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ABSTRACT

DEVELOPMENT OF A TRAFFIC SAFETY INDEX FOR URBAN INTERSECTIONS

by
Jae-Hong Kang

Conventional safety analysis focuses on the accident environment at specific locations or a limited segment of highways or arterials, and attempts to identify the effects of accident contributing factors. The development of a safety index in the past was based on a statistical summary for county or statewide areas, using general indicators such as population, number of registered vehicles, vehicle miles traveled and so on. This research effort presents a state-of-the-art procedural analytical approach for the safety analysis of Manhattan intersections that are exposed to a unique urban environment. The computed index provides safety ratings that can identify potential safety problems for Manhattan intersections, on the basis of accident frequency and severity. The analytical models correlate city or borough-wide averages with an individual intersection. A user-friendly software program is developed to compute a safety index rating to evaluate the relative hazardousness of city intersections. The computer program consists of a database module and an analysis module. The analysis module identifies locations with safety problems based on a composite factor which includes accident severity and accident frequency.

DEVELOPMENT OF A TRAFFIC SAFETY INDEX FOR URBAN INTERSECTIONS

by
Jae-Hong Kang

A Dissertation
Submitted to the Faculty of
New Jersey Institute of Technology
in Partial Fulfillment of the Requirement for the Degree of
Doctor of Philosophy

Interdisciplinary Program in
Transportation

May 1996

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This dissertation is dedicated to
my mother

ACKNOWLEDGMENT

This research effort has been funded through the State of New York Governor's Traffic Safety Committee by a 402 Federal Highway Safety Grant.

The author wishes to express his sincere appreciation to his supervisors, Dr. Athanassios K. Bladikas and Dr. Louis J. Pignataro, for their guidance, help, and moral support throughout this research.

Special thanks to Dr. Lazar N. Spasovic, Mr. Joel Friedman, P.E., and Dr. Kyriacos C. Mouskos for serving as members of the committee.

The author is grateful to Mr. Michael Graham for providing an innovative tool for data collection and processing. Special gratitude is owed to Mr. Seung-Won Chung for his active part in data reduction and computer programming. Additional thanks go to Mrs. Claudia Joseph and Mr. David Winters who helped with the final reproduction.

And finally, much thanks to Mr. Jack Knoll of the New York State Department of Transportation's Traffic Engineering and Safety for his help.

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GLOSSARY

DOT
Department of Transportation

FARS
Fatal Accident Reporting System

VMT
Vehicle Miles Traveled

NYCDOT
New York City Department of Transportation

CASIUS
Computer-Aided Safety Index for Urban Streets

PDO
Property Damage Only

LSD
Logarithmic Series Distribution

AHI
Accident Hazard Index

PAI
Population Average Index

VAI
Vehicles Average Index

MAI
Mileage Average Index

IEI
Improvement Emphasis Index

TCT
Traffic Conflicts Technique

CSI
Corridor Safety Index

GLOSSARY
(Continued)

MEV
Million Entering Vehicles

AAA
American Automobile Association

PV
Pedestrian-Vehicle

PHI
Pedestrian Hazard Index

NSC
National Safety Council

NHTSA
National Highway Traffic Safety Administration

MAIS
Maximum Abbreviated Injury Scale

WTP
Willingness To Pay

NCSS
National Crash Severity Study

NASS
National Accident Sampling System

HC
Human Capital

FHWA
Federal Highway Administration

NYSDOT
New York State Department of Transportation

CLASS
Centralized Local Accident Surveillance System

GLOSSARY
(Continued)

TVV
Total Vehicle Volume

SCV
Sum of Critical Volume

CVV
Critical Vehicle Volume

EPDO
Equivalent Property Damage Only

DMV
Department of Motor Vehicles

HISAM
Highway Safety Analysis and Monitoring

CHAPTER I

INTRODUCTION

1.1 Historical Perspective

The history of traffic safety shares its origins with the automobiles. The nineteenth century witnessed the development of various types of transportation modes. Early in the century, comparatively slow-moving automobiles appeared with characteristics similar to those of horse-drawn carriages competing with each other on narrow streets in the industrialized urban environment. As automobiles started playing a major role in the transportation field, the roadway system was expanded and brought under mechanical traffic signal control to improve traffic safety and roadway efficiency. Accidents are an unwanted by-product of the automobile, shadowing its many conveniences. Since the advent of the automobile age, traffic accidents have become more frequent and severe. Speeding vehicles and the construction of a highway system since the days of urban sprawl in the 1960's resulted in a tremendous societal cost in terms of personal loss and property damage. After the oil embargo in the 1970's, there was a trend to reduce the average size of private motor vehicles to conserve energy and reduce air pollution. Although the argument of whether the smaller vehicles are less safe than larger ones has not been clearly settled, it is true that the size of commercial vehicles has been increasing as trucks try to compete with the railroads and become more efficient.

According to the U.S. Department of Transportation's (DOT) Fatal Accident Reporting System (FARS), 54,724 motor vehicles were involved in 36,895 fatal crashes in

1991, resulting in 41,462 deaths. Of these, 75 percent involved drivers or occupants of vehicles, and 14 percent involved pedestrians. Nationally, traffic fatalities have been declining since 1988. The fatality rate per 100 million Vehicle Miles Traveled (VMT) for 1991 was estimated at 1.9, the lowest in U. S. history, and 42 percent lower than that of 1980. This positive change is more encouraging if one considers the continuing growth of registered vehicles and licensed drivers. More vehicle crashes occur in urban than rural areas, but more motor vehicle deaths occur on rural than on urban roads (Institute for Highway Safety, 1992).

In 1991, 1,807 fatal accidents were reported out of 274,875 total accidents in New York State. In New York City during the same period, 546 fatal accidents were reported out of 105,266 accidents, accounting for 38 percent of the total State fatalities (New York State Department of Motor Vehicles, 1991). For the same year, the New York City Department of Transportation's (NYCDOT) fatality database shows 609 deaths out of 574 fatal crashes.

1.2 Problem Identification

Currently, locations perceived as dangerous in New York City are submitted for study by community, political and civic groups, and the mass media. Many traffic engineers and decision-makers in local government use the number of traffic fatals, or severe injuries, as the sole barometer with which to compare the safety performance of specific segments of limited access highways, arterials, and local streets. This type of approach may result in subjective or misleading conclusions because the sample size per location is generally too small to draw effective conclusions.

From the area-wide perspective, however, most municipalities would have difficulty in obtaining and processing an accident database which includes all types of incidents, information on geometric characteristics and traffic parameters, and the other numerous factors contributing to traffic incidents in the subject area. New York City, for example, has approximately 38,000 intersections. The signalized intersections in most urbanized areas are exposed to generally higher vehicular and pedestrian traffic.

1.3 Purpose and Objective

Accident statistics are very important in traffic safety. They allow identification of locations for potential improvements in the areas of engineering countermeasures, public education, and enforcement. Reliable databases and complete analyses allow for a more effective allocation of limited resources. A comprehensive safety index which reflects the traffic elements and contributing factors to accidents in a study area can be used as a toolbox to implement countermeasures, as well as a planning tool for improving unsafe locations.

The approach taken in this dissertation is unique because it develops an area-wide safety index for an urban municipality. The City of New York is the biggest city in the United States, and the Borough of Manhattan, as one of the most congested urban cores in the country, has been selected for the case study. The island of Manhattan represented New York City, until the City annexed its peripheral districts during the Great Congregation in 1898. At present, 1.5 million people are estimated to reside on the 15,170 acres of the island. About 73 percent of the 3,695 intersections in Manhattan are signalized and one-third of the total citywide pedestrian accidents take place in Manhattan.

The primary objective is to develop a methodology to identify urban intersections with accident rates significantly higher than the areawide average for locations with similar traffic environments. Using this type of study will allow traffic engineers of different municipalities to: 1) prioritize safety problems by location, and 2) cope with community and political pressures in a productive way. Other by-products of this effort include a simple reference guide of accident frequency and severity by intersection and designation of target locations for safety planning, a user-friendly software program called CASIUS (Computer-Aided Safety Index for Urban Streets), an increase of the public's awareness about traffic safety, and the transferability of the methodology to other cities in the United States.

In the past, conventional safety analysis focused on the accident environment at specific locations or limited segments of arterials. For limited-access highways, accident rates were simply calculated using more general and static accident surrogates, such as vehicle-miles-traveled (VMT). For county/statewide areas, safety indices are usually based on some aggregate statistic, e.g., population, registrations, mileage, etc.

This dissertation evaluates Manhattan intersections that are exposed to the uniqueness of the urban environment, and the intersection variables reviewed are correlated with the summary for all Manhattan accidents. The developed index can provide its end-users with safety ratings for Manhattan intersections, in terms of accident frequency and severity. Furthermore, candidate intersections for further investigation of potential safety problems can be rated on a scale from 0 to 10.

CHAPTER II

LITERATURE REVIEW

2.1 Objective of Literature Review

The literature review presented here covers the three major areas of safety evaluation methods, pedestrian safety, and accident cost.

The safety evaluation method section covers comprehensive studies measuring safety performance, including an existing safety index study using less comprehensive accident parameters than those included in this dissertation. The key words used to search this area were: (intersections) accidents, traffic/hazards/near miss/accident, incident/safety management/urban accidents, traffic/accident rates/accident traffic, guidelines/accidents, traffic prevention/accidents traffic risks.

Pedestrians play a vital role in traffic accidents in urban areas because pedestrian fatalities are predominantly an urban problem. In 1990, pedestrian-involved injury/fatal accidents comprised about 17 percent of total police-reported accidents in New York City. The key words used to search this areas were: (pedestrian) accident/characteristics/counter measures/safety program/programs/protection.

Accident cost and economic analysis review can be used to develop a multiplication factor which can be used to convert fatal and injury accidents to equivalent property damage only (PDO) accidents. The key words used to search this area were (traffic) accident cost.

The literature search for each area was conducted manually and through a National Safety Council (NSC) library database search of pertinent highway safety related literature published from 1965 to the present. The primary findings of the literature review are discussed below.

2.2 Safety Evaluation Methods

Khisty (1990) listed the following seven procedures, which vary in complexity and data needs, and can be used to identify hazardous spots, sections, and elements based on accident, traffic, and highway data.

- frequency method
- accident rate method
- frequency-rate method
- rate quality control method
- accident severity method
- hazard index method
- hazardous roadway features inventory

2.2.1 Frequency Method

The frequency method is used to identify and rank locations on the basis of the number of accidents. Andreassen and Hoque (1992) conducted a study to examine the distribution of "collisions between vehicles from adjacent approaches" accidents per intersection for a six year period (1973-1978) in Metropolitan Melbourne, Australia.

The study concluded that the use of aggregated accident data was inappropriate, since countermeasures usually do not have the same input on different accident types. Some accident types may be increased while others may be decreased by a countermeasure, and the distribution of the frequencies of the various accident types should be studied separately rather than by looking only at the distribution of the aggregated accidents. The negative binomial distribution did not fit the data well; however, the study indicated that a logarithmic series distribution (LSD) was found to adequately describe the observed data of intersection frequencies for the network as a whole, for the four functional road classes and for the subdivision of intersections within each road class.

2.2.2 Accident Rate Method

The accident rate method combines accident frequency with vehicle exposure. California's Office of Traffic Safety introduced an accident rate concept in 1976 based on the number of fatal and injury accidents per 1,000 population. California's accident rate method has the disadvantage of not considering other factors such as the number of registered vehicles, mileage of paved highways, and vehicle-miles traveled.

