين انت ذاهب ( ) التسوق ( ) البيت ( ) العمل ( ) ذاهب لذلك ( )
أحدد ( )
Where are you going? Work Home Shopping Others Specify

ما هي المهنة التي تزاولها ؟
What is your occupation

( ) بائع / مشتري ( ) Salesman/Buyer
( ) مدرس / أستاذ ( ) Teacher/Professor
( ) مهني / فني / اداري ( ) Professional/Technical/Managerial
( ) حرفي / ميكانيكي / عامل مصنع ( ) Craftsman/Mechanic/Factory Worker
( ) كاتب / سكرتير / عامل مكتب ( ) Clerical/Secretarial/Office Worker
( ) طالب ( ) Student
( ) متقاعد ( ) Retired
( ) سائق ( ) Driver

ما المؤهل الدراسي الذي حصلت عليه ؟ ( ) ابتدائي ( ) متوسط ( ) ثانوي ( ) جامعي ( ) بدون ( )
What is your educational level? Preparatory Intermediate High School College None

---

هل تملك هذه السيارة ؟ ( ) نعم ( ) لا ( )
Do you own this car? yes no

من يملكها اذا ؟ ( )
Who own it then?

كم عدد سنوات قيادتكم للسيارة ؟ ( ) 1-2 سنة ( ) 3-5 سنوات ( ) أكثر من 5 سنوات
How many years did you drive? 1-2 years 3-5 years More than 5 years

---

ما نوع السيارة التي تقودها ؟ ( ) سيارة صغيرة ( ) سيارة حمل ( ) أتوبيس ( ) أخرى ( )
What type of car you drive? Passenger car Truck Bus Others

كم من السنوات عشت في هذه المنطقة ؟
How many years have you live in this area?

هل التحقت بمدارس قيادة ؟ ( ) لا ( ) ظهران ( ) أرامكو ( ) دلة ( ) أخرى ( ) أحدد
Have you been to driving schools? No Dallah Aramco Others (specify)

تقريبا كم من الكيلومترات تقطع في اليوم ، أو الشهر ، أو السنة
How many kilometers you drive in a day, month, or year?

كم من الحوادث تعرضت لها خلال السنتين الماضيتين ؟ ( ) أكثر من اثنين ( ) اثنان ( ) واحد ( ) بدون ( )
How many accidents did you have during last two years? None One Two More than two

وكم حادثا تعرض خلال سنوات قيادتك ( ) أكثر من اثنين ( ) اثنان ( ) واحد ( ) بدون ( )
How many accidents occured in your total driving experience. None One Two More than two

---

هل أنت متزوج ؟ ( ) لا ( ) نعم ( ) لا ( ) نعم ( )
Are you married? No Yes Yes No

هل لديك أطفال ؟
Do you have children?

كم عدد السيارات على عائلتك ؟ ( ) واحدة ( ) اثنان ( ) أكثر من اثنين ( )
How many cars with your family? One Two More than two

هل تعمل فرامل سيارتك ؟ ( ) تعمل جيدا ( ) حسنة ( ) ضعيفة
Do you have operational brakes? Very well All right Weak

ما هو مرتبك الشهري ؟ ( ) أقل من ٣٠٠٠ ريال ( ) ٣٠٠٠ - ١٠٠٠ ( ) أكثر من ١٠٠٠ ( )
What is your monthly income Less than SR.3000 SR3000 - 6000 More than 6000

هل تحمل رخصة قيادة سعودية ؟ ( ) نعم ( ) لا ( ) لا أحملها الآن ( )
Do you have a Saudi Arabia's driver licenses? Yes No I don't have with me now

---

مع الشكر الجزيل

APPENDIX B

Chi-Square Test of Population Assumption

B-1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B U L A
Q1 AGE B
* *

		V3		
	COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 2.	WEDNESDAY 5.	ROW TOTAL
Q1				
19-25	2.	28	9	37
		75.7	24.3	32.5
		31.1	37.5	
		24.6	7.9	
26-45	3.	62	15	77
		80.5	19.5	67.5
		68.9	62.5	
		54.4	13.2	
	COLUMN TOTAL	90	24	114
		78.9	21.1	100.0

CORRECTED CHI SQUARE = .12154 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = .35279 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 12

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B J . A I
* * Q2 NATIONALITY * 31

	V3		
COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 2.	WEDNESDAY 5.	ROW TOTAL
Q2			
1. SAUDI	63 78.7 86.3 64.9	17 21.2 70.6 17.5	80 82.5
3. MIDDLE EASTERN	10 58.8 13.7 10.3	7 41.2 29.2 7.2	17 17.5
COLUMN TOTAL	73 75.3	24 24.7	97 100.0

CORRECTED CHI SQUARE = 2.01539 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 2.98977 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 29

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B J _ A T
Q3 TRIP PURPOSE 81

Q3	COUNT / ROW PCT / COL PCT / TOT PCT	V3 SUNDAY 2.	V3 WEDNESDAY 5.	ROW TOTAL
WORK	1.	40	16	56
		71.4	28.6	49.6
		45.5	64.0	
		35.4	14.2	
HOME	2.	31	8	39
		79.5	20.5	34.5
		35.2	32.0	
		27.4	7.1	
SHOPPING	3.	17	1	18
		94.4	5.6	15.9
		19.3	4.0	
		15.0	.9	
	COLUMN TOTAL	88	25	113
		77.9	22.1	100.0

RAW CHI SQUARE = 4.27783 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 13

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B U L A T
Q4 OCCUPATION BY
* *

Q4	COUNT / ROW PCT / COL PCT / TOT PCT	V3 SUNDAY 2.	V3 WEDNESDAY 5.	ROW TOTAL
1. SALES,TEACH,CLER		24	10	34
		70.6	29.4	27.2
		24.5	37.0	
		19.2	8.0	
2. CRAFT,STUDENT,DR		23	6	34
		82.4	17.6	27.2
		28.6	22.2	
		22.4	4.8	
3. PROFESSIONAL		46	11	57
		80.7	19.3	45.6
		46.9	40.7	
		36.8	8.8	
COLUMN TOTAL		93	27	125
		78.4	21.6	100.0

RAW CHI SQUARE = 1.71726 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

B-5

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A
Q5 EDUCATION LEVEL
* *

Q5	COUNT / ROW PCT / COL PCT / TOT PCT	V3: SUNDAY 2.	WEDNESDAY 5.	ROW TOTAL
PREP OR LESS	1.	39 88.6 39.4 31.0	5 11.4 18.5 4.0	44 34.9
INTERMEDIATE	2.	19 82.6 19.2 15.1	4 17.4 14.8 3.2	23 18.3
HIGH SCHOOL	3.	18 64.3 18.2 14.3	10 35.7 37.0 7.9	28 22.2
COLLEGE	4.	23 74.2 23.2 18.3	8 25.8 29.6 6.3	31 24.6
	COLUMN TOTAL	99 78.6	27 21.4	126 100.0

RAW CHI SQUARE = 6.61587 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/92)
SUBFILE ONE

* C R O S S T A B U L A
Q11 KILOMETERS DRIVEN A DAY
* *

	V3		
COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 2.	WEDNESDAY 5.	ROW TOTAL
Q11			
1. <13000 MI-YR	57 87.7 57.6 45.2	8 12.3 29.6 6.3	65 51.6
3. >13000 MI-YR	42 68.9 42.4 33.3	19 31.1 70.4 15.1	61 48.4
COLUMN TOTAL	99 78.6	27 21.4	126 100.0

CORRECTED CHI SQUARE = 5.56212 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 6.63391 WITH 1 DEGREE OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B U L A T
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY
* *

		V3		
	COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 2.	WEDNESDAY 5.	ROW TOTAL
Q12				
1. NONE		73	12	85
		85.9	14.1	68.0
		74.5	44.4	
		58.4	9.6	
2. ONE		19	10	29
		65.5	34.5	23.2
		19.4	37.0	
		15.2	8.0	
3. TWO OR MORE		6	5	11
		54.5	45.5	8.8
		6.1	18.5	
		4.8	4.0	
COLUMN TOTAL		98	27	125
		78.4	21.6	100.0

RAW CHI SQUARE = 9.34855 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE

* C R O S S T A B U L A T I O N
Q18 INCOME,MONTHLY,S.R.