Lalani and Walker (1981) developed a correlation between accident frequency and average daily volume in 1981 for signalized intersections and urban arterial street segments. No correlation was found between accidents and volume at unsignalized intersections. Jadaan and Nicholson (1983) conducted a statistical analysis in 1983 of data relating to accidents, traffic flows and road type in the vicinity of the Christchurch Southern Arterial in New Zealand. Their study indicates that the analysis of accident, traffic volume, roadway and land-use data for urban road links resulted in statistically significant relationships between the number of accidents and amount of travel, for certain combinations of roadway and land-use types. Nicholson (1985) also analyzed accident data for Auckland intersections in New Zealand, and found a considerable variation which was inconsistent with the "Poisson assumption".

2.2.3 Frequency-Rate Method

Shen (1982) developed a general index to measure highway safety performance in South Carolina. An Accident Hazard Index (AHI) was used to identify counties with serious highway safety problems through comparison of county accident rate indices based on Population (PAI), Registered Vehicles (VAI) and Paved Highway Mileage (MAI).

$$\text{AHI} = \frac{(\text{PAI} + \text{VAI} + \text{MAI})}{3} \tag{2.1}$$

The Improvement Emphasis Index (IEI) supplements the AHI by incorporating more information about accidents, therefore enabling it to pinpoint the specific problem areas that were responsible for poor safety performance. Speed, pedestrian, youthful driver, alcohol, truck, driver violation, school bus, roadway and roadside hazards, passenger car, motorcycle, and bicycle accident involvements were selected as the 11 parameters to use in constructing the IEI.

2.2.4 Kansas City Study

Bhesania (1991) summarized the accident statistics and characteristics observed in Kansas City in 1991. Signalized locations experienced the largest number of accidents when compared with other forms of traffic control. The average number of accidents per year occurring at signalized intersections was 9.6 compared with an average of about 2 per year at stop-sign or yield-sign controlled locations. Intersections without any control experienced only 1.3 accidents per year. However, uncontrolled intersections normally carry very small volumes of traffic.

The study also revealed that the most frequent type of collision at all intersections was the right-angle accident (43%) followed by the rear-end (24%) and the left-turn (14%) accident. Stop-sign-controlled intersections experienced a larger percentage of right-angle accidents and a smaller percentage of rear-end accidents when compared with intersections controlled by signals. The Kansas City intersections controlled by yield signs experienced the largest percentage of right-angle accidents. A cross-classification of accident severity and traffic control indicates that accident severity is not influenced by the type of traffic control. Injuries are found to be least likely in rear-end and side-swipe collisions. The probability of being injured in these types of accidents is at least 50 percent less than in right-angle or left-turn accidents.

The most frequent type of midblock accident in Kansas City was the rear-end type (25.9%), followed by side-swipe (18.6%) and accidents involving parked cars (17.9%). Pedestrian accidents make up 2 percent of the total collisions. The largest number of pedestrian accidents occurred in the 3 p.m. to 6 p.m. period. Children 5 to 11 years old were involved in 20 percent of the collisions.

2.2.5 Hazardous Roadway Features Inventory

Blakstad (1989) conducted two studies of accident rates in 1976-77 and 1989 on Norwegian road sections and junctions. The studies show that main roads with a high design standard have lower accident rates than collector roads and much lower rates than access roads; accident rates in suburban areas are lower than in urban areas (i.e. city centers); 3-way intersections perform far better than 4-ways; round-abouts are the best type of junction from a traffic safety point of view; low speed limits and pedestrian facilities have a positive effect on road safety, but they can not remove the impact of poor road and environmental standards.

Poppe (1988) conducted research at 1,643 intersections in 19 different cities in the Netherlands comparing accident history with intersection geometry, traffic volume, and the priority control at the intersection. Poppe's study concludes that intersections in built-up areas cannot be categorized into groups on the basis of intersection geometry or traffic volume. In addition, the accidents happening in those intersections display a great variation on vehicle type and maneuvers, among other factors.

2.2.6 Traffic Conflicts Technique (TCT)

Glauz et al (1985) established relationships between traffic conflicts and accidents at 46 signalized and unsignalized intersections in Kansas City in 1982. The study concludes that accident/conflict ratios can be applied to comparable intersections to obtain an expected accident rate of a specific type.

$$A_0 = C_0R \tag{2.2}$$

$$\mathrm{Var}(A_0) = \mathrm{Var}(C)\mathrm{Var}(R) + C_0^2\mathrm{Var}(R) + R^2\mathrm{Var}(C) \tag{2.3}$$

where:

A_0 = expected number of accidents,

C_0 = expected conflict rate obtained from the field study at the intersection,

R = estimate of the accident/conflict ratio for that class of intersections

Traffic conflicts of certain types were found to be good surrogates of accidents, and the TCT study is helpful especially when there is insufficient accident data to produce an estimate.

Brown (1981) studied the feasibility of predicting the accident potential at an intersection by the application of a model based on accident occurrences at individual conflict points within a four-legged intersection with two-way flow on each leg and controlled by traffic signals. Unlike prior studies of its kind, the study was to assess and predict the effect on safety performance of proposed road changes both from the point of view of the type of intersection and the volume and pattern of traffic movements at that intersection.

2.2.7 Accident Severity Method

Accident severities are classified by the National Safety Council and many states, within the following categories: (Khisty, 1990)

Fatal accident: one or more deaths (F)
A-type injury: incapacitating accident (A)
B-type injury: nonincapacitating accident (B)
C-type injury: probable injury (C)
PDO: property damage only (PDO)

Locations are ranked based on their computed EPDO (equivalent property damage only) number.

$$\text{EPDO} = 9.5(F + A) + 3.5(B + C) + \text{PDO} \qquad (2.4)$$

Funawatashi (1987) supplemented the conventional accident rate method by separating injury/fatal accidents from the total accident rate. Total accident rate 'R_t' is total accident frequency divided by standard variables such as hourly volume (V).

$$R_t = \frac{A_t}{V} = \frac{A_i + A_p}{V} \tag{2.5}$$

Where 'A_i' is injury accidents, 'A_p' is property damage only, and 'A_t' indicates total accident frequency.

The proposed simple index contrasts PDO type accidents with injury type accidents.

$$I = \frac{A_p}{A_i} \tag{2.6}$$

2.2.8 Hazard Index Method

Taylor and Thomson, (1977) totaled partial hazard indices to obtain a hazard index for a particular location. Hazard factors from the raw data can be converted to an indicator value, and then multiplied by a weighing factor. Funawatashi (1987) developed an intersection safety analysis based on roadway width. Supposedly, the size of entering vehicles to the intersection has a close relationship with the number of accidents. Likewise the width of the intersection can be used as a replica of traffic volume and of expected accident frequency. However, the district with more arterials and larger roadway widths (W1 + W3) had a lower accident rate.

Chang (1982) presented an overview of exposure measures for evaluating safety at signalized intersections and comparing unsignalized with signalized intersections. He suggested that the number of accidents is the square of the exposure measure that prevails in the highway-traffic-environment system. Unsignalized intersections and signalized intersections present different risks for different accident types. Holland (1967) added overall conflict zones within a four-leg intersection and derived the basic equation below for a range of volumes and turning flows.

$$E = KV_1^a V_2^b \tag{2.7}$$

where:

E = accident exposure per time unit,

V1, V2 = hourly aggregate major and minor traffic volume, and

K, a, b, = constants.

Chang assumed that different conflicting maneuvers have different accident risks. For example, crossing maneuvers at intersections may have a greater accident risk than other conflicting maneuvers and can be included in the equation in a product form while others may be included in summation form. At signalized intersections, the magnitude of accident risk depends not only on conflicting traffic volumes but also on site parameters such as signal phases, cycle length, splits, lens size, signal mountings, and the types of signal actuation. Many factors were recommended to be incorporated to distinguish varying accident experiences at signalized intersections.

Terhune and Parker (1986) tested isolated horizontal curves and unsignalized intersections on 2-lane New York state highways. Curve equations were developed from western New York.

Total accidents per 10^6 vehicles

$$= [0.15 + 0.000026 \text{ (degree of curvature x AADT)}]^2 \tag{2.8}$$

Among the surrogate variables, the degree of curvature and traffic volume were found to be the best curves, while major and minor road traffic volume, minor road average stopped delay, and percent left turns were the best predictor variables for intersections. The maximum variance in accident rates accounted for was 31 percent.

2.2.9 New York's Rate Quality Control Method

Recently, the New York State Department of Transportation (1991) formulated a corridor safety index to identify 31 limited access corridors within New York City with higher than statewide average accident rates for highway facilities.

$$\text{Accident Rate} = \frac{\text{\# of Corridor Accidents}}{\text{Cor. Length(Miles)} \times \text{AADT} \times 365} \times 10^6 \qquad (2.9)$$

The calculated accident rate for each corridor was compared to the Statewide accident rate for similar roadways. The Corridor Safety Index (CSI) was computed.

$$\text{CSI} = \frac{\text{Accident Rate}}{\text{State Accident Rate}} - 1 + 0.25 \times \frac{\text{AADT}}{100{,}000} \qquad (2.10)$$

For intersections, New York State DOT uses Mean Rate Book for intersections where volume data exist. There are 40 different intersection classes by intersection type, intersection control, and the existence of a left turn bay. Calculated mean rate includes all accidents per million entering vehicles (MEV), pedestrian accidents per intersection, and non-pedestrian accidents per intersection. However, this study covers intersections adjacent to state highways that are not in NYSDOT's region 11 (New York City area).

2.2.10 Summary

It is evident from this literature review that there have been numerous studies done based on regional traffic safety indices and on safety evaluation methods for locations. However, there have been few studies found that analyze the urban traffic environment and evaluate traffic safety in the core area of a city. Hence, the purpose of this study is to investigate contributing factors to traffic conflicts in the Manhattan area and eventually to create a comprehensive safety index to reflect New York City intersections.

2.3 Pedestrian Safety

The problem of pedestrian accidents is primarily an urban one, with approximately 83 percent of all pedestrian accidents and 74 percent of all pedestrian fatalities in the United States in 1985 occurring in urban areas (Lalani, 1992). In New York City, on the average 314 pedestrians were killed and 14,781 injured by automobiles annually during the three year period of 1989-1991. Over the past decade, pedestrian deaths comprised more than 50 percent of all traffic-related fatalities in New York City. Twenty nine percent of the citywide total pedestrian accidents took place in Manhattan, although Manhattan's population accounts for only 20 percent of the City's total population. The higher percentage of pedestrian accidents might be explained by the population and employment density of the area.

2.3.1 Pedestrian Characteristics

Pedestrian actions are less predictable and controllable than those of drivers. Pedestrians are vulnerable in a collision with a motor vehicle because of the vehicle's greater mass and higher speed. In terms of age, pedestrian accidents are most over-represented among the young and older adult pedestrians. Based on accident data from more than 1,900 cities, the American Automobile Association (AAA) found that children between the ages of 2 and 14 (particularly ages 5 and 6) were over-represented in pedestrian-accident involvement based on their population. Numerous studies (Pfefer et al, 1982, NYCDOT, 1992) have found that persons older than 55 years of age are also over-represented in pedestrian fatalities for the most part because of the greater accident severity to pedestrians in that older age group.

Drinking contributes to pedestrian accidents. Two percent of the total pedestrian accidents in Manhattan (or Statewide) during 1990 were alcohol related. For the same year in New York City, alcohol and other drugs were detected in thirty two percent of pedestrian fatals. The intoxicated pedestrian represents just as great a hazard to himself as to others. Another significant factor relating to pedestrian safety would be pedestrian traffic law violations.

2.3.2 Pedestrian Fatals in Virginia

Worthington (1991) examined 216 accident reports of fatal pedestrian crashes occurring in an urban area of Virginia during 1985-1987. The study sponsored by Virginia DOT concluded that negligent pedestrian behavior contributed to urban pedestrian fatalities more than factors related to driver behavior, the roadway and environment at the crash site, or the vehicle itself. Alcohol use by the pedestrian was also found to be a major factor.

Similar to most research in this type, high-risk periods are reported to be the end of the week and weekends, late afternoon to late evening, and darkness. Elderly pedestrians have greater difficulty negotiating complex situations and are more likely than younger persons to be fatally injured when struck by a vehicle.

2.3.3 Pedestrian Accidents in the Montreal CBD

Seneviratne and Shuster (1989) reviewed pedestrian accidents in the Montreal Central Business District between 1985 and 1987. Over 40 percent of the accidents occurred during the 12-6 PM period and 80 percent of the accidents within commercial land use areas.

Accidents were classified into four general types according to the direction of travel of the vehicle. These included a)"direct hits," or conflicts that occurred when a pedestrian crossing a street was hit by a vehicle moving straight through; b)"left-turn hits", c)"right-turn hits," and d)"reverse hits," or vehicles backing up from parking spots and driveways. "Direct hits" by a vehicle moving straight through are the major direction of vehicular movements (70%) compared to the portion of accidents that occurred while a vehicle was turning. The study also hypothesized that intersections with pedestrian signals are more hazardous than those without them, considering the ratio of the number of accidents to the number of sites in each category.

2.3.4 Urban and Rural Environments

Mueller et al (1988) compared the pedestrian-vehicle collision injury and fatality rates for urban and rural areas of Washington State from 1981 through 1983. According to their study, rates of `injuries' are higher in urban areas, even though the pedestrian `fatality' rate in rural areas is higher for nearly all age groups, and at all posted speeds. Faster posted vehicle speeds were noted in the study, but they did not account entirely for the difference seen. The authors assume that slower rapid Emergency Medical Service care contributes to the fact, and accessibility to trauma centers is more limited in rural areas.

2.3.5 Pedestrian Exposure Measures

Knoblauch et al (1984) developed pedestrian exposure measures based on specific pedestrian trip-making characteristics, and examined the exposure measures relative to accident information to determine the relative hazardousness of various pedestrian characteristics and behaviors. Exposure measures have been used to define high-risk locations for pedestrians. Exposure can be seen as the product of pedestrian volume (P) and vehicle volume (V), P x V, since pedestrian accident risk cannot occur where both pedestrian and vehicle volumes do not exist. Turning volumes, type of traffic control or violations that produce conflicts were also introduced into the pedestrian/vehicle volume (P x V) concept. Relative hazardousness was determined by comparing the exposure data with pedestrian accident data. Hazard scores were developed to analyze the relationship between the occurrence of certain factors in the accident population and their occurrence in the general population at risk. The hazard scores are the ratio created by dividing the percentage of occurrence of a characteristic in either the accident population or the exposure population by the percentage of occurrence in the other population. If the accident population had the larger percentage--an indication that more hazard is associated with the characteristic--the hazard score is presented as a positive number. If the exposure population had the larger percentage, the hazard score is presented as a negative number--an indication that less hazard is associated with the characteristic. Three types of hazard scores were examined in this study: site, pedestrian volume, and pedestrian-vehicle interactions (PV).

A study on a stratified random sample of 495 sites in five randomly selected cities indicates that the majority of the pedestrian-vehicle (PV) exposure occurs in commercial (71.8%) and mixed residential (21.6%) areas. Only 6.6 percent of the exposure occurs in areas classified as 100 percent residential. The pedestrian-vehicle (PV) score for the roadway functional classification variable indicates that both major arterials and local streets are relatively hazardous. Also shown in the report is that the traditional afternoon peak in pedestrian accidents follows a similar peak in the PV exposure measure plot. According to the study, the periods of darkness, after 8:00 p.m., represent the greatest relative hazard for pedestrians.

2.3.6 Pedestrian Crossings

Zaidel and Hocherman (1989) analyzed the accidents that occurred between 1977 and 1982 at 520 signalized intersections in Tel Aviv, Jerusalem, and Haifa. Table 2.1 shows the distribution of pedestrian accidents by direction of vehicle movement as reported in several U.S. studies and in Israel. The proportion of accidents related to turning (both left and right) in the U.S. studies and in Israel is between 30 and 45 percent. According to the U.S. data, left-turn maneuvers are generally more hazardous for pedestrians than right-turn maneuvers.

Table 2.1 Pedestrian Accidents at Signalized Intersections

	Percentage of Accidents by Vehicle Direction				
Study	Left Turn	Right Turn	Straight	No. of Acc.	No. of Int.
[U.S.]					
Fruin (1973)[1]	31	14	55	172	32
Habib (1984)[2]	25	13	62	455	45
Zegeer (1984)[3]	22	15	63	2,081	1,297
Robertson (1984)[4]	17	12	71	202	62*
[Israel]	13	17	70	850	520

[1,2] One-way grid intersections, Manhattan
[3] Fifteen cities
[4] Washington, D.C., area
* Of which 54 were signalized

Considering that turning vehicles are approximately 15 to 25 percent of the traffic volume approaching an intersection, the hazard associated with turning vehicles is higher than that for those going straight ahead. Nwankwor (1978) analyzed pedestrian safety at crosswalks of Manhattan's one-way grid. Left-turn accidents were about twice those associated with right-turn movements. Pedestrian direction is also significant for left-turn accidents, in a ratio of 65 to 46, or 40 percent higher for pedestrians starting from the near side of the crosswalk. From the analysis, Nwankwor also observed human characteristics which are unique to Manhattan, such as the hurried nature of New York City taxi drivers. Vehicles more often come into conflict with pedestrians while reacting too quickly to traffic light changes, and pedestrians are equally guilty of prematurely reacting when they walk into the crosswalk as soon as the walk signal changes while the vehicle has not cleared the crosswalk.

Knoblauch et al (1984) reported a lower hazard index for intersections equipped with pedestrian signals compared with intersections without. However, the report concludes that pedestrian accidents were more influenced by the factors of vehicle volume, pedestrian activity, and intersection complexity, and the various crossing types--uncontrolled, or with a pedestrian crossing phase--had little effect on the number of pedestrian accidents, and no effect on the number of vehicle collisions.

2.3.7 Intersection Ranking Methodology

Robertson and Carter (1988) developed a method of constructing a pedestrian hazard index (PHI) using the hazard indicators; number of pedestrian accidents, pedestrian accident rate, proportion of special pedestrian groups crossing (young, old, or disabled), noncompliance with the signal, and pedestrian/vehicle conflicts. Three combinations of pedestrian and vehicle volumes were selected; vehicle volume divided by pedestrian volume, vehicle volume multiplied by pedestrian volume, and vehicle volume multiplied by pedestrian volume divided by the percentage turns.

The calculation of the correlation coefficient (r) for pedestrian accident frequency versus each of the candidate exposure measures indicated that none of the correlations were particularly strong. However, the coefficients of determination (r^2) were considerably higher for intersections with pedestrian signals. The coefficients of determination for "vehicle volume times pedestrian volume" and "vehicle volume times pedestrian volume divided by percentage turns" were consistently higher than those for pedestrian or vehicle volume alone. Based on limited data, accident rates were computed for each of the 47 intersections:

$$AR = \frac{AF \times 10^7}{P \times V} \times T \qquad (2.11)$$

Where

AR = pedestrian accident rate;

AF = three-year pedestrian accident frequency;

P = pedestrian volume (10-hr period);

V = vehicle volume (10-hr period); and

T = percentage turning vehicles (10-hr period).

The raw accident data were converted from each hazard indicator into a hazard value, ranging from 0 to 100. The final step was to assign weights to each hazard indicator value to produce a pedestrian hazard index for each intersection. Overall, the method seems logical and practical in rating intersections with respect to pedestrian safety. The authors recommended future research should explore other hazard indicators, such as accident severity, for possible inclusion in the index.

2.3.8 Application of Traffic Conflicts Technique (TCT)

Javid and Seneviratne (1991) applied their conflict technique to pedestrian safety evaluation. The study concluded that the expected conflicts can be estimated with a reasonable degree of certainty from a few measurable variables, such as traffic volume and clearance time.

$$\text{Left turn conflicts } LC = 2.7 - 0.09\ CT + 23.3\ (p \times Q_L) \tag{2.12}$$

$$\text{Right turn conflicts } RC = 0.22 + 30.1\ (p - Q_R) + 0.12\ CT \tag{2.13}$$

$$\text{Total number of conflicts } C = 6.2 + 3.81\ (P \times Q) - 0.096\ ACT \tag{2.14}$$

Where:

LC = Left-turn conflicts, per hour

CT = Clearance time, in seconds

p = Pedestrian crossings, in thousands per hour

Q_L = Vehicles turning left, in thousands per hour

RC = Right-turn conflicts, per hour

Q_R = Vehicles turning right, in thousands per hour

C = Total conflicts, per hour

Q = Total hourly approach volume, in thousands

P = Total hourly pedestrian volume crossing all legs, in thousands

ACT = Average clearance time considering all approaches, in seconds

Since accident rates are variable over time, the approach used a nonhomogeneous Poisson process to estimate the critical number of accidents that would occur with a certain predetermined degree of confidence. The deficiencies in this approach, however, are the unknown validity of the conflict estimation models over time and space. Secondly, establishing the threshold or critical level of confidence (significance) for identifying sites with a high accident potential is arbitrary.

Davis et al (1989) conducted a study to determine the relationship between pedestrian/vehicle conflicts and accidents to develop a reliable model to predict the occurrence of pedestrian accidents. Accident group models were developed using discriminate analysis for the cities of Washington, D.C., and Seattle. The intersection samples were divided into three groups on the basis of pedestrian accident frequency in three years, and subdivided into two subgroups with respect to type of control: Group1, zero-accident intersections; Group2, one- and two-accident intersections; and Group3, three-or-more-accident intersections. Authors found that the variables of pedestrian and vehicle volumes, conflicts, type of control, and pedestrian violations were best explained in group 3, in Washington, D.C., with a model accuracy of 83 percent.

$$\text{group1: } G1 = -0.0829C + 0.0041P + 0.0026V + 3.4671S + 0.0222Vp - 3.3074 \tag{2.15}$$

$$\text{group2: } G2 = -0.0099C + 0.0006P + 0.0016V - 1.0553S + 0.0127Vp - 1.5951 \tag{2.16}$$

$$\text{group3: } G3 = -0.0989C + 0.0045P + 0.0037V + 4.8675S + 0.0254Vp - 6.1205 \tag{2.17}$$

Where:

C = conflict

P = pedestrian volume

V = vehicle volume

S = type of control (1-signal, 0-stop)

Vp = pedestrian violations

The study explains the differences in pedestrian behavior between the two cities in terms of pedestrian violations. In Washington, D.C., where numerous pedestrian violations occurred, the violations were found to be indicators of accident groupings; however, in Seattle, the opposite was true. The authors also found that vehicle violations were not useful in defining accident groupings. In their research, vehicle violations of running a red signal or stopping in the crosswalk did not endanger a pedestrian when the pedestrian signal indicated "Don't Walk" and pedestrians complied.