Q18	V3 SUNDAY (2.)	V3 WEDNESDAY (5.)	ROW TOTAL
1. LESS THAN 3000	COUNT 30	7	37
	ROW PCT 81.1	18.9	31.1
	COL PCT 32.6	25.9	
	TOT PCT 25.2	5.9	
2. 3000-6000	COUNT 44	11	55
	ROW PCT 80.0	20.0	46.2
	COL PCT 47.8	40.7	
	TOT PCT 37.0	9.2	
3. MORE THAN 6000	COUNT 18	9	27
	ROW PCT 66.7	33.3	22.7
	COL PCT 19.6	33.3	
	TOT PCT 15.1	7.6	
COLUMN TOTAL	92	27	119
	77.3	22.7	100.0

RAW CHI SQUARE = 2.27051 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 7

APPENDIX C

Chi-Square Test for Driver Characteristics In Sampe 1 vs. Sample 2 Using all Intersections

SHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A
Q1 AGE

Q1	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
<= 18	1.	24	43	67
		35.8	64.2	13.2
		11.3	14.5	
		4.7	8.5	
19-25	2.	73	114	187
		39.0	61.0	36.8
		34.4	38.5	
		14.4	22.4	
26-45	3.	106	121	227
		46.7	53.3	44.7
		50.0	40.9	
		20.9	23.8	
>=46	4.	9	18	27
		33.3	66.7	5.3
		4.2	6.1	
		1.8	3.5	
	COLUMN TOTAL	212	296	508
		41.7	58.3	100.0

RAW CHI SQUARE = 4.60469 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/92)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N *

Q2 NATIONALITY

Q2	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
1. SAUDI	COUNT 139 ROW PCT 40.8 COL PCT 65.4 TOT PCT 27.2	200 59.2 67.6 39.4	338 66.7
2. PAKISTANI, INDIAN	COUNT 12 ROW PCT 40.0 COL PCT 5.7 TOT PCT 2.4	18 60.0 6.1 3.6	30 5.9
3. MIDDLE EASTERN	COUNT 30 ROW PCT 35.3 COL PCT 14.2 TOT PCT 5.9	55 64.7 18.6 10.8	85 16.8
4. FAR EASTERN	COUNT 5 ROW PCT 33.3 COL PCT 2.4 TOT PCT 1.0	10 66.7 3.4 2.0	15 3.0
5. ALL OTHERS	COUNT 26 ROW PCT 66.7 COL PCT 12.3 TOT PCT 5.1	13 33.3 4.4 2.6	39 7.7
COLUMN TOTAL	211 41.6	296 58.4	507 100.0

RAW CHI SQUARE = 12.01288 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

C-3

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q4 OCCUPATION BY
* *

Q4	V2 COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
SALESMAN	1.	20	37	57
		35.1	64.9	11.3
		9.5	12.6	
		4.0	7.3	
TEACHER	2.	6	5	11
		54.5	45.5	2.2
		2.8	1.7	
		1.2	1.0	
PROFESSIONAL	3.	82	93	175
		46.9	53.1	34.7
		38.9	31.6	
		16.2	18.4	
CRAFTSMAN	4.	14	23	37
		37.8	62.2	7.3
		6.6	7.8	
		2.8	4.6	
CLERICAL	5.	28	27	55
		50.9	49.1	10.9
		13.3	9.2	
		5.5	5.3	
STUDENT	6.	34	60	94
		36.2	63.8	18.6
		16.1	20.4	
		6.7	11.9	
PROF. DRIVER	8.	27	49	76
		35.5	64.5	15.0
		12.8	16.7	
		5.3	9.7	
	COLUMN TOTAL	211	294	505
		41.8	58.2	100.0

RAW CHI SQUARE = 8.19971 WITH 6 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 3

SHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N
Q5 EDUCATION LEVEL
* *

Q5	V2	1ST SAMPLE	2ND SAMPLE	ROW TOTAL
PREPARATORY	1.	32	47	79
		40.5	59.5	15.6
		15.1	15.9	
		6.3	9.3	
INTERMEDIATE	2.	46	71	117
		39.3	60.7	23.1
		21.7	24.1	
		9.1	14.0	
HIGH SCHOOL	3.	55	87	142
		38.7	61.3	28.0
		25.9	29.5	
		10.8	17.2	
COLLEGE	4.	41	34	75
		54.7	45.3	14.8
		19.3	11.5	
		8.1	6.7	
NONE	5.	38	56	94
		40.4	59.6	18.5
		17.9	19.0	
		7.5	11.0	
COLUMN TOTAL		212	295	507
		41.8	58.2	100.0

RAW CHI SQUARE = 6.07647 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A
Q10 DRIVING SCHOOLS E
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q10				
	1.	83	132	215
NO		38.6	61.4	42.4
		39.2	44.7	
		16.4	26.0	
	2.	89	138	227
DALLAH		39.2	60.8	44.8
		42.0	46.8	
		17.6	27.2	
	4.	40	25	65
OTHERS		61.5	38.5	12.8
		18.9	8.5	
		7.9	4.9	
	COLUMN TOTAL	212	295	507
		41.8	58.2	100.0

RAW CHI SQUARE = 11.93825 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N
Q11 KILOMETERS DRIVEN A DAY
* *

	V2			
COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q11			
1. <9000 MI-YR	93 / 45.9 / 39.2 / 16.3	98 / 54.1 / 33.1 / 19.3	191 / 35.6
2. 9001-12999	38 / 38.8 / 17.9 / 7.5	60 / 61.2 / 20.3 / 11.8	98 / 19.3
3. >13000 MI-YR	91 / 39.7 / 42.9 / 17.9	138 / 60.3 / 46.6 / 27.2	229 / 45.1
COLUMN TOTAL	212 / 41.7	296 / 58.3	508 / 100.0

RAW CHI SQUARE = 1.99288 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE
TWO

* C R O S S T A B U L A T I O N *

Q12 NUMBER OF ACCIDENTS LAST TWO YEARS

V2

COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q12			
NONE 1.	137 / 43.4 / 64.9 / 27.0	179 / 56.6 / 60.5 / 35.3	316 / 62.3
ONE 2.	81 / 42.9 / 24.2 / 10.1	68 / 57.1 / 23.0 / 13.4	119 / 23.5
2 OR MORE 3.	23 / 31.9 / 10.9 / 4.5	49 / 68.1 / 16.6 / 9.7	72 / 14.2
COLUMN TOTAL	211 / 41.6	296 / 58.4	507 / 100.0

RAW CHI SQUARE = 3.24032 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A
Q18 INCOME,MONTHLY,S.R.
* *

Q18	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
1. LESS THAN 3000		81	115	196
		41.3	58.7	43.1
		40.5	45.1	
		17.8	25.3	
2. 3000-6000		82	108	190
		43.2	56.8	41.8
		41.0	42.4	
		18.0	23.7	
3. MORE THAN 6000		37	32	69
		53.6	46.4	15.2
		18.5	12.5	
		8.1	7.0	
COLUMN TOTAL		200	255	455
		44.0	56.0	100.0

RAW CHI SQUARE = 3.21692 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 53

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/83)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q19 DRIVER'S LICENCE AVAILABILITY BY
* *

Q19	V2 COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
1. WITH DRIVER'S LI		181	250	431
		42.0	58.0	86.2
		85.4	86.8	
		36.2	50.0	
2. WITHOUT DRIVER'S		13	13	26
		50.0	50.0	5.2
		6.1	4.5	
		2.6	2.6	
3. NOT CARRIED		18	25	43
		41.9	58.1	8.6
		8.5	8.7	
		3.6	5.0	
COLUMN TOTAL		212	288	500
		42.4	57.6	100.0

RAW CHI SQUARE = .64893 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 8

APPENDIX D

Chi-Square Test for Driver Characteristics In Sample 1 vs. Sample 2 Using Signalized Intersection Data

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/92)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N

Q1 AGE

	V2		
COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q1			
1. <= 18	7 / 43.8 / 5.6 / 2.7	9 / 56.3 / 6.9 / 3.5	16 / 6.3
2. 19-25	57 / 43.0 / 29.4 / 14.5	49 / 57.0 / 37.7 / 19.1	86 / 33.6
3. 26-45	77 / 56.6 / 61.1 / 30.1	59 / 43.4 / 45.4 / 23.0	136 / 53.1
4. >=46	5 / 27.8 / 4.0 / 2.0	13 / 72.2 / 10.0 / 5.1	18 / 7.0
COLUMN TOTAL	126 / 49.2	130 / 50.8	256 / 100.0

RAW CHI SQUARE = 7.80173 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C P O S S T A B U L A T I O N
Q2 NATIONALITY Q2

Q2	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
1. SAUDI	80 48.8 64.0 31.4	84 51.2 64.6 32.9	164 64.3
3. MIDDLE EASTERN	17 36.2 13.6 6.7	30 63.8 23.1 11.8	47 18.4
4. FAR EASTERN	7 41.2 5.6 2.7	10 58.8 7.7 3.9	17 6.7
5. ALL OTHERS	21 77.8 16.8 8.2	6 22.2 4.6 2.4	27 10.6
COLUMN TOTAL	125 49.0	130 51.0	255 100.0

RAW CHI SQUARE = 12.46280 WITH 3 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N *

Q4 OCCUPATION

Q4		V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
SALESMAN	1.	12	19	31
		38.7	61.3	12.2
		9.6	14.7	
		4.7	7.5	
TEACHER	2.	22	19	41
		53.7	46.3	16.1
		17.6	14.7	
		8.7	7.5	
PROFESSIONAL	3.	57	30	87
		65.5	34.5	34.3
		45.6	23.3	
		22.4	11.8	
CRAFTSMAN	4.	9	13	22
		40.9	59.1	8.7
		7.2	10.1	
		3.5	5.1	
STUDENT	6.	9	18	27
		33.3	66.7	10.6
		7.2	14.0	
		3.5	7.1	
PROF. DRIVER	8.	16	30	46
		34.8	65.2	18.1
		12.9	23.3	
		6.3	11.8	
	COLUMN TOTAL	125	129	254
		49.2	50.8	100.0

RAW CHI SQUARE = 18.10911 WITH 5 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 2

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q5 EDUCATION LEVEL

Q5	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
PREPARATORY	1.	20	24	44
		45.5	54.5	17.3
		15.9	18.6	
		7.8	9.4	
INTERMEDIATE	2.	23	29	52
		44.2	55.8	20.4
		18.3	22.5	
		9.0	11.4	
HIGH SCHOOL	3.	28	26	54
		51.9	48.1	21.2
		22.2	20.2	
		11.0	10.2	
COLLEGE	4.	31	21	52
		59.6	40.4	20.4
		24.6	16.3	
		12.2	8.2	
NONE	5.	24	29	53
		45.3	54.7	20.8
		19.0	22.5	
		9.4	11.4	
COLUMN TOTAL		126	129	255
		49.4	50.6	100.0

RAW CHI SQUARE = 3.49998 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q10 DRIVING SCHOOLS BY
* *

		V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
Q10	COUNT			
	ROW PCT			
	COL PCT			
	TOT PCT			
1. NO		62	61	123
		50.4	49.6	48.0
		49.2	46.9	
		24.2	23.8	
2. DALLAH		42	58	100
		42.0	58.0	39.1
		33.3	44.6	
		16.4	22.7	
4. OTHERS		22	11	33
		66.7	33.3	12.9
		17.5	8.5	
		8.6	4.3	
COLUMN TOTAL		126	130	256
		49.2	50.8	100.0

RAW CHI SQUARE = 6.17380 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/8[illegible])
SUBFILE ONE TWO

* CROSSTABULAT
Q11 KILOMETERS DRIVEN A DAY BY
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q11				
<9000 MI-YR	1.	45 / 59.2 / 35.7 / 17.6	31 / 40.8 / 23.8 / 12.1	76 / 29.7
9001-12999	2.	20 / 38.5 / 15.9 / 7.8	32 / 61.5 / 24.6 / 12.5	52 / 20.3
>13000 MI-YR	3.	61 / 47.7 / 48.4 / 23.8	67 / 52.3 / 51.5 / 26.2	128 / 50.0
	COLUMN TOTAL	126 / 49.2	130 / 50.8	256 / 100.0

RAW CHI SQUARE = 5.56329 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY
* *

		V2		
	COUNT	1ST SAMPLE	2ND SAMPLE	ROW TOTAL
	ROW PCT			
	COL PCT			
Q12	TOT PCT	1.	2.	
NONE	1.	85	86	171
		49.7	50.3	67.1
		68.0	66.2	
		33.3	33.7	
ONE	2.	29	29	58
		50.0	50.0	22.7
		23.2	22.3	
		11.4	11.4	
2 OR MORE	3.	11	15	26
		42.3	57.7	10.2
		8.8	11.5	
		4.3	5.9	
COLUMN TOTAL		125	130	255
		49.0	51.0	100.0

RAW CHI SQUARE = .52339 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q18 INCOME,MONTHLY,S.R. BY
* *

Q18	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
1. LESS THAN 3000		57	51	88
		42.0	58.9	37.6
		31.1	44.3	
		15.3	21.8	
2. 3000-6000		55	48	103
		53.4	46.6	44.0
		46.2	41.7	
		23.5	20.5	
3. MORE THAN 6000		27	16	43
		62.8	37.2	18.4
		22.7	13.9	
		11.5	6.8	
COLUMN TOTAL		119	115	234
		50.9	49.1	100.0

RAW CHI SQUARE = 5.45017 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 22

D-9

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T
Q19 DRIVER'S LICENCE AVAILABILITY BY
* *

Q19	COUNT / ROW PCT / COL PCT / TOT PCT	V2: 1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
1. WITH DRIVER'S LI		113 47.9 89.7 44.3	123 52.1 95.3 48.2	236 92.5
2. WITHOUT DRIVER'S		13 68.4 10.3 5.1	6 31.6 4.7 2.4	19 7.5
COLUMN TOTAL		126 49.4	129 50.6	255 100.0

CORRECTED CHI SQUARE = 2.20297 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 2.96779 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

APPENDIX E

Chi-Square Test for Driver Characteristics in Sample 1 vs. Sample 2 Using Unsignalized Intersection Data

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A
Q1 AGE B
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q1				
<= 18	1.	17	34	51
		33.3	66.7	20.2
		19.8	20.5	
		6.7	13.5	
19-25	2.	36	65	101
		35.6	64.4	40.1
		41.9	39.2	
		14.3	25.8	
26-45	3.	29	62	91
		31.9	68.1	36.1
		33.7	37.3	
		11.5	24.6	
>=46	4.	4	5	9
		44.4	55.6	3.6
		4.7	3.0	
		1.6	2.0	
	COLUMN TOTAL	86	166	252
		34.1	65.9	100.0

RAW CHI SQUARE = .75034 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q2 NATIONALITY BY
* *

	V2		
COUNT ROW PCT COL PCT TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q2			
1. SAUDI	58 33.3 67.4 23.0	116 66.7 69.9 46.0	174 69.0
3. MIDDLE EASTERN	13 34.2 15.1 5.2	25 65.8 15.1 9.9	38 15.1
4. FAR EASTERN	10 35.7 11.6 4.0	18 64.3 10.8 7.1	28 11.1
5. ALL OTHERS	5 41.7 5.8 2.0	7 58.3 4.2 2.8	12 4.8
COLUMN TOTAL	86 34.1	166 65.9	252 100.0

RAW CHI SQUARE = .38370 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q4 OCCUPATION BY
* *

Q4	V2 COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
SALESMAN	1.	8	18	26
		30.8	69.2	10.4
		9.3	10.9	
		3.2	7.2	
TEACHER	2.	12	13	25
		48.0	52.0	10.0
		14.0	7.9	
		4.8	5.2	
PROFESSIONAL	3.	25	63	88
		28.4	71.6	35.1
		29.1	38.2	
		10.0	25.1	
CRAFTSMAN	4.	5	10	15
		33.3	66.7	6.0
		5.8	6.1	
		2.0	4.0	
STUDENT	6.	25	42	67
		37.3	62.7	26.7
		29.1	25.5	
		10.0	16.7	
PROF. DRIVER	8.	11	19	30
		36.7	63.3	12.0
		12.8	11.5	
		4.4	7.6	
COLUMN TOTAL		86	165	251
		34.3	65.7	100.0

RAW CHI SQUARE = 3.93333 WITH 5 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

E-4

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T I O N *

Q5 EDUCATION LEVEL

Q5		V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
PREPARATORY	1.	12	23	35
		34.3	65.7	13.9
		14.0	13.9	
		4.8	9.1	
INTERMEDIATE	2.	23	42	65
		35.4	64.6	25.8
		26.7	25.3	
		9.1	16.7	
HIGH SCHOOL	3.	27	61	88
		30.7	69.3	34.9
		31.4	36.7	
		10.7	24.2	
COLLEGE	4.	10	13	23
		43.5	56.5	9.1
		11.6	7.8	
		4.0	5.2	
NONE	5.	14	27	41
		34.1	65.9	16.3
		16.3	16.3	
		5.6	10.7	
COLUMN TOTAL		86	166	252
		34.1	65.9	100.0

RAW CHI SQUARE = 1.40342 WITH 4 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q10 DRIVING SCHOOLS BY
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q10				
NO	1.	21	71	92
		22.8	77.2	36.7
		24.4	43.0	
		8.4	28.3	
DALLAH	2.	47	80	127
		37.0	63.0	50.6
		54.7	48.5	
		18.7	31.9	
OTHERS	4.	18	14	32
		56.3	43.8	12.7
		20.9	8.5	
		7.2	5.6	
COLUMN TOTAL		86	165	251
		34.3	65.7	100.0

RAW CHI SQUARE = 12.63591 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q11 KILOMETERS DRIVEN A DAY BY
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q11				
<9000 MI-YR	1.	38 / 36.2 / 44.2 / 15.1	67 / 63.8 / 40.4 / 26.6	105 / 41.7
9001-12999	2.	18 / 39.1 / 20.9 / 7.1	28 / 60.9 / 16.9 / 11.1	46 / 18.3
>13000 MI-YR	3.	30 / 29.7 / 34.9 / 11.9	71 / 70.3 / 42.8 / 28.2	101 / 40.1
COLUMN TOTAL		86 / 34.1	166 / 65.9	252 / 100.0

RAW CHI SQUARE = 1.59046 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY
* *

		V2		
	COUNT			
	ROW PCT	1ST SAMP	2ND SAMP	ROW
	COL PCT	LE	LE	TOTAL
	TOT PCT	1.	2.	
Q12				
	1.	52	93	145
NONE		35.9	64.1	57.5
		60.5	56.0	
		20.6	36.9	
	2.	22	39	61
ONE		36.1	63.9	24.2
		25.6	23.5	
		8.7	15.5	
	3.	12	34	46
2 OR MORE		26.1	73.9	18.3
		14.0	20.5	
		4.8	13.5	
	COLUMN	86	166	252
	TOTAL	34.1	65.9	100.0

RAW CHI SQUARE = 1.61887 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* C R O S S T A B U L A T
Q18 INCOME,MONTHLY,S.R. BY
* *

	V2		
COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q18			
1. LESS THAN 3000	44	64	108
	40.7	59.3	48.9
	54.3	45.7	
	19.9	29.0	
2. 3000-6000	27	60	87
	31.0	69.0	39.4
	33.3	42.9	
	12.2	27.1	
3. MORE THAN 6000	10	16	26
	38.5	61.5	11.8
	12.3	11.4	
	4.5	7.2	
COLUMN TOTAL	81	140	221
	36.7	63.3	100.0

RAW CHI SQUARE = 1.99674 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 31

E-9

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 02/12/82)
SUBFILE ONE TWO

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T
Q19 DRIVER'S LICENCE AVAILABILITY BY
* *

Q19 (COUNT / ROW PCT / COL PCT / TOT PCT)	V2: 1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
1. WITH DRIVER'S LI	69 34.9 79.1 27.8	127 65.1 79.9 51.8	195 79.6
2. WITHOUT DRIVER'S	18 36.0 20.9 7.3	32 64.0 20.1 13.1	50 20.4
COLUMN TOTAL	86 35.1	159 64.9	245 100.0