2.3.9 Summary

The literature review indicated that most pedestrian studies focus on the analysis of data such as pedestrian characteristics or accident environments. While the many reports reviewed were limited to pedestrian accidents with fatals or severe injuries, there has been little work done to establish a comprehensive safety index which includes accident severity and incident parameters. The concept of hazard index theory has been discussed, but no study was found that correlates a pedestrian trip generation study with pedestrian exposure to enable traffic engineers to use it as a quick reference without a field count.

The studies are also focused on road and vehicle factors rather than human factors. There were few studies found which included urban pedestrian factors. Nwankwor, however, observed the hurried nature of New York City drivers and pedestrians. Vehicle violations would be more critical to pedestrian safety than various crossing types, in an urban core like New York City. Since New York City has a high frequency of pedestrian accidents, the Traffic Conflict Technique (TCT) may have to be adjusted for urban intersections.

2.4 Accident Cost

Motor vehicle accident costs are an important component in benefit-cost evaluations of highway safety improvements. However, the costs of injuries and property damage resulting from traffic accidents are often hard to estimate and easily misinterpreted.

The first accident cost study was conducted in 1953 in Massachusetts. By means of mail questionnaires and through personal interviews with a sample of vehicle owners, the accident experience for one year was obtained. From these data the direct cost of accidents was estimated. The Washington Area Motor Vehicle Accident Cost Study in 1964-65 was the first comprehensive study of traffic accident costs to concentrate on a predominantly urban area.

Much of the literature reviewed is too outdated to represent current prices, and difficulties exist in estimating accident costs. Variables in cost estimation derive from geographic differences, such as rural and urban, or whether they are viewed as incident-based or per vehicle of involvement. Various cost components, such as direct costs and indirect costs, are other parameters which make a uniform scaled cost evaluation difficult.

2.4.1 National Safety Council (NSC) Study

The National Safety Council has attempted to put a price on losses due to motor vehicle accidents. The NSC accident cost data includes wage loss, medical expense, insurance administration costs, and property damage. In 1990, the cost of each death, injury, or property damage accident were:

Death (fatalities)--$410,000

Nonfatal Disabling Injury --$17,400

Property Damage Accident--$3,500
(including minor injuries)

The NSC data applies different ratios of nonfatal injuries and property damage accidents per death. The cost per death for all accidents--fatal, nonfatal, and property damage--differs for urban and rural accidents. The cost of a fatal accident including injuries and property damage would be $3,100,000 for urban areas and $1,100,000 for rural areas. Many cities and states do not keep complete injury and property damage accident records. If a city's records are believed incomplete, the National Safety Council recommends to use the $3,100,000 unit cost per death. Motor vehicle injuries are classified by severity: $38,200 for incapacitating injury, $8,900 for nonincapacitating evident injury, and $2,900 for possible injury.

Peszek (1973) developed a "price tag" on the annual losses due to motor vehicle accidents, by comparing the National Safety Council's (NSC) estimate with that of the National Highway Traffic Safety Administration (NHTSA). The price tag is the amount of money that could be saved by society if motor vehicle accident losses were to cease.

The Department of Transportation's NHTSA estimated $46 billion as the loss in 1971, whereas The National Safety Council's estimate for the same year was $15.8 billion.

2.4.2 National Highway Traffic Safety Administration (NHTSA) Study

NHTSA attempts to measure the total societal costs of motor vehicle accidents and translates all inconvenience and hardship associated with motor vehicle accidents. As shown in Table 2.2, The NHTSA estimate includes dollar allowances for intangibles such as pain and suffering; community loss of the services of a killed or disabled person; and the loss of the value of the casualty victim's household duties. NSC, on the other hand, attempts to measure the real dollars lost as the result of motor vehicle accidents.

Table 2.2 National Highway Traffic Safety Administration (NHTSA) Accident Cost Data 1990

TOTAL COST (in millions)		UNIT COST	
PDO*	35,597	PDO (per vehicle)	1,481
Nonfatal Injury	70,613	MAIS 0:	1,238
		MAIS 1:	6,145
		MAIS 2:	26,807
		MAIS 3:	84,189
		MAIS 4:	158,531
		MAIS 5:	589,055
Fatal	31,273	Fatal (per person)	702,281

*PDO: Property Damage Only

The principal shortcoming of the study is its failure to express accident costs in a form that can be directly used with state accident data, with injury severities coded by the A-B-C scale (incapacitating, nonincapacitating, and possible injury, respectively) rather than by the Maximum Abbreviated Injury Scale (MAIS: 0, no injury; 1 to 5, least to most severe nonfatal injury; 6, fatality). NHTSA's accident cost for a fatality is almost double the fatality accident cost estimate of the NSC. Since the 1970's, this difference has become smaller. The property damage accident cost is higher in the NSC estimate because it includes minor injuries. As a result, a multiplication factor between PDO and fatal accidents is much higher in NHTSA's estimate in comparison with that of the NSC.

2.4.3 The Costs of Motor Vehicle Injuries

The costs of injury to society are enormous. Faigin's (1991) technical paper reviewed a report to Congress, "Cost of Injury in the United States" (October 1989), to focus on the findings for motor vehicle injuries. The total lifetime cost of injury from all causes was $158 billion in 1985, with motor vehicle injuries--the single most costly category of injury--accounting for nearly $49 billion.

The author explains that an incidence-based "human capital" methodology estimates the costs of injury, in terms of lifetime economic costs of fatalities and injuries occurring in a given year. Direct costs include first- and later-year medical costs, emergency services, nursing home care, rehabilitation, home modifications, and insurance administration expenses. Indirect costs result from losses in present and future productivity due to death (mortality), and permanent or temporary disability (morbidity).

Nonetheless, economic costs derived from the human capital method do not include dollar estimates for pain and suffering and value-of-life factors. An alternative methodology, described as the "Willingness To Pay" (WTP) approach, assigns values to these factors. The report on Cost of Injury in the United States acknowledges this method and two different values are shown in Table 2.3.

Table 2.3 Costs per Injured Person: Human Capital and Willingness-to-Pay Methods (Dollars)

HUMAN CAPITAL COSTS ($)		WILLINGNESS-TO-PAY VALUES ($)		
Injury		Injury	(Individual)	(Societal)
Not Hospitalized	1,570	Moderate	25,000	30,000
Hospitalized	43,409	Serious	100,000	115,000
		Severe	260,000	375,000
		Critical	1,225,000	1,525,000
Fatal Injury	352,042	Fatal Injury	1,950,000	2,000,000

2.4.4 Per Accident Costs

Rollins and McFarland (1986) developed per-accident costs based on accident severities and on the A-B-C injury severity scale (incapacitating, nonincapacitating, and possible injury, respectively) commonly used in state accident records, rather than on the Maximum Abbreviated Injury Scale (MAIS) used by NHTSA. Accident data from five states, the National Crash Severity Study (NCSS) and the National Accident Sampling System (NASS), were used to relate percentage distributions of injury severities by the MAIS and A-B-C scale.

With this method the cost per property-damage-only (PDO) accident, for example, can be readily calculated from the tables of (1)cost per vehicle involvement and (2)the average number of involvements per PDO accident.

Direct cost = Direct cost per involvement x Involvement per accident

Indirect cost = Indirect cost/involvement x Involvement per accident

Total cost = Total cost per involvement x Involvements per accident

2.4.5 Indirect Accident Costs: Valuation Approaches

Direct costs represent a smaller portion of total motor vehicle accident costs than indirect costs. The Granville Corporation (1984) defined four categories of indirect costs: 1) Social mechanism costs, 2) Human capital (HK) costs, 3) The costs or value of psychosocial deteriorations, and 4) The value of life and safety, as estimated by willingness-to-pay and related approaches.

Social mechanism costs are the costs of managing the activities subsequent to an accident or preventing accidents from occurring. The major sources of social mechanism costs are: Police costs, Fire department costs, Coroner/medical examiner costs, Insurance administration costs, Welfare and public assistance costs, State motor vehicle agency costs, and State and local highway department costs. Human capital (HK) costs are the costs of goods and services not produced as a result of motor vehicle accidents. In other words, human capital costs are equal to the present value of expected future earnings, productivity, or income lost due to morbidity (permanent or temporary disability) and mortality (death). The category of psychosocial deteriorations include pain, family erosion and marital decay, drug and alcohol abuse, juvenile delinquency, missed education, overall reduction in quality of life, and loss of contact with friends, family, and community. Finally, the value of life and safety are individuals' valuations of their "life and limb." More accurately, they are individuals' "willingness to pay" to avoid or be compensated for exposure to risks of death and injury.

Willingness-to-pay estimates are comprehensive assessments of the value of life and safety, including the value of all activities that provide individuals with benefits of living and a premium for psychosocial deteriorations. These values are intended to be used in place of the human capital costs and the psychosocial deterioration costs of motor vehicle accidents.

2.4.6 Federal Highway Administration (FHWA) Study

In 1989, the U.S. Office of Management and Budget directed Federal agencies to compute the dollar benefits of preventing deaths on the basis of the amount that people actually pay or say they would pay for small increases in safety (NYSDOT, 1989). Data systems count crashes and injuries in varied categories to determine the comprehensive cost/crash and cost/person by police-reported crash severity, in 1988 dollars. Nonfatal crashes cost an average of $72,000, and fatal crashes $2,722,000. However, it should be noted that the estimate includes pain, suffering, and lost quality of life, wages and household production, as well as out-of-pocket costs.

2.4.7 New York Study

The New York State Department of Transportation (NYSDOT) updates accident costs annually. With the 1989 update, the Department adopted the "Willingness-To-Pay" approach. Table 2.4 shows average accident costs, with New York City included under a separate category.

The NYSDOT also updates the property damage reporting level with the Consumer Price Index. Non-reportable accidents are included in average accident costs. There is only one category of injury.

Table 2.4 NYSDOT Average Accident Costs For Calendar Year 1993

Area Type	Fatal Acc.	Injury Acc.	Fatal & Injury	PDO*
URBAN/SUBURBAN/VILLAGE	3,158,700	85,000	112,000	3,300
RURAL	3,273,800	89,100	166,900	4,600
NEW YORK CITY	3,023,000	84,600	105,500	3,300

*PDO accident includes reportable and non-reportable.

2.4.8 Summary

It is evident from the literature review that any standard or uniform cost data are non-existent. It is difficult to get consistent cost data which would be applicable to general cost-benefit analysis or to the rate of accident severity. The reasons for the discrepancies in accident costs are due to the differences between the concepts of economic cost, and value concept. Indirect values are especially difficult to measure and there are various parameters to be determined in cost studies.

Most states currently use values based on: (1) direct costs, (2) NSC values, or (3) NHTSA values. For fatal accidents, the NSC values do not include any value for the person's self worth, while the NHTSA values include the present value of the person's expected earnings. Although both cost values are commonly used in estimating accident costs, they lack an interpretive value of life or the real market approach. New York State DOT has adopted the "Willingness-To-Pay" concept, which is believed to be a more reasonable approach. NYSDOT's cost data for New York City would be a primary reference in this study.

Table 2.5 presents an overall summary of the literature review indicating studies that were: 1) used for developing ideas, 2) not relevant, and 3) expanded for this study. The literature review was conducted in 1992.