CORRECTED CHI SQUARE = 0 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = .02224 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 7

APPENDIX F

Chi-Square Test for Driver Characteristics In Sample 1 vs. Sample 2 Using Unsignalized Intersection Data for Drivers with a Double Conflict

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N

Q1 AGE BY V2

Q1	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
<= 18	1.	24	18	42
		57.1	42.9	14.9
		11.8	23.1	
		8.5	6.4	
19-25	2.	73	28	101
		72.3	27.7	35.9
		36.0	35.9	
		26.0	10.0	
26-45	3.	106	32	138
		76.8	23.2	49.1
		52.2	41.0	
		37.7	11.4	
COLUMN TOTAL		203	78	281
		72.2	27.8	100.0

RAW CHI SQUARE = 6.21209 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 11

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE GUEST (CREATION DATE = 03/15/82)

* CROSSTABULAT
Q2 NATIONALITY BY
* *

		V2		
	COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
Q2				
1. SAUDI		138	56	194
		71.1	28.9	73.2
		74.6	70.0	
		52.1	21.1	
3. MIDDLE EASTERN		30	18	48
		62.5	37.5	18.1
		16.2	22.5	
		11.3	6.8	
4. FAR EASTERN		17	6	23
		73.9	26.1	8.7
		9.2	7.5	
		6.4	2.3	
COLUMN TOTAL		185	80	265
		69.8	30.2	100.0

RAW CHI SQUARE = 1.56214 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 27

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N *

Q4 OCCUPATION BY V2

Q4	V2	1ST SAMPLE	2ND SAMPLE	ROW TOTAL
SALES,TEACH,CLER	1.	54	12	66
		81.8	18.2	25.8
		29.3	16.7	
		21.1	4.7	
PROFESSIONAL	3.	82	32	114
		71.9	28.1	44.5
		44.6	44.4	
		32.0	12.5	
CRAFTSMAN	4.	14	8	22
		63.6	36.4	8.6
		7.6	11.1	
		5.5	3.1	
STUDENT	6.	34	20	54
		63.0	37.0	21.1
		18.5	27.8	
		13.3	7.8	
COLUMN TOTAL		184	72	256
		71.9	28.1	100.0

RAW CHI SQUARE = 6.02846 WITH 3 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 36

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T

Q5 EDUCATION LEVEL BY

* *

Q5	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMPLE 1.	V2 2ND SAMPLE 2.	ROW TOTAL
1. PREP OR LESS		70	14	84
		83.3	16.7	28.8
		33.0	17.5	
		24.0	4.8	
2. INTERMEDIATE		46	24	70
		65.7	34.3	24.0
		21.7	30.0	
		15.8	8.2	
3. HIGH SCHOOL		55	36	91
		60.4	39.6	31.2
		25.9	45.0	
		18.8	12.3	
4. COLLEGE		41	6	47
		87.2	12.8	16.1
		19.3	7.5	
		14.0	2.1	
COLUMN TOTAL		212	80	292
		72.6	27.4	100.0

RAW CHI SQUARE = 15.35897 WITH 3 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

C R O S S T A B U L A

Q11 KILOMETERS DRIVEN A DAY

Q11	COUNT / ROW PCT / COL PCT / TOT PCT	V2 1ST SAMP LE 1.	V2 2ND SAMP LE 2.	ROW TOTAL
<9000 MI-YR	1.	83	32	115
		72.2	27.8	39.4
		39.2	40.0	
		28.4	11.0	
9001-12999	2.	38	16	54
		70.4	29.6	18.5
		17.9	20.0	
		13.0	5.5	
>13000 MI-YR	3.	91	32	123
		74.0	26.0	42.1
		42.9	40.0	
		31.2	11.0	
	COLUMN TOTAL	212	80	292
		72.6	27.4	100.0

RAW CHI SQUARE = .26385 WITH 2 DEGREES OF FREEDOM.

F-6

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS
* *

Q12	COUNT / ROW PCT / COL PCT / TOT PCT	V2: 1ST SAMPLE 1.	2ND SAMPLE 2.	ROW TOTAL
NONE	1.	137 77.4 64.9 47.1	40 22.6 50.0 13.7	177 60.8
ONE	2.	51 73.9 24.2 17.5	18 26.1 22.5 6.2	69 23.7
TWO OR MORE	3.	23 51.1 10.9 7.9	22 48.9 27.5 7.6	45 15.5
	COLUMN TOTAL	211 72.5	80 27.5	291 100.0

RAW CHI SQUARE = 12.52972 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N

Q16 INCOME,MONTHLY,S.R. B

V3

COUNT / ROW PCT / COL PCT / TOT PCT	1ST SAMP LE 1.	2ND SAMP LE 2.	ROW TOTAL
Q16			
1. LESS THAN 3000	81 80.2 40.5 30.9	20 19.8 32.3 7.6	101 38.5
2. 3000-6000	82 71.9 41.0 31.3	32 28.1 51.6 12.2	114 43.5
3. MORE THAN 6000	37 78.7 18.5 14.1	10 21.3 16.1 3.8	47 17.9
COLUMN TOTAL	200 76.3	62 23.7	262 100.0

RAW CHI SQUARE = 2.20744 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 38

APPENDIX G

Chi-Square Test for Conflict Involved Drivers

Intersection 1 vs. Intersection 2 (Signalized)

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L

Q1 AGE

* *

		V1		
	COUNT / ROW PCT / COL PCT / TOT PCT	1.	2.	ROW TOTAL
Q1				
<=18 >45	1.	11 50.0 16.7 8.5	11 50.0 17.2 8.5	22 16.9
19-25	2.	29 59.2 43.9 22.3	20 40.8 31.3 15.4	49 37.7
26-45	3.	26 44.1 39.4 20.0	33 55.9 51.6 25.4	59 45.4
COLUMN TOTAL		66 50.8	64 49.2	130 100.0

RAW CHI SQUARE = 2.45338 WITH 2 DEGREES OF FREEDOM

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q2 NATIONALITY RY
* *

Q2	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	V1 2.	ROW TOTAL
1. SAUDI		47	37	84
		56.0	44.0	64.6
		71.2	57.8	
		36.2	28.5	
3. MIDDLE EASTERN		15	15	30
		50.0	50.0	23.1
		22.7	23.4	
		11.5	11.5	
5. ALL OTHERS		4	12	16
		25.0	75.0	12.3
		6.1	18.8	
		3.1	9.2	
COLUMN TOTAL		66	64	130
		50.8	49.2	100.0

RAW CHI SQUARE = 5.16093 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

G-3

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T

Q4 OCCUPATION

Q4	V1	1.	2.	ROW TOTAL
1. SALES,TEACH,CLER	COUNT	21	17	38
	ROW PCT	55.3	44.7	29.5
	COL PCT	32.3	26.6	
	TOT PCT	16.3	13.2	
3. PROFESSIONAL	COUNT	17	13	30
	ROW PCT	56.7	43.3	23.3
	COL PCT	26.2	20.3	
	TOT PCT	13.2	10.1	
4. CRAFTSMAN	COUNT	4	9	13
	ROW PCT	30.8	69.2	10.1
	COL PCT	6.2	14.1	
	TOT PCT	3.1	7.0	
6. STUDENT	COUNT	11	7	18
	ROW PCT	61.1	38.9	14.0
	COL PCT	16.9	10.9	
	TOT PCT	8.5	5.4	
8. PROF. DRIVER	COUNT	12	18	30
	ROW PCT	40.0	60.0	23.3
	COL PCT	18.5	28.1	
	TOT PCT	9.3	14.0	
COLUMN TOTAL		65	64	129
		50.4	49.6	100.0

RAW CHI SQUARE = 4.95890 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A

Q5 EDUCATION LEVEL B

* *

Q5	V1	1.	2.	ROW TOTAL
PREPARATORY	1.	11 45.8 16.7 8.5	13 54.2 20.6 10.1	24 18.6
INTERMEDIATE	2.	16 55.2 24.2 12.4	13 44.8 20.6 10.1	29 22.5
HIGH SCHOOL	3.	13 50.0 19.7 10.1	13 50.0 20.6 10.1	26 20.2
COLLEGE	4.	10 47.6 15.2 7.8	11 52.4 17.5 8.5	21 16.3
NONE	5.	16 55.2 24.2 12.4	13 44.8 20.6 10.1	29 22.5
COLUMN TOTAL		66 51.2	63 48.8	129 100.0

RAW CHI SQUARE = .76562 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N
Q10 DRIVING SCHOOLS
* *

		V1		
	COUNT / ROW PCT / COL PCT / TOT PCT	1.	2.	ROW TOTAL
Q10				
1. NO		29	32	61
		47.5	52.5	46.9
		43.9	50.0	
		22.3	24.6	
2. DALLAH		33	25	58
		56.9	43.1	44.6
		50.0	39.1	
		25.4	19.2	
4. OTHERS		4	7	11
		36.4	63.6	8.5
		6.1	10.9	
		3.1	5.4	
COLUMN TOTAL		66	64	130
		50.8	49.2	100.0

RAW CHI SQUARE = 2.03868 WITH 2 DEGREES OF FREEDOM.

G-6

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A B
Q11 KILOMETERS DRIVEN A DAY
* *

Q11	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	V1 2.	ROW TOTAL
<9000 MI-YR	1.	19 61.3 28.8 14.6	12 38.7 18.8 9.2	31 23.8
9001-12999	2.	15 46.9 22.7 11.5	17 53.1 26.6 13.1	32 24.6
>13000 MI-YR	3.	32 47.8 48.5 24.6	35 52.2 54.7 26.9	67 51.5
	COLUMN TOTAL	66 50.8	64 49.2	130 100.0

RAW CHI SQUARE = 1.80963 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS P
* *

		V1		
	COUNT ROW PCT COL PCT TOT PCT	1.	2.	ROW TOTAL
Q12				
1. NONE		47 54.7 71.2 36.2	39 45.3 60.9 30.0	86 66.2
2. ONE		10 34.5 15.2 7.7	19 65.5 29.7 14.6	29 22.3
3. TWO OR MORE		9 60.0 13.6 6.9	6 40.0 9.4 4.6	15 11.5
COLUMN TOTAL		66 50.8	64 49.2	130 100.0

RAW CHI SQUARE = 4.10749 WITH 2 DEGREES OF FREEDOM.

G-8

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A
Q18 INCOME,MONTHLY,S.R. B
* *

Q13 (COUNT / ROW PCT / COL PCT / TOT PCT)	V1: 1.	V1: 2.	ROW TOTAL
1. LESS THAN 3000	22 43.1 37.9 19.1	29 56.9 50.9 25.2	51 44.3
2. 3000-6000	29 60.4 50.0 25.2	19 39.6 33.3 16.5	48 41.7
3. MORE THAN 6000	7 43.8 12.1 6.1	9 56.3 15.8 7.8	16 13.9
COLUMN TOTAL	58 50.4	57 49.6	115 100.0

RAW CHI SQUARE = 3.28567 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 15

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q19 DRIVER'S LICENCE AVAILABILITY BY

Q19	V1 1.	V1 2.	ROW TOTAL
1. WITH DRIVER'S LI	COUNT 61	62	123
	ROW PCT 49.6	50.4	95.3
	COL PCT 92.4	98.4	
	TOT PCT 47.3	48.1	
2. WITHOUT DRIVER'S	COUNT 5	1	6
	ROW PCT 83.3	16.7	4.7
	COL PCT 7.6	1.6	
	TOT PCT 3.9	.8	
COLUMN TOTAL	66	63	129
	51.2	48.8	100.0

CORRECTED CHI SQUARE = 1.43101 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 2.60644 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHADI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * * C R O S S T A B U L A

Q1 AGE

Q1	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	V1 2.	V1 3.	ROW TOTAL
<=18 >45	1.	11 26.2 16.7 5.2	11 26.2 17.2 5.2	20 47.6 25.0 9.5	42 20.0
19-25	2.	29 37.7 43.9 13.8	20 26.0 31.3 9.5	28 36.4 35.0 13.3	77 36.7
26-45	3.	26 28.6 39.4 12.4	33 36.3 51.6 15.7	32 35.2 40.0 15.2	91 43.3
	COLUMN TOTAL	66 31.4	64 30.5	80 38.1	210 100.0

RAW CHI SQUARE = 4.58624 WITH 4 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N

Q2 NATIONALITY BY V1

Q2	COUNT / ROW PCT / COL PCT / TOT PCT	1.	2.	3.	ROW TOTAL
1. SAUDI		47	37	56	140
		33.6	26.4	40.0	66.7
		71.2	57.8	78.9	
		22.4	17.6	26.7	
3. MIDDLE EASTERN		15	15	18	48
		31.3	31.3	37.5	22.9
		22.7	23.4	25.4	
		7.1	7.1	8.6	
5. ALL OTHERS		4	12	6	22
		18.2	54.5	27.3	10.5
		6.1	18.8	8.5	
		1.9	5.7	2.9	
COLUMN TOTAL		66	64	80	210
		31.4	30.5	38.1	100.0

RAW CHI SQUARE = 7.19164 WITH 4 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/92)

* C R O S S T A B U L A T I O N

Q4 OCCUPATION

Q4	V1 1.	2.	3,4,5,6 3.	ROW TOTAL
1. ALL OTHERS	25 35.2 38.5 12.1	26 36.6 40.6 12.6	20 28.2 25.6 9.7	71 34.3
2. STUD & PROF DRIV	23 31.1 35.4 11.1	25 33.8 39.1 12.1	26 35.1 33.3 12.6	74 35.7
3. PROFESSIONAL	17 27.4 26.2 8.2	13 21.0 20.3 6.3	32 51.6 41.0 15.5	62 30.0
COLUMN TOTAL	65 31.4	64 30.9	78 37.7	207 100.0

RAW CHI SQUARE = 8.59799 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 3

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
05 EDUCATION LEVEL BY

05	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	2.	3,4,5,6 3.	ROW TOTAL
< HIGH SCHOOL	1.	43	39	38	120
		35.8	32.5	31.7	57.4
		65.2	61.9	47.5	
		20.6	18.7	18.2	
HIGH SCHOOL	3.	13	13	36	62
		21.0	21.0	58.1	29.7
		19.7	20.6	45.0	
		6.2	6.2	17.2	
COLLEGE	4.	10	11	6	27
		37.0	40.7	22.2	12.9
		15.2	17.5	7.5	
		4.8	5.3	2.9	
	COLUMN TOTAL	66	63	80	209
		31.6	30.1	38.3	100.0

RAW CHI SQUARE = 15.64197 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

H-5

GHANA DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T
Q13 DRIVING SCHOOLS BY
* *

Q13	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	2.	3.	ROW TOTAL
NC	1.	29 / 30.5 / 43.9 / 13.9	32 / 33.7 / 50.0 / 15.4	34 / 35.8 / 43.6 / 16.3	95 / 45.7
DALLAH	2.	33 / 34.4 / 50.0 / 15.9	25 / 26.0 / 39.1 / 12.0	38 / 39.6 / 48.7 / 18.3	96 / 46.2
OTHERS	4.	4 / 23.5 / 6.1 / 1.9	7 / 41.2 / 10.9 / 3.4	6 / 35.3 / 7.7 / 2.9	17 / 8.2
	COLUMN TOTAL	66 / 31.7	64 / 30.8	78 / 37.5	208 / 100.0

RAW CHI SQUARE = 2.33071 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 2

GRANT DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATAY

Q11 KILOMETERS DRIVEN A DAY BY

Q11	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	2.	3.	ROW TOTAL
<9000 MI-YR	1.	19	12	32	63
		30.2	19.0	50.8	30.0
		28.8	18.8	40.0	
		9.0	5.7	15.2	
9001-12999	2.	15	17	16	48
		31.3	35.4	33.3	22.9
		22.7	26.6	20.0	
		7.1	8.1	7.6	
>13000 MI-YR	3.	32	35	32	99
		32.3	35.4	32.3	47.1
		48.5	54.7	40.0	
		15.2	16.7	15.2	
COLUMN TOTAL		66	64	80	210
		31.4	30.5	38.1	100.0

RAW CHI SQUARE = 7.73339 WITH 4 DEGREES OF FREEDOM.

GHANA DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A

Q12 NUMBER OF ACCIDENTS LAST TWO YEARS

Q12	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	V1 2.	V1 3.	ROW TOTAL
1. NONE		47	39	40	126
		37.3	31.0	31.7	60.0
		71.2	60.9	50.6	
		22.4	18.6	19.0	
2. ONE		16	19	12	47
		34.0	40.4	25.5	22.4
		24.2	29.7	15.2	
		7.6	9.0	5.7	
3. TWO OR MORE		3	6	27	36
		8.3	16.7	75.0	17.1
		4.5	9.4	34.2	
		1.4	2.9	12.9	
COLUMN TOTAL		66	64	79	210
		31.4	30.5	37.6	100.0

RAW CHI SQUARE = 13.24991 WITH 4 DEGREES OF FREEDOM.

GHANT DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

CROSS TABULATION

Q13 NUMBER OF ACCIDENTS SINCE DRIVING

Q13	COUNT / ROW PCT / COL PCT / TOT PCT	V1 1.	2.	3.	ROW TOTAL
NONE	1.	29 / 29.6 / 58.0 / 15.0	33 / 33.7 / 52.4 / 17.1	36 / 36.7 / 46.1 / 18.7	98 / 50.8
ONE	2.	12 / 26.7 / 24.0 / 6.2	17 / 37.8 / 27.0 / 8.8	16 / 35.6 / 20.5 / 8.3	45 / 23.3
TWO OR MORE	3.	9 / 18.0 / 18.0 / 4.7	13 / 26.0 / 20.6 / 6.7	26 / 52.0 / 33.3 / 13.5	50 / 25.9
COLUMN TOTAL		50 / 25.9	63 / 32.6	78 / 40.4	193 / 100.0

RAW CHI SQUARE = 6.25813 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 17

GHANA DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 13/15/82)

* C R O S S T A B U L A

Q18 INCOME, MONTHLY, G.H.