Table 2.5 Summary of Literature Review

Study/Method	Used for Ideas	Not Relevant	Expanded
I. Safety Evaluation			
1. Frequency Method	X		
2. Accident Rate Method	X		
3. Frequency-Rate Method		X	
4. Kansas City Study	X		
5. Hazardous Roadway Features Method		X	
6. Traffic Conflict Technique			X
7. Accident Severity Method			X
8. Hazard Index Method	X		
9. New York's Rate Quality Control Method		X	
II. Pedestrian Safety			
1. Pedestrian Characteristics		X	
2. Pedestrian Fatals in Virginia		X	
3. Pedestrian Accidents in the Monterial CBD		X	
4. Urban and Rural Environments		X	
5. Pedestrian Exposure Measures			X
6. Pedestrian Crossings			X
7. Intersection Ranking Methodology		X	
8. Traffic Conflict Technique		X	
III. Accident Cost			
1. National Safety Council Study		X	
2. National Highway Traffic Safety Admin.		X	
3. Costs of Motor Vehicle Injuries		X	
4. Per Accident Costs		X	
5. Indirect Accident Costs		X	
6. Federal Highway Administration Study		X	
7. New York Study	X		

CHAPTER III

DATA COLLECTION AND PROCESSING

3.1 Introduction

To improve the safety of the highway system, the traffic engineer must have information and data on the location, frequency, severity, and type of accidents that are occurring. The study of accidents is fundamentally different from that employed to observe other traffic parameters. Because accidents occur relatively infrequently, and at unpredictable times and locations, they cannot be objectively observed as they occur. Thus, all accident data come from secondary sources--motorist and police accident reports. A notable exception to this is a system for gathering, sorting, and retrieving such information in a useful form must be carefully designed and monitored to provide the traffic engineer with the data needed to properly evaluate and correct traffic-safety deficiencies.

This study consists of data collection and analyses of accident contributing factors. The research is focused on accidents at intersections which comprise 64 percent of total Manhattan accidents, excluding limited-access highways. The product of this study is called the CASIUS (Computer-Aided Safety Index for Urban Streets) program. The outcome of this program is 1) expected number of accidents, 2) severity factors, and 3) frequency factor of the intersection being studied. The frequency and the severity factors are very important in safety analysis because of their ability to identify locations with the highest potential of safety improvement, especially when an identical accident type appears repeatedly.

3.2 Data Collection

Data were collected to quantify accident experience, vehicle counts, and inventories of intersections including traffic operations, traffic and pedestrian movements, and parking characteristics.

3.2.1 Field Inventory

The NYCDOT Safety Unit made available the required manpower and equipment for the field work. Two surveyors visited 202 study intersections to fill out the prepared field forms. The following equipment were used for the field inventory:

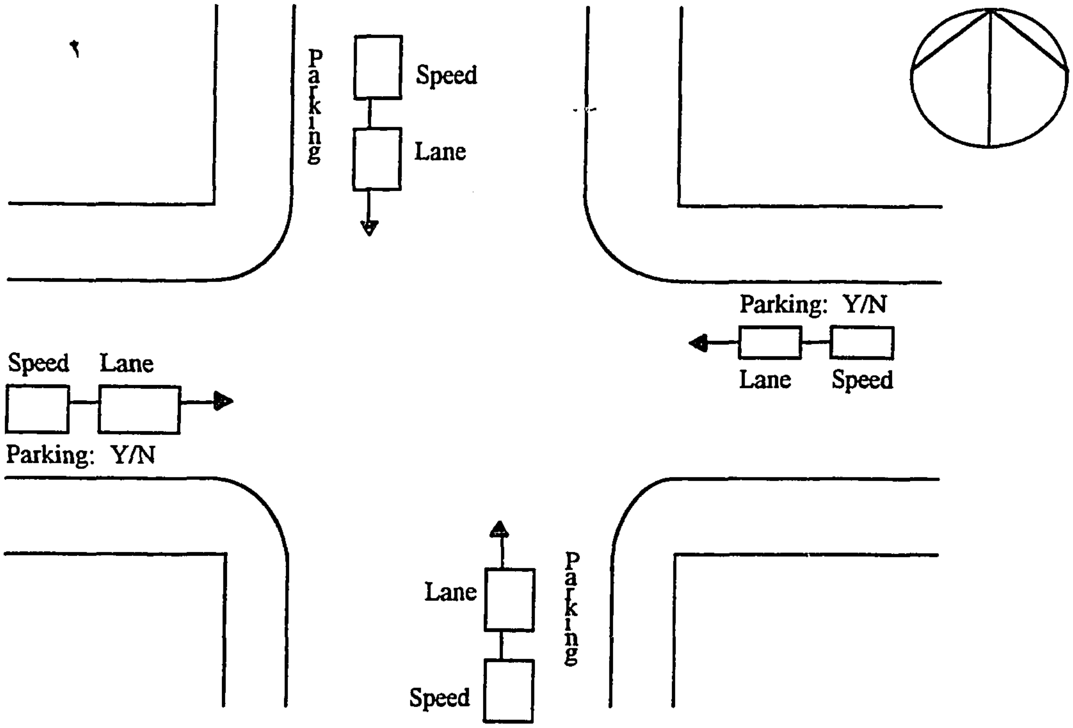
- Length measuring wheel
- Stop watch
- Polaroid camera

Photo-logging was conducted at all study intersections to maintain the record along with the diagrams from the field work.

3.2.1.1 Intersection Characteristics: The field survey form "A" presented in Figure 3.1 was designed to collect the following intersection characteristics:

1. Type of land use (R/C/M--Residential/Commercial/Industrial).
2. Posted speed limit (30 mph for the majority of intersections in NYC).
3. Geometry of intersection including lane markings, sight distance (G/F/P--good/fair/poor), median, left turn bay, and channelization.
4. Type of roadway and intersection (e.g., arterial-local, 4-way/T-type).

Location____________@________ Boro & Ser. #_______ By_____
Date____________ Day________ Time_______ Weather____



INTERSECTION CHARACTERISTICS

Land Use	R/C/M	Posted Speed	Major; Minor;
Geometry	Grade/Level	Median on Any Leg	Y/N
Channelization	Y/N	Sight Distance	G/F/P
Comm. Traffic	Y/N	Left Turn Lane	Y/N
Lane Markings	G/F/P/None	Overall Marking Condition	G/F/P
Roadway Type	Arterial & Art/ Art & Local/ Local & Local (rf. Hagstrom Map)		
Intersection Type	4-Way/ T/ Y/ Multi-Leg		
Type of Control	Signal/ Stop/ Yield/ Flash/N-Control		
Signal Control	Cycle Length 60/ 90/ 120	No. of Phases 2/ 3/ 4	

Figure 3.1 CASIUS Field Survey Form A

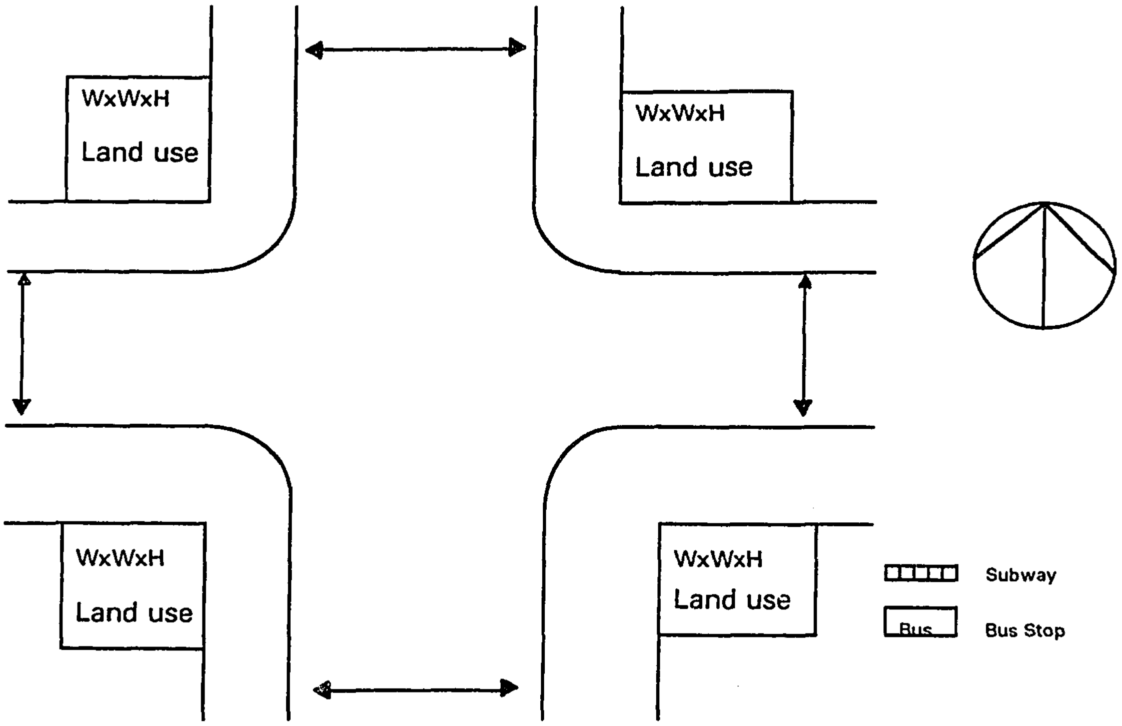
5. Type of traffic control (e.g., signalized, stop controlled).
6. Signal timings and phasing.

3.2.1.2 Pedestrian Data: The field survey form "B" presented in Figure 3.2 was designed to collect the following field information on pedestrian activities:

1. Sketch of crosswalk pavement markings.
2. Condition of crosswalk (good/fair/poor)
3. Crosswalk with the highest pedestrian activity (north/south/east/west).
4. Width of crosswalk.
5. Pedestrian level of service (determined visually by taking photographs and using professional judgement).
6. Pedestrian signal timings.
7. Pedestrian volume (high/medium/ low).
8. Existence of mass transportation.

Pedestrian exposure measures can be developed by combining the pedestrian and vehicle activity and eventually relating it to the pedestrian accident characteristics. However, pedestrian counts at the 202 sample intersections were not available, and obtaining those counts was quite a difficult process. As an alternative, a Traffic Conflicts Technique (TCT) concept was used which requires parameters such as pedestrian signal timing, crosswalk condition, and the dimension of pedestrian crossings--sum of major and minor (W1 + W2), the ratio (W1/W2), and the product (W1 x W2), or just the width of the major pedestrian crossing (W1).

Boro & Ser. #_______ By______



PEDESTRIAN ACTIVITY

1) Sketch the crosswalk markings on the above diagram.
2) The condition of crosswalk markings (overall: G/F/P)
3) Select one crosswalk with the higher pedestrian activity: N/S/E/W (Leg)
4) Measure the width of that one crosswalk: ______Ft.
5) Take pictures of the same crosswalk to show the pedestrian level of service (to cover the whole distance).
6) Pedestrian Signal of the same Leg: Legend/Color Lens/None.
7) Pedestrian count (overall: High/Med/Low)
8) Platoon effect observed due to pedestrian congestion: Y/N

Type of Ped Signal				Pedestrian Cycle (Sec.)			
Leg	Legend	Lens	None	Walk	Fldw	Dont Walk	Total C/L
N							
E							
S							
W							

Figure 3.2 CASIUS Field Survey Form B

3.2.2 Accident Data

Accident experience was compiled from:

1. Three years of Centralized Local Accident Surveillance System (CLASS) data from the New York State Department of Transportation, January 1989-December 1991.
2. Three years of accident summaries and summary descriptions at each of the 202 study intersections, January 1989-December 1991.
3. Five years of traffic fatality data and analyses from the New York City Department of Transportation, 1987-1991;

The CLASS data have a detailed breakdown by accident type and intersection characteristics, including various sub-categories of pedestrian and non-pedestrian accidents, such as at-intersection and not-at-intersection, signalized and unsignalized intersections. Table 3.1 shows the number of intersections and accidents in the boroughs of Manhattan, Queens, Kings (Brooklyn), the Bronx, Richmond (Staten Island), and the entire City of New York during 1989-1991. A summary of motor vehicle accidents in Manhattan is included in Appendix A.