Q18	V1	1.	2.	3.	ROW TOTAL
LESS THAN 3000	1.	22	29	20	71
		31.0	40.8	28.2	40.1
		37.9	50.9	32.3	
		12.4	16.4	11.3	
3000-6000	2.	29	19	32	80
		36.2	23.8	40.0	45.2
		50.0	33.3	51.6	
		16.4	10.7	18.1	
MORE THAN 6000	3.	7	9	10	26
		26.9	34.6	38.5	14.7
		12.1	15.8	16.1	
		4.0	5.1	5.6	
COLUMN TOTAL		58	57	62	177
		32.8	32.2	35.0	100.0

RAW CHI SQUARE = 5.71021 WITH 4 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 33

GHANT DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * * C R O S S T A B U L A

Q19 DRIVER'S LICENCE AVAILABILITY

Q19	V1 1.	2.	3.	ROW TOTAL
1. WITH DRIVER'S LI	61	62	50	173
	35.3	35.8	28.9	84.4
	92.4	98.4	66.7	
	29.8	30.2	24.4	
2. WITHOUT DRIVER'S	5	1	26	32
	15.6	3.1	81.3	15.6
	7.6	1.6	34.2	
	2.4	.5	12.7	
COLUMN TOTAL	66	63	76	205
	32.2	30.7	37.1	100.0

RAW CHI SQUARE = 32.59030 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 5

APPENDIX I

Cross Tabulation of Conflict Type and Characteristics of Drivers

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE 0

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION OF Q1 AGE BY RQ20 RQ20 VALUE

CONTROLLING FOR.. INT INTERSECTION TYPE

Q1	RQ20	0	1.	2.	3.	4.	ROW TOTAL
	1. COUNT	49	7	15	22	25	118
<=25 >=46	ROW PCT	41.5	5.9	12.7	18.6	21.2	47.0
	COL PCT	38.9	50.0	65.2	55.0	52.1	
	TOT PCT	19.5	2.8	6.0	8.8	10.0	
	3. COUNT	77	7	8	18	23	133
26-45	ROW PCT	57.9	5.3	6.0	13.5	17.3	53.0
	COL PCT	61.1	50.0	34.8	45.0	47.9	
	TOT PCT	30.7	2.8	3.2	7.2	9.2	
COLUMN TOTAL		126	14	23	40	48	251
		50.2	5.6	9.2	15.9	19.1	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE 0

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F

Q1 AGE BY RQ20

CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

* *

	RQ20						
	COUNT / ROW PCT / COL PCT / TOT PCT	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
Q1							
1. <=25 >=46		57	29	5	6	8	105
		54.3	27.6	4.8	5.7	7.6	63.3
		65.3	60.4	45.5	66.7	66.7	
		34.3	17.5	3.0	3.6	4.8	
3. 26-45		29	19	6	3	4	61
		47.5	31.1	9.8	4.9	6.6	36.7
		33.7	39.6	54.5	33.3	33.3	
		17.5	11.4	3.6	1.8	2.4	
COLUMN TOTAL		86	48	11	9	12	166
		51.8	28.9	6.6	5.4	7.2	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE C

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F

Q2 NATIONALITY BY RQ20

CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

* *

	RQ20					
	COUNT / ROW PCT / COL PCT / TOT PCT	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
Q2							
1. SAUDI		80	7	15	25	33	160
		50.0	4.4	9.4	15.6	20.6	77.3
		82.5	53.8	71.4	75.8	76.7	
		38.6	3.4	7.2	12.1	15.9	
3. MIDDLE EASTERN		17	6	6	8	10	47
		36.2	12.8	12.8	17.0	21.3	22.7
		17.5	46.2	28.6	24.2	23.3	
		8.2	2.9	2.9	3.9	4.8	
COLUMN TOTAL		97	13	21	33	43	207
		46.9	6.3	10.1	15.9	20.8	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F

CONTROLLING FOR.. Q2 NATIONALITY BY RQ20 INT INTERSECTION TYPE VAUUE

* *

Q2	RQ20	RIGHT AN GLE	TURNING 1.	REAR END 2.	SIDE SWI PE 3.	4.	ROW TOTAL
1. SAUDI	COUNT	58	34	6	7	9	114
	ROW PCT	50.9	29.8	5.3	6.1	7.9	78.6
	COL PCT	81.7	75.6	75.0	77.8	75.0	
	TOT PCT	40.0	23.4	4.1	4.8	6.2	
3. MIDDLE EASTERN	COUNT	13	11	2	2	3	31
	ROW PCT	41.9	35.5	6.5	6.5	9.7	21.4
	COL PCT	18.3	24.4	25.0	22.2	25.0	
	TOT PCT	9.0	7.6	1.4	1.4	2.1	
COLUMN TOTAL		71	45	8	9	12	145
		49.0	31.0	5.5	6.2	8.3	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION OF

Q4 OCCUPATION BY RQ20

CONTROLLING FOR.. INT INTERSECTION TYPE VALUE = 1.00

Q4	RQ20	0	1.	2.	3.	4.	ROW TOTAL
1. SALES TEACH PROF	COUNT	73	6	9	16	17	121
	ROW PCT	60.3	5.0	7.4	13.2	14.0	48.6
	COL PCT	58.4	42.9	40.9	40.0	35.4	
	TOT PCT	29.3	2.4	3.6	6.4	6.8	
4. OTHER	COUNT	52	8	13	24	31	128
	ROW PCT	40.6	6.3	10.2	18.8	24.2	51.4
	COL PCT	41.6	57.1	59.1	60.0	64.6	
	TOT PCT	20.9	3.2	5.2	9.6	12.4	
COLUMN TOTAL		125	14	22	40	48	249
		50.2	5.6	8.8	16.1	19.3	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F
Q4 OCCUPATION BY RQ20
CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

	RQ20					
Q4	COUNT / ROW PCT / COL PCT / TOT PCT	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
1. SALES TEACH PROF	35	23	4	4	7		73
	47.9	31.5	5.5	5.5	9.6		44.5
	40.7	50.0	36.4	44.4	58.3		
	21.3	14.0	2.4	2.4	4.3		
4. OTHER	51	23	7	5	5		91
	56.0	25.3	7.7	5.5	5.5		55.5
	59.3	50.0	63.6	55.6	41.7		
	31.1	14.0	4.3	3.0	3.0		
COLUMN TOTAL	86	46	11	9	12		164
	52.4	28.0	6.7	5.5	7.3		100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE 0

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F
Q5 EDUCATION LEVEL BY RQ20
CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

Q5	RQ20	RIGHT ANGLE 0.	TURNING 1.	REAR END 2.	SIDE SWIPE 3.	4.	ROW TOTAL
< HIGH SCHOOL	1.	67	8	12	29	30	146
		45.9	5.5	8.2	19.9	20.5	58.4
		53.2	57.1	52.2	74.4	62.5	
		26.8	3.2	4.8	11.6	12.0	
>= HIGH SCHOOL	3.	59	6	11	10	18	104
		56.7	5.8	10.6	9.6	17.3	41.6
		46.8	42.9	47.8	25.6	37.5	
		23.6	2.4	4.4	4.0	7.2	
COLUMN TOTAL		126	14	23	39	48	250
		50.4	5.6	9.2	15.6	19.2	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE CUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F

Q5 EDUCATION LEVEL BY RQ20

CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

* *

	RQ20					
COUNT / ROW PCT / COL PCT / TOT PCT	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
Q5						
1. < HIGH SCHOOL	49 56.3 57.0 29.5	22 25.3 45.8 13.3	7 8.0 63.6 4.2	4 4.6 44.4 2.4	5 5.7 41.7 3.0	87 52.4
3. >= HIGH SCHOOL	37 46.8 43.0 22.3	26 32.9 54.2 15.7	4 5.1 36.4 2.4	5 6.3 55.6 3.0	7 8.9 58.3 4.2	79 47.6
COLUMN TOTAL	86 51.8	48 28.9	11 6.6	9 5.4	12 7.2	166 100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION OF
Q11 KILOMETERS DRIVEN A DAY BY RQ20
CONTROLLING FOR..
INT INTERSECTION TYPE VALUE

Q11	RQ20 COUNT / ROW PCT / COL PCT / TOT PCT	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
1. <9000 MI-YR		45	5	6	12	7	75
		60.0	6.7	8.0	16.0	9.3	29.9
		35.7	35.7	26.1	30.0	14.6	
		17.9	2.0	2.4	4.8	2.8	
2. 9001-12999		20	3	6	12	10	51
		39.2	5.9	11.8	23.5	19.6	20.3
		15.9	21.4	26.1	30.0	20.8	
		8.0	1.2	2.4	4.8	4.0	
3. >13000 MI-YR		61	6	11	16	31	125
		48.8	4.8	8.8	12.8	24.8	49.8
		48.4	42.9	47.8	40.0	64.6	
		24.3	2.4	4.4	6.4	12.4	
COLUMN TOTAL		126	14	23	40	48	251
		50.2	5.6	9.2	15.9	19.1	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F
Q11 KILOMETERS DRIVEN A DAY BY RQ20
CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

Q11	RQ20	0 RIGHT ANGLE	1. TURNING	2.	3. REAR END	4. SIDE SWIPE	ROW TOTAL
<9000 MI-YR	1.	38	20	4	4	4	70
	ROW PCT	54.3	28.6	5.7	5.7	5.7	42.2
	COL PCT	44.2	41.7	36.4	44.4	33.3	
	TOT PCT	22.9	12.0	2.4	2.4	2.4	
9001-12999	2.	18	9	2	1	4	34
	ROW PCT	52.9	26.5	5.9	2.9	11.8	20.5
	COL PCT	20.9	18.8	18.2	11.1	33.3	
	TOT PCT	10.8	5.4	1.2	.6	2.4	
>13000 MI-YR	3.	30	19	5	4	4	62
	ROW PCT	48.4	30.6	8.1	6.5	6.5	37.3
	COL PCT	34.9	39.6	45.5	44.4	33.3	
	TOT PCT	18.1	11.4	3.0	2.4	2.4	
COLUMN TOTAL		86	48	11	9	12	166
		51.8	28.9	6.6	5.4	7.2	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE CUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY RQ20
CONTROLLING FOR.. INT INTERSECTION TYPE VALUE

Q12	RQ20	0	1.	2.	3.	4.	ROW TOTAL
NONE ONE	1.	114	13	22	36	38	224
		50.9	5.8	9.8	16.1	17.4	89.6
		91.2	92.9	95.7	90.0	81.3	
		45.6	5.2	8.8	14.4	15.6	
TWO OR MORE	3.	11	1	1	4	3	26
		42.3	3.8	3.8	15.4	34.6	10.4
		8.8	7.1	4.3	10.0	18.8	
		4.4	.4	.4	1.6	3.6	
COLUMN TOTAL		125	14	23	40	48	250
		50.0	5.6	9.2	16.0	19.2	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE CUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N O F

Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY RQ20

CONTROLLING FOR..

INT INTERSECTION TYPE VALUE

* *

		RQ20					
	COUNT / ROW PCT / COL PCT / TOT PCT	RIGHT ANGLE	TURNING	REAR END	SIDE SWIPE		ROW TOTAL
		BI	1.	2.	3.	4.	
Q12							
1. NONE ONE		74	35	8	7	8	132
		56.1	26.5	6.1	5.3	6.1	79.5
		86.0	72.9	72.7	77.8	66.7	
		44.6	21.1	4.8	4.2	4.8	
3. TWO OR MORE		12	13	3	2	4	34
		35.3	38.2	8.8	5.9	11.8	20.5
		14.0	27.1	27.3	22.2	33.3	
		7.2	7.8	1.8	1.2	2.4	
COLUMN TOTAL		86	48	11	9	12	166
		51.8	28.9	6.6	5.4	7.2	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION OF

Q18 INCOME,MONTHLY,S.R. BY RQ20

CONTROLLING FOR..

INT INTERSECTION TYPE VALUE

Q18	RQ20	0. RIGHT ANGLE	1. TURNING	2. REAR END	3. SIDE SWIPE	4.	ROW TOTAL
1. LESS THAN 3000	COUNT	37	6	8	15	20	86
	ROW PCT	43.0	7.0	9.3	17.4	23.3	37.4
	COL PCT	31.1	50.0	38.1	46.9	43.5	
	TOT PCT	16.1	2.6	3.5	6.5	8.7	
2. 3000-6000	COUNT	55	3	10	13	21	102
	ROW PCT	53.9	2.9	9.8	12.7	20.6	44.3
	COL PCT	46.2	25.0	47.6	40.6	45.7	
	TOT PCT	23.9	1.3	4.3	5.7	9.1	
3. MORE THAN 6000	COUNT	27	3	3	4	5	42
	ROW PCT	64.3	7.1	7.1	9.5	11.9	18.3
	COL PCT	22.7	25.0	14.3	12.5	10.9	
	TOT PCT	11.7	1.3	1.3	1.7	2.2	
COLUMN TOTAL		119	12	21	32	46	230
		51.7	5.2	9.1	13.9	20.0	100.0

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION OF

Q18 INCOME,MONTHLY,S.R. BY RQ20

CONTROLLING FOR..

INT INTERSECTION TYPE VALUE

Q18	RQ20	0	1.	2.	3.	4.	ROW TOTAL
1. LESS THAN 3000	COUNT	44	11	5	2	2	64
	ROW PCT	68.8	17.2	7.8	3.1	3.1	44.8
	COL PCT	54.3	30.6	55.6	28.6	20.0	
	TOT PCT	30.8	7.7	3.5	1.4	1.4	
2. 3000-6000	COUNT	27	21	2	4	5	59
	ROW PCT	45.8	35.6	3.4	6.8	8.5	41.3
	COL PCT	33.3	58.3	22.2	57.1	50.0	
	TOT PCT	18.9	14.7	1.4	2.8	3.5	
3. MORE THAN 6000	COUNT	10	4	2	1	3	20
	ROW PCT	50.0	20.0	10.0	5.0	15.0	14.0
	COL PCT	12.3	11.1	22.2	14.3	30.0	
	TOT PCT	7.0	2.8	1.4	.7	2.1	
COLUMN TOTAL		81	36	9	7	10	143
		56.6	25.2	6.3	4.9	7.0	100.0

APPENDIX J

Chi-Square for Conflict Type by Intersection

J-1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T I O N

RQ20 B

RQ20	INTTYP1 1.	INTTYP1 2.	ROW TOTAL
1. RIGHT ANGLE	COUNT 9	5	14
	ROW PCT 64.3	35.7	11.2
	COL PCT 13.8	8.3	
	TOT PCT 7.2	4.0	
2. TURNING	COUNT 18	5	23
	ROW PCT 78.3	21.7	18.4
	COL PCT 27.7	8.3	
	TOT PCT 14.4	4.0	
3. REAR END	COUNT 15	25	40
	ROW PCT 37.5	62.5	32.0
	COL PCT 23.1	41.7	
	TOT PCT 12.0	20.0	
4. SIDE SWIPE	COUNT 23	25	48
	ROW PCT 47.9	52.1	38.4
	COL PCT 35.4	41.7	
	TOT PCT 18.4	20.0	
COLUMN TOTAL	65	60	125
	52.0	48.0	100.0

RAW CHI SQUARE = 10.89144 WITH 3 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 5

Signalized Intersections

J-2

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A

RQ20

* *

RQ20	INTTYP1 3.	4.	ROW TOTAL
1. RIGHT ANGLE	18	30	48
	37.5	62.5	60.0
	52.9	65.2	
	22.5	37.5	
2. TURNING	5	6	11
	45.5	54.5	13.7
	14.7	13.0	
	6.3	7.5	
3. REAR END	5	4	9
	55.6	44.4	11.2
	14.7	8.7	
	6.3	5.0	
4. SIDE SWIPE	6	6	12
	50.0	50.0	15.0
	17.6	13.0	
	7.5	7.5	
COLUMN TOTAL	34	46	80
	42.5	57.5	100.0

RAW CHI SQUARE = 1.43429 WITH 3 DEGREES OF FREEDOM.

Unsignalized Intersections

APPENDIX K

Chi-Square Test for Conflict Type vs. Sample 1 For Each Driver Characteristic

K-1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULATION *

Q1 AGE BY

		ROW RIGHT ANGLE 0.	ROW RIGHT ANGLE 1.	ROW TOTAL
Q1				
1. <=25 >=46	COUNT	49	7	56
	ROW PCT	87.5	12.5	40.0
	COL PCT	38.9	50.0	
	TOT PCT	35.0	5.0	
3. 26-45	COUNT	77	7	84
	ROW PCT	91.7	8.3	60.0
	COL PCT	61.1	50.0	
	TOT PCT	55.0	5.0	
COLUMN TOTAL		126	14	140
		90.0	10.0	100.0

CORRECTED CHI SQUARE = .26756 WITH 1 DEGREE OF FREEDOM.

RAW CHI SQUARE = .64815 WITH 1 DEGREE OF FREEDOM.

K-2

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q2 NATIONALITY BY
* *

		RQ20		
	COUNT / ROW PCT / COL PCT / TOT PCT	RIGHT ANGLE 0.	RIGHT ANGLE 1.	ROW TOTAL
Q2				
SAUDI	1.	138	41	179
		77.1	22.9	79.2
		82.1	70.7	
		61.1	18.1	
MIDDLE EASTERN	3.	30	17	47
		63.8	36.2	20.8
		17.9	29.3	
		13.3	7.5	
	COLUMN TOTAL	168	58	226
		74.3	25.7	100.0

CORRECTED CHI SQUARE = 2.77346 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 3.43359 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 48

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY
* *

		RQ20		
	COUNT / ROW PCT / COL PCT / TOT PCT	RIGHT ANGLE 0	RIGHT ANGLE 1.	ROW TOTAL
Q12				
1. NONE ONE		188	48	236
		79.7	20.3	86.4
		89.1	77.4	
		68.9	17.6	
3. TWO OR MORE		23	14	37
		62.2	37.8	13.6
		10.9	22.6	
		8.4	5.1	
COLUMN TOTAL		211	62	273
		77.3	22.7	100.0

CORRECTED CHI SQUARE = 4.62744 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 5.57984 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A

Q18 INCOME,MONTHLY,S.R.

* *

Q18	Q23 RIGHT ANGLE 0	Q23 RIGHT ANGLE 1.	ROW TOTAL
1. LESS THAN 3000	COUNT 44 ROW PCT 80.0 COL PCT 64.3 TOT PCT 37.6	11 20.0 30.6 9.4	55 47.0
2. 3000-6000	COUNT 27 ROW PCT 56.3 COL PCT 39.3 TOT PCT 23.1	21 43.8 58.3 17.9	48 41.0
3. MORE THAN 6000	COUNT 10 ROW PCT 71.4 COL PCT 14.3 TOT PCT 8.5	4 28.6 11.1 3.4	14 12.0
COLUMN TOTAL	81 69.2	36 30.8	117 100.0

RAW CHI SQUARE = 6.82307 WITH 2 DEGREES OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 17

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* CROSSTABULAT
Q1 AGE BY
* *

Q1		R020 TURNING 1.	2.	ROW TOTAL
<=25 >=46	1.	49	15	64
		76.6	23.4	43.0
		38.9	65.2	
		32.9	10.1	
26-45	3.	77	8	85
		90.6	9.4	57.0
		61.1	34.8	
		51.7	5.4	
COLUMN TOTAL		126	23	149
		84.6	15.4	100.0

CORRECTED CHI SQUARE = 4.48919 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 5.50222 WITH 1 DEGREE OF FREEDOM.