Table 3.1 Accident Frequency at NYC Signalized and Unsignalized Intersections

	INTERSECTIONS			ACCIDENTS				
Boro	Signalized	Unsig-	Total.	In 1989	In 1990	In 1991	Avg/Yr	Per Int.
Manh.	2709	986	3695	22055	22197	20603	21618	5.9
Queens	2285	11812	14097	36028	35946	32233	34735	2.5
Kings	3262	6552	9814	32524	33450	31441	32471	3.3
Brook.	1483	4321	5804	16917	16680	15106	16234	2.8
Richm.	359	4203	4562	6249	6398	5883	6176	1.4
Citywide	10098	27874	37972	113773	114671	105266	111237	2.9

Boro	%Ped.	1989 Ped.	1990 Ped.	1991 Ped.	Ped. Avg.	% of Ped. at Int.
Manh.	20	4393	4529	4364	4429	68.5
Citywide	14	14841	15544	14992	15124	65.1

Source: NYSDMV MV-144 Summary (1989-1991)

3.2.3 Vehicular Volume Data

Automated traffic recorder (ATR) counts from 1987 to 1992 were obtained from the NYCDOT's Planning Office. For all approaches of the 202 intersections used for this study, the ATR counts were available. Weekday averages between 7 AM and 7 PM were selected to measure the magnitude of traffic demand in terms of total entering vehicles (V1 + V2 + V3 + V4), or the product of critical approach volumes (V1 x V3).

3.3 Data Processing

The Paradox 4.0 software was used for data processing. A custom form for data entry was developed which consisted of four tables comprising; 1) intersection number, location, node number, 2) three-year accident summary, 3) intersection characteristics such as land use, intersection type, control type, pavement marking condition, roadway type, existence of public transit, signal operation, and 4) vehicular volume and traffic operation.

CHAPTER IV

DEVELOPMENT OF CORRELATION AMONG VARIABLES

4.1 Identifying Problem Areas

Establishing a comprehensive safety index for urban intersections involves contributing factors more complicated than those of suburban areas. Due to many variables, including accident frequency, the sample size of 202 intersections used in this study may not be sufficient to identify all contributing factors to intersection safety. Grouping of sample intersections and setting a set of stratified accident data may be difficult because of the complex interaction of contributing factors. Calculating the proper ratio of severity factor will be very important. For example, if the severity factor of fatal accidents is too high, the random fatalities will be overvalued against PDO accidents that usually are more frequent and offer easier countermeasures. Safety countermeasures can be suggested from the product of accident frequency and severity by intersection.

The surrogates to pedestrian volume data, such as land use, may not be able to represent the actual pedestrian activity or pedestrian/vehicle conflicts. Pedestrian behavior at signalized intersections varies. Although the study aims to separate pedestrian accidents from non-pedestrian accidents from its early stage, pedestrian accidents have higher accident severity and randomness. Developing a formula to reflect relative hazards would also be complex because most of the existing equations are based on traffic conflicts, or accident potential.

4.2 Analysis on Contributing Factors

Figure 4.1 is a schematic diagram of procedures for evaluating signalized intersection accident surrogates. The establishment of the comprehensive safety index includes parameters of 1) local factors: roadway classification, land use, and demographics, and 2) node factors: roadway geometry, vehicular speed, traffic volume, traffic operation, traffic control, parking characteristics, and pedestrian activity.

Expected number of accidents per intersection classification is a multiplication of normalizing factors onto average annual accident factors at study intersections. Normalizing factors related with accident frequency or accident severity are the function of the pedestrian volume (P) factor, the vehicular volume (V) factor, and the pedestrian/vehicle interaction (PV) factor as a multiplication of both. The evaluation of the pedestrian factor is discussed in Section 4.3.

Based on the above frequency distribution and sensitivity analysis, a safety index formula can be derived:

$$\mathrm{SI} = \frac{\text{Reported Number of Accidents}}{\text{Expected Number of Accidents}} \tag{4.1}$$

Accident rates at intersections can be produced through the merge of data files--intersection file, traffic file (pedestrian and vehicular), and accident file (NYSDOT CLASS data). The reported number of accidents at the location, in terms of accident frequency, can be compared with various normalizing factors and traffic exposures at the subject location and with the Manhattan average. The ten-year Manhattan accident figures during 1983-1992 are presented in Table 4.1.

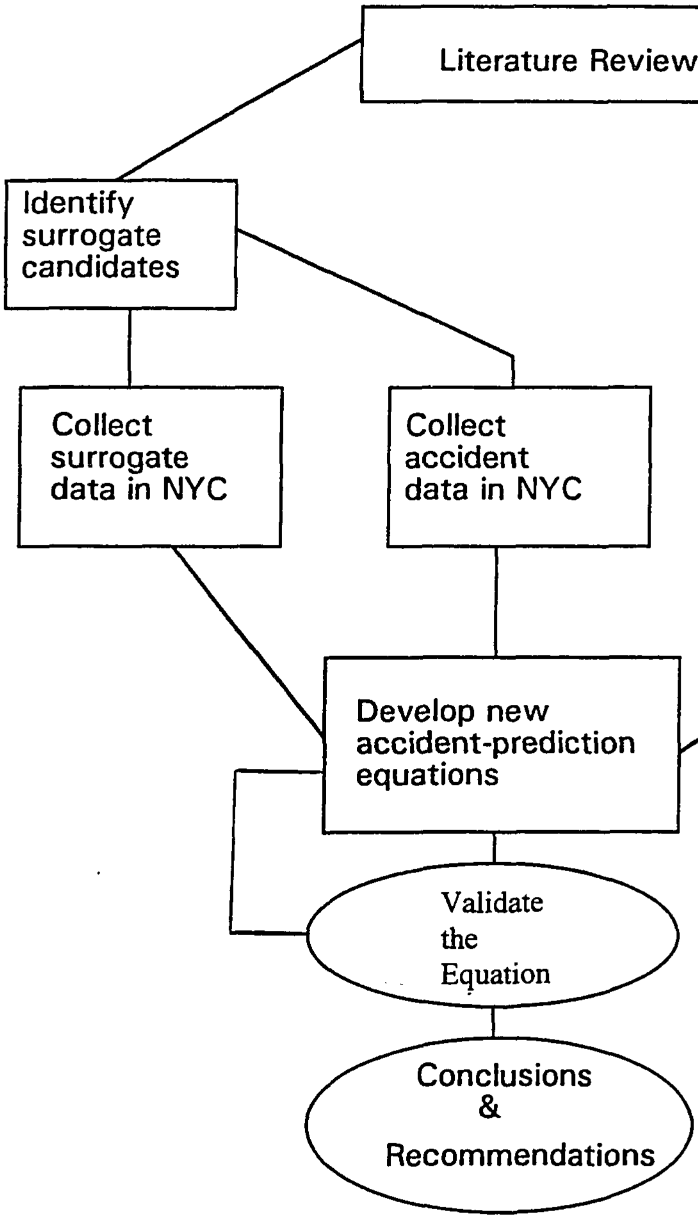


Figure 4.1 Schematic Diagram of Procedures for Evaluating Signalized Intersection Accident Surrogates

Table 4.1 Manhattan 10-Year Accident (1983-1992)

YEAR	FAT.	INJ.	PROP DMGE	NON-RPRT	TOTAL ACC	TOTAL LOCS	N- L*	PED ACC
1983	111	13229	6904	29389	4963	8212	60-40	3825
1984	107	13594	6636	30690	51027	8187	58-42	4020
1985	90	14473	6050	38628	59241	8882	60-40	4441
1986	108	15913	5562	42514	64097	9225	62-38	4657
1987	105	15925	6053	43215	65298	9444	62-38	4563
1988	100	15799	6365	45631	67895	9172	61-39	4637
1989	109	15731	6215	46926	68980	9090	61-39	4504
1990	132	16110	5955	44033	66230	9140	60-40	4529
1991	95	15917	4591	44955	65558	9196	60-40	4364
10 YEAR AVERAGE								
		105	15348	5755	41121	62329	8967	60-40

Source: Borough-wide Accident Information Report

* N-L: Node vs. link data

4.2.1 Accident Rate Based on Vehicle Volume

Conventional traffic safety analysis systems compute accident rates for county/statewide areas using general accident parameters such as population, miles of highway, or vehicle miles traveled (VMT). At intersections, the accident rate can be expressed as accidents per vehicles entering the subject intersection. The objective of the analysis is to determine the relationship between accident characteristics at intersections and vehicle volume at 202 sample intersections. Approach volumes are categorized in three different ways: 1) Total Vehicle Volume (TVV), 2) Sum of Critical Volume (SCV), and 3) Critical Vehicle Volume (CVV).

Table 4.2 shows the relationship between accidents and volume, as determined by curve fitting analysis.

Table 4.2 Relationship Between Accidents and Volume

	Correlation Coefficient	Determination Coefficient	Error (%)
Total Volume	0.61	0.3734	58
Sum of Critical Volume	0.49	0.2132	96
Critical Volume	0.41	0.1659	93

The highest correlation coefficient does not necessarily indicate the best relationship between the two variables of accidents and volume. However, total vehicle volume (TVV) in Table 4.2 has a higher coefficient than other variables compared, and it means that accident frequency is more closely related to the number of total entering vehicles than critical approach volume. Also, the error is smaller (58%) for total vehicle volume. Therefore, the TVV variable will be used hereafter as an accident surrogate.

The average vehicle volume at the sample intersections is 22,321, and the average accident frequency during the three-year period is 74. At the intersection with the highest vehicle volume, the total volume is 52,883 with an accident frequency of 66, and the intersection with the lowest vehicle volume of 1,168 has an accident frequency of 33. The highest accident frequency at an intersection is 387 with a 33,040 vehicle volume, and the lowest frequency is 3 with volume of 7,503 vehicles. However, this relationship is not applicable to the intersections with extreme accident frequency or volume size. At these intersections, other accident variables prevail, and have a greater safety impact than traffic volume.

For example, the intersection with the highest volume (52,883) has a critical crosswalk length of 104 feet, which is the longest among sample intersections. However, the sum of conflict point is low (9.82) at this intersection, compared to the highest conflict point (16) among the sample intersections. It means that the accident rate is lower at intersections with large dimensions because lane capacity is higher at multi-lane approaches, whereas the conflict point is low, perhaps because of turning restrictions at major approaches. The critical crosswalk length at the intersection with the highest accident frequency is only 73, but the conflict point is considerably high (11.5), resulting in a higher accident rate. In these extreme cases, other accident variables such as conflict points have a greater impact on safety than traffic volume.

Table 4.3 presents the results of a curve fitting analysis for the categories of signal-controlled and stop-controlled intersections.

Table 4.3 Signalized and Stop-Controlled Intersections

	Correlation Coefficient	Determination Coefficient	Average Volume	Average Acci.	Number of Intersection	Error (%)
Signal	0.49	0.24	25588	85.7	167	66
Stop	0.53	0.28	6729	18.1	35	53

The accident rate based on vehicle volume is higher at signalized intersections. Vehicle volume per accident at signalized intersections is 298, and 370 at stop-controlled intersections. In general, accident frequency is proportional to traffic volume. However, the issue of signalization has not been considered because the correlation is lower than that of other variables applicable to all intersections.

Figure 4.2 shows the relationship between accident frequency and traffic volume. The curve fitting equation is:

$$Y = -4.71325 + 0.00353X \qquad (4.2)$$

However, the difference between calculated accident frequency and real accident frequency increases when vehicle volume is more than 30,000. The relationship is weak as the number of total entering vehicles increases. Table 4.4 shows the relationships by aggregated volume size.

Table 4.4 Accident Relationship by Aggregated Volume Size

Volume	Correlation Coefficient	Determination Coefficient	Avg. Volume	Avg. Accident	# of Locat.	Error (%)
<5,000	-0.0143	0.000190.24	2835	12.57	14	65
<10,000	0.22875	0.0523	7622	21.22	18	80
<20,000	0.51787	0.26818	14849	48.27	43	58
<30,000	0.04540	0.0020	25098	77.39	85	42
>30,000	0.11594	0.01344	35861	133.5	42	58

The correlation for each volume size does not show better results than the fitting curve analysis for total vehicle volume. The analysis per vehicle volume indicates that accident frequency generally increases with vehicle volume, but not with a strong relationship.

4.2.2 Conflict Point System

The traffic conflicts technique (TCT) has been used to estimate the relationship between traffic conflicts and accidents. Despite the diversity of opinions on its usefulness, the

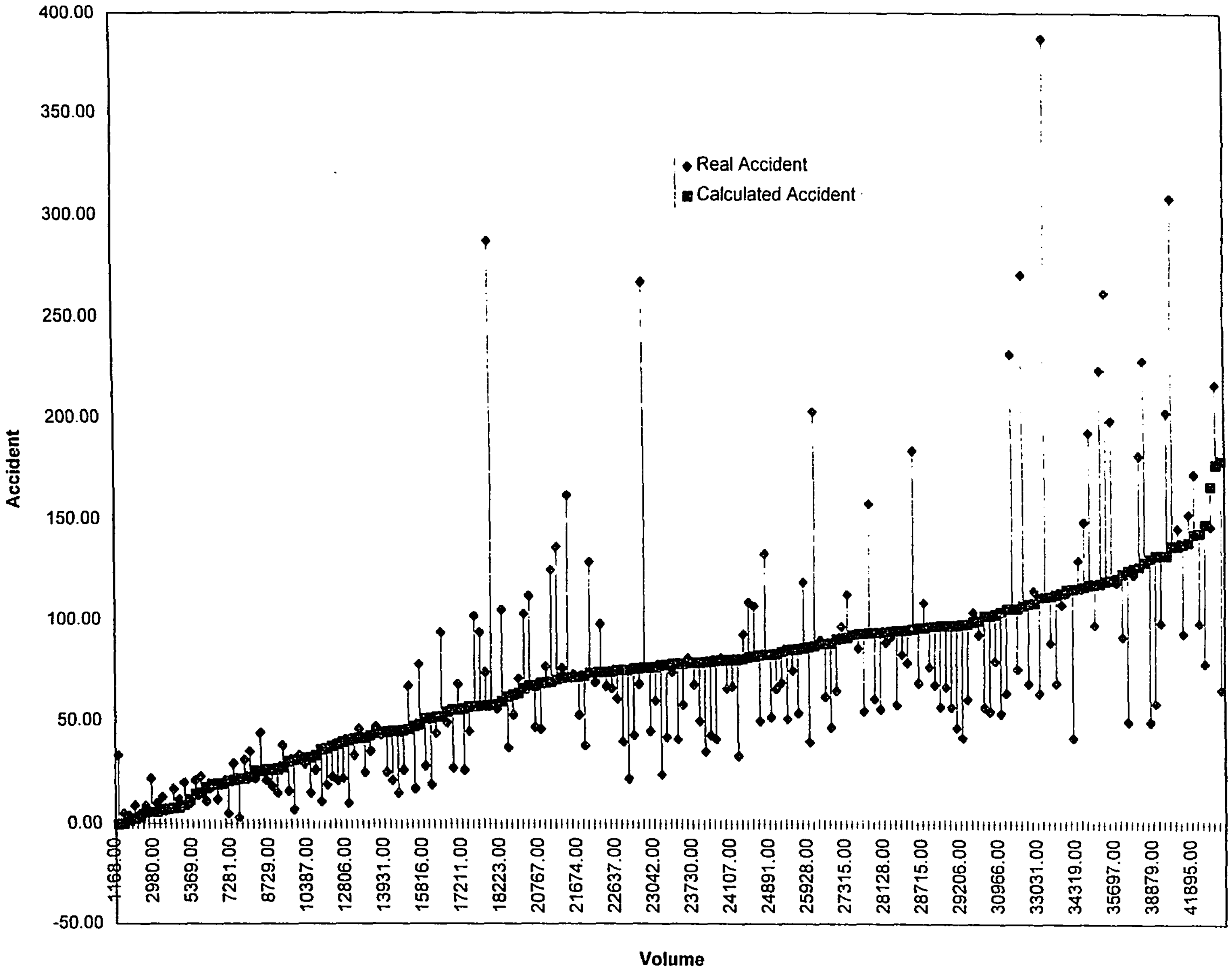


Figure 4.2 Accident Frequency and Traffic Volume

concept is widespread and the method is used by many safety engineers for its convenient technique of field observation. The definition of conflict in this study differs from the conventional meaning of traffic conflict. Conflicting points at intersection would mean number of conflicting points between maneuvering vehicles as the denominator of an intersection safety index. The number of conflict points at study intersections will reflect the conflict potential. To reflect the risk involved with left-turn movements, left-turn maneuvers have been considered to be equivalent to three through or right-turn movements. Total conflict points have been calculated in two different ways, and the results are shown in Table 4.5.

1. Sum: (Left Turn * 3) + Thru + Right
2. Product: (Left Turn * 3) * Thru * Right

Table 4.5 Conflict Method

Conflict Method	Correlation Coefficient	Determination Coefficient	Average Conflict	Avg. Acci.	# of Location	Error
1	0.56	0.32	6.69	74	202	1.01
2	0.40	0.16	20.59	74	202	1.31

Both the correlation coefficient and determination coefficient work out better when the number of conflict points are added (Method 1), rather than multiplied (Method 2). The fitting curve equations for methods 1 and 2 are:

$$1) \quad Y = -8.3140 + 12.2978X \qquad (4.3)$$

$$2) \quad Y = 62.1775 + 0.57697X \qquad (4.4)$$

Method 1 has been selected for application because of its lower error rate. As shown in Figure 4.3, the real accident frequency is lower than that calculated at conflict points below 10, but it becomes very high when the conflict points are over 10. Figure 4.4 shows a better relationship between conflict points and accident frequency, using method 1. The correlation is high (0.56146), but the error is also high (100.8%).

Table 4.6 shows the results of curve fitting analyses for different ranges of conflict points.

Table 4.6 Conflict Analysis per Aggregate Conflict Points

Interval	Correlation Coefficient	Determination Coefficient	Average Conflict	Avg. Acci.	# of Locat.	Error
0.00 - 3.99	0.34419	0.11168	2.9	15.90	11	0.62810
4.00 - 4.99	0.46937	0.2203	4.37	44.57	49	0.68479
5.00 - 5.99	0.18929	0.0358	5.46	64.58	51	0.5177
6.00 - 6.99	-0.12275	0.015	6.45	56.60	25	1.22376
7.00 - 7.99	-0.13911	0.01935	7.185	54.12	8	2.47469
8.00 - 8.99	-0.809	0.6544	8.205	76.75	4	1.358
9.00 - 9.99	-0.35826	0.1283	9.092	120.33	30	0.51219
10.00 -	0.01832	0.00035	12.6108	147.08	24	0.58959

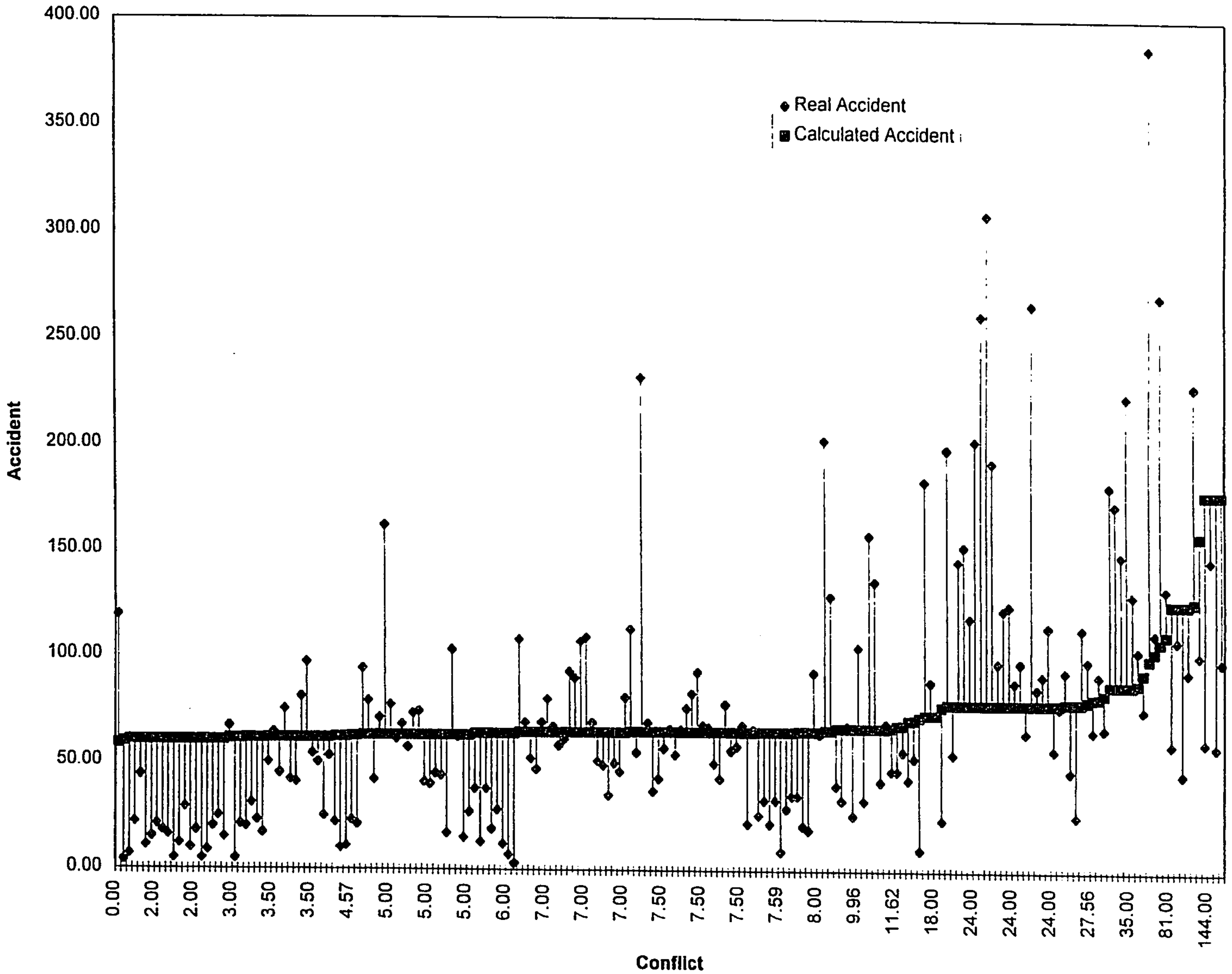


Figure 4.3 Accident and Conflict Multiplied (Method 1)