K-6

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* * * * * * * * * * * * * * * * * * C R O S S T A B U L A T
Q4 OCCUPATION BY
* *

Q4	COUNT / ROW PCT / COL PCT / TOT PCT	R020 0.	REAR END 3.	ROW TOTAL
SALES TEACH PROF	1.	73 82.0 58.4 44.2	16 18.0 40.0 9.7	89 53.9
OTHER	4.	52 68.4 41.6 31.5	24 31.6 60.0 14.5	76 46.1
	COLUMN TOTAL	125 75.8	40 24.2	165 100.0

CORRECTED CHI SQUARE = 3.42206 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 4.12539 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/83)

* CROSSTABULAT
05 EDUCATION LEVEL BY
* *

05	ROW	REAR END 1.	REAR END 3.	ROW TOTAL
< HIGH SCHOOL	1.	67	29	96
		69.8	30.2	58.2
		53.2	74.4	
		40.6	17.6	
>= HIGH SCHOOL	3.	59	10	69
		85.5	14.5	41.8
		46.8	25.6	
		35.8	6.1	
COLUMN TOTAL		126	39	165
		76.4	23.6	100.0

CORRECTED CHI SQUARE = 4.65707 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 5.49326 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/92)

* C R O S S T A B U L A T

Q5 EDUCATION LEVEL BY

* *

Q5	RQ20 REAR END 0	RQ20 REAR END 3.	ROW TOTAL
< HIGH SCHOOL 1.	COUNT 116	33	149
	ROW PCT 77.9	22.1	57.3
	COL PCT 54.7	68.8	
	TOT PCT 44.6	12.7	
>= HIGH SCHOOL 3.	COUNT 96	15	111
	ROW PCT 86.5	13.5	42.7
	COL PCT 45.3	31.3	
	TOT PCT 36.9	5.8	
COLUMN TOTAL	212	48	260
	81.5	18.5	100.0

CORRECTED CHI SQUARE = 2.60277 WITH 1 DEGREE OF FREEDOM.

RAW CHI SQUARE = 3.15024 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q4 OCCUPATION BY
* *

		ROW		
	COUNT / ROW PCT / COL PCT / TOT PCT	SIDE SWI PE 0	SIDE SWI PE 4.	ROW TOTAL
Q4	1. SALES TEACH PROF	73 91.1 58.4 42.2	17 18.9 35.4 9.8	90 52.0
	4. OTHER	52 62.7 41.6 30.1	31 37.3 64.6 17.9	83 48.0
	COLUMN TOTAL	125 72.3	48 27.7	173 100.0

CORRECTED CHI SQUARE = 6.44815 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 7.34011 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A T
Q12 NUMBER OF ACCIDENTS LAST TWO YEARS BY
* *

		RG20 SIDE SWIPE 0	RG20 SIDE SWIPE 4.	ROW TOTAL
Q12				
1. NONE ONE	COUNT	188	47	235
	ROW PCT	80.0	20.0	86.7
	COL PCT	89.1	78.3	
	TOT PCT	69.4	17.3	
3. TWO OR MORE	COUNT	23	13	36
	ROW PCT	63.9	36.1	13.3
	COL PCT	10.9	21.7	
	TOT PCT	8.5	4.8	
COLUMN TOTAL		211	60	271
		77.9	22.1	100.0

CORRECTED CHI SQUARE = 3.81249 WITH 1 DEGREE OF FREEDOM.
RAW CHI SQUARE = 4.70064 WITH 1 DEGREE OF FREEDOM.

NUMBER OF MISSING OBSERVATIONS = 1

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE QUEST (CREATION DATE = 03/15/82)

* C R O S S T A B U L A

Q11 KILOMETERS DRIVEN A DAY

* *

		RQ20		
	COUNT / ROW PCT / COL PCT / TOT PCT	0	4.	ROW TOTAL
Q11				
	1.	83	11	94
<9000 MI-YR		88.3	11.7	34.6
		39.2	18.3	
		30.5	4.0	
	2.	38	14	52
9001-12999		73.1	26.9	19.1
		17.9	23.3	
		14.0	5.1	
	3.	91	35	126
>13000 MI-YR		72.2	27.8	46.3
		42.9	58.3	
		33.5	12.9	
	COLUMN TOTAL	212	60	272
		77.9	22.1	100.0

RAW CHI SQUARE = 8.97692 WITH 2 DEGREES OF FREEDOM.

GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE

FILE GUEST (CREATION DATE = 03/15/82)

* C R O S S T A b U L A T
Q11 KILOMETERS DRIVEN A DAY
* *

Q11	COUNT / ROW PCT / COL PCT / TOT PCT	Q20 SIDE SWIPE 0.	Q20 SIDE SWIPE 4.	ROW TOTAL
<9000 MI-YR	1.	45	7	52
		86.5	13.5	29.9
		35.7	14.6	
		25.9	4.0	
9001-12999	2.	20	10	30
		66.7	33.3	17.2
		15.9	20.8	
		11.5	5.7	
>13000 MI-YR	3.	61	31	92
		66.3	33.7	52.9
		48.4	64.6	
		35.1	17.8	
COLUMN TOTAL		126	48	174
		72.4	27.6	100.0

RAW CHI SQUARE = 7.40838 WITH 2 DEGREES OF FREEDOM.

APPENDIX L

THE MODEL

VARIABLE(S) ENTERED ON STEP NUMBER 2.. Q1R1

MULTIPLE R	.71280	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANCE
R SQUARE	.50809	REGRESSION	2.	57151.70963	28575.85431	1.54934	.345
ADJUSTED R SQUARE	.18015	RESIDUAL	3.	55331.53050	18443.84350		
STD DEVIATION	135.80911	COEFF OF VARIABILITY	52.5 PCT				

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY
Q1P2	-218.81945	175.91188	1.5473249 .302	-.5079153 -.87197
Q1R1	-61.692369	57.259539	1.1608262 .360	-.4328449 -.33466
(CONSTANT)	570.70399	196.71311	8.4169590 .062	

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	PARTIAL	TOLERANCE	F SIGNIFICANCE
Q1R3	-.39220	.29694	.34212940 .618

REGRESSION
FILE NONAME (CREATION DATE = 04/13/82)

* M U L T I P L E R E G R E S S I O N *

DEPENDENT VARIABLE.. RATE

MEAN RESPONSE 258.63123 STD. DEV. 149.98883

VARIABLE(S) ENTERED ON STEP NUMBER 1.. Q1R2

MULTIPLE R	.56369	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F SIGNIFICANCE
R SQUARE	.31775	REGRESSION	1.	35741.61150	35741.61150	1.86296 .244
ADJUSTED R SQUARE	.14719	RESIDUAL	4.	76741.62764	19185.40691	
STD DEVIATION	138.51140	COEFF OF VARIABILITY	53.6 PCT			

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY
				-.5636937
Q1R2	-242.89763	177.95972	1.8629592 .244	-.96792
(CONSTANT)	508.96656	131.92816	7.3323528 .057	

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	PARTIAL	TOLERANCE	F SIGNIFICANCE
Q1R1	-.52819	.98396	1.1608262 .360
Q1R3	.11249	.53805	.38448960E-01 .857

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GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE                    04/13/82    SPSS V8.0    .13.27.33.    PAGE   5
REGRESSION
FILE   NONAME   (CREATION DATE =  04/13/82 )

* * * * * * * * * * * * * * * * * * * * * * *  M U L T I P L E   R E G R E S S I O N  * * * * * * * * * * * * * * * * * * * * * * *

DEPENDENT VARIABLE..    RATE

VARIABLE(S) ENTERED ON STEP NUMBER   3..   Q1R3

MULTIPLE R            .76154     ANALYSIS OF VARIANCE    DF     SUM OF SQUARES     MEAN SQUARE         F     SIGNIFICANCE
R SQUARE              .57995     REGRESSION              3.       65234.32919     21744.77640     .92044           .558
ADJUSTED R SQUARE          0     RESIDUAL                2.       47248.90994     23624.45497
STD DEVIATION      153.70249     COEFF OF VARIABILITY    59.4 PCT

-------------------- VARIABLES IN THE EQUATION --------------------    ---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE           B          STD ERROR B         F             BETA         VARIABLE     PARTIAL    TOLERANCE        F
                                            ------------   -----------                                        ------------
                                            SIGNIFICANCE   ELASTICITY                                         SIGNIFICANCE

Q1R2          -349.55882      299.32756     1.3637888      -.8112228
                                                 .363       -1.39296
Q1R1          -95.848847      87.232980     1.2072921      -.6833671
                                                 .386        -.51994
Q1R3          -149.28741      255.22780     .34212940      -.4919240
                                                 .618        -.56443
(CONSTANT)     925.20914      645.67312     2.0533095
                                                 .288

ALL VARIABLES ARE IN THE EQUATION.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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GHANI DRIVER CHARACTERISTICS QUESTIONNAIRE 04/13/82 SPSS V8.0 .13
REGRESSION
FILE NONAME (CREATION DATE = 04/13/82)

* MULTIPLE REGRESSION * * * * * * * * *

DEPENDENT VARIABLE.. RATE

SUMMARY TABLE

STEP	VARIABLE ENTERED	VARIABLE REMOVED	F TO ENTER OR REMOVE	SIGNIFICANCE	MULTIPLE R	R SQUARE	R SQUARE CHANGE	SIMPLE R	OVERALL F	SIGNIFICANCE
1	Q1R2		1.86296	.244	.56369	.31775	.31775	-.56369	1.86296	.244
2	Q1R1		1.16093	.363	.71280	.50809	.19034	-.50436	1.54934	.345
3	Q1R3		.34213	.618	.76154	.57995	.07186	.45128	.92044	.558