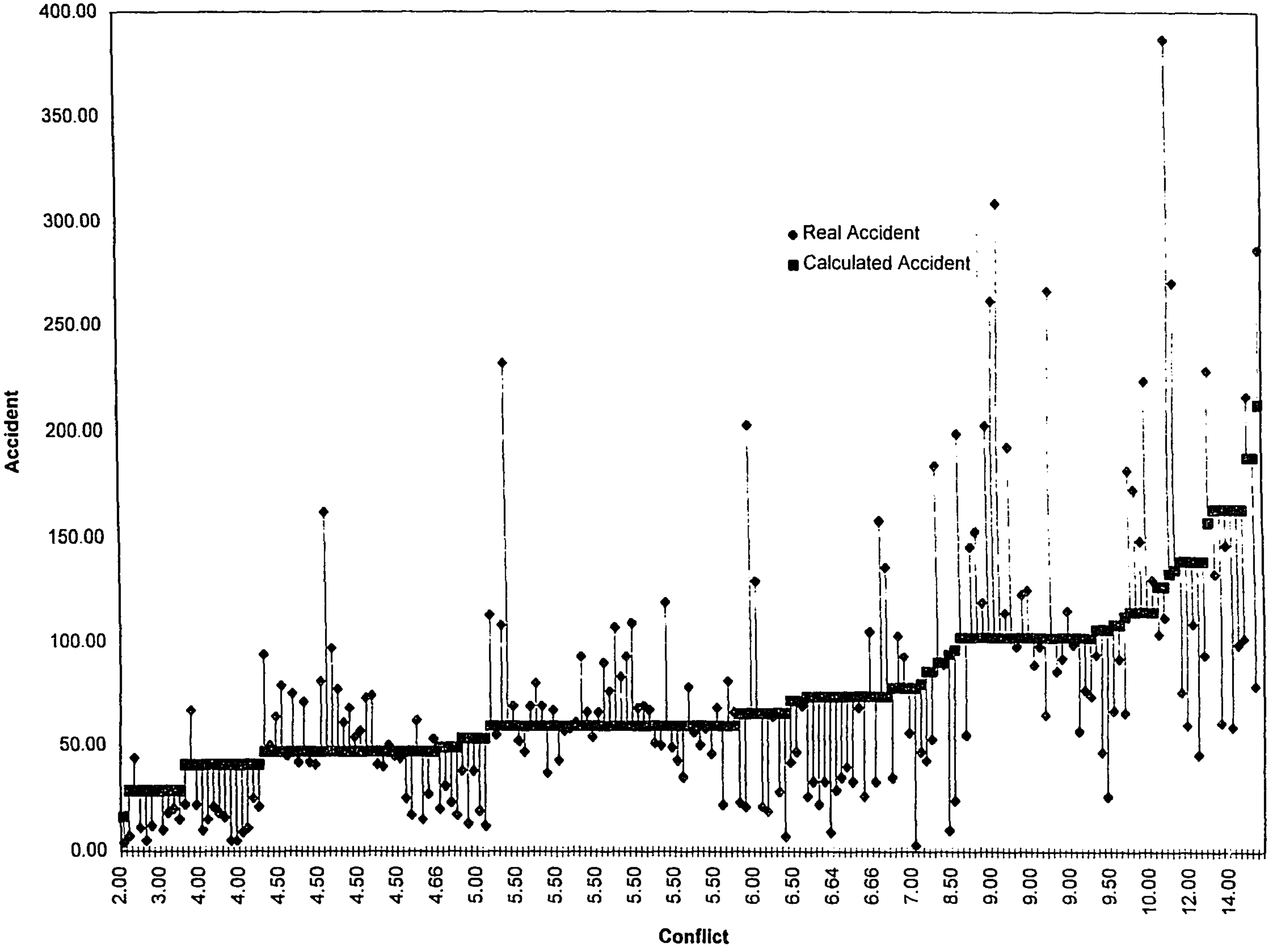


Figure 4.4 Accident and Sum of Conflict (Method 2)

The correlation of each individual conflict range is no better than that of total conflicts. In either case, the two variables of accident frequency and traffic conflicts have a good relationship. However, the conflict itself may not be able to represent the accident environment of the subject intersection.

4.2.3 Accident Rate Based on Signal Timing

With a few exceptions, signalized intersections in Manhattan have 90 seconds of pre-timed signal length. Out of the 202 study intersections, 167 intersections are signalized. Signal timing is a variation of longest signal phase within 90 seconds of cycle length. The proportion of signal timing has been explored for a possible relationship with accidents. The curve fitting analysis on the relationship between signal timing and accident frequency is as following:

Correlation Coefficient: -0.33634

Determination Coefficient: 0.113126

Error: 78.923%

The negative number in the correlation coefficient indicates that total accident frequency decreases as the longest signal phase increases. From the curve fitting equation, accident frequency becomes negative when the signal phase on the major approach goes beyond 72.65 seconds. However, the maximum timing in Manhattan is 65 seconds.

$$Y = 305.87845 - 4.21901X \qquad (4.5)$$

Table 4.7 shows average accident frequency per signal timing.

Table 4.7 Signal Timing and Accident Frequency

Signal Timing	Average Accidents	Number of Intersections
35	229	1
40	155.75	4
45	120.13	23
50	89.74	51
55	69	71
60	72	15
65	65.5	2

As shown in Figure 4.5, the number of accidents decreases as the signal phase on major approaches increases. As previously discussed, lane efficiency is higher at multi-lane approaches and the accident rate per vehicle volume declines. Consequently, signal timing variation can be used as an accident surrogate representing the ratio of major and minor approaches.

4.2.4 Accident Rate Based on Crosswalk Dimension

Crosswalk dimension represents the overall size of intersections, unless medians or other exceptional geometry exists. When the size of an intersection increases, traffic demand is assumed to generally increase as well. Table 4.8 shows a curve fitting analysis on crosswalk dimension in four different types of calculations.

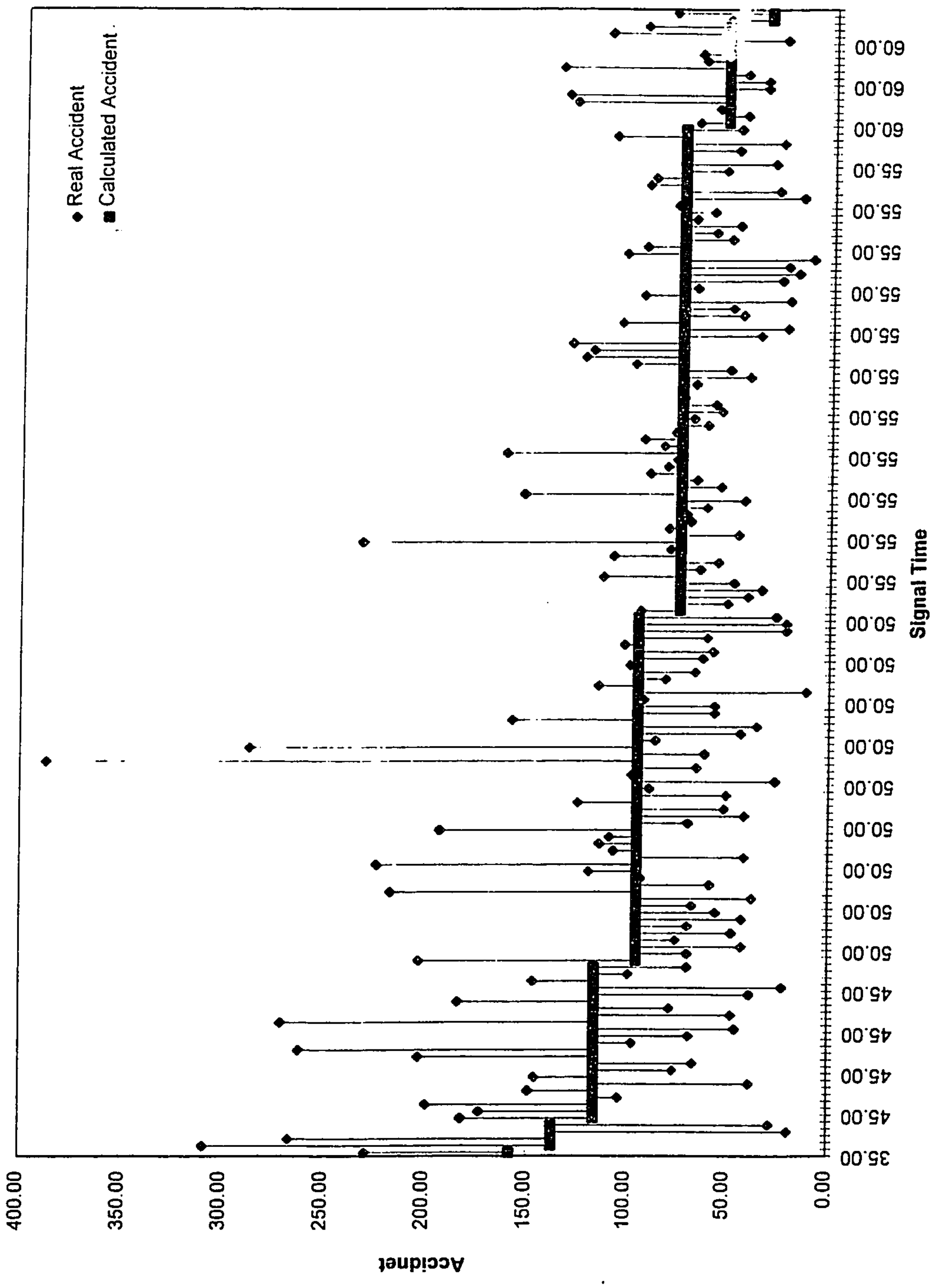


Figure 4.5 Signal Timing and Accident Frequency

Table 4.8 Crosswalk Dimension Correlations

Crosswalk Dimension	Correlation Coefficient	Determination Coefficient	Error
W1	0.45	0.1998	1.09
W1/W2	0.18	0.0328	1.46
W1*W2	0.54	0.2947	0.98
W1+W2	0.57	0.3202	0.91

W1: the longest crosswalk

W2: longer crosswalk adjacent to W1

The highest correlations are found for the sum of W1 and W2, and correlations are lowest for the ratio of W1/W2. Figure 4.6 contains the graph for the variable W1 + W2. Crosswalk dimensions are also related to traffic demand and to accident frequency. In general, accident frequency increases as more vehicles transverse wider intersections. The calculated correlation between crosswalk dimension and traffic volume is considerably high, 0.59, and the relationship between traffic volume, crosswalk dimension, and accident frequency is higher than any other variables discussed so far. Table 4.9 and Figure 4.7 present a breakdown of crosswalk dimension and its relationship to traffic volume and average accidents.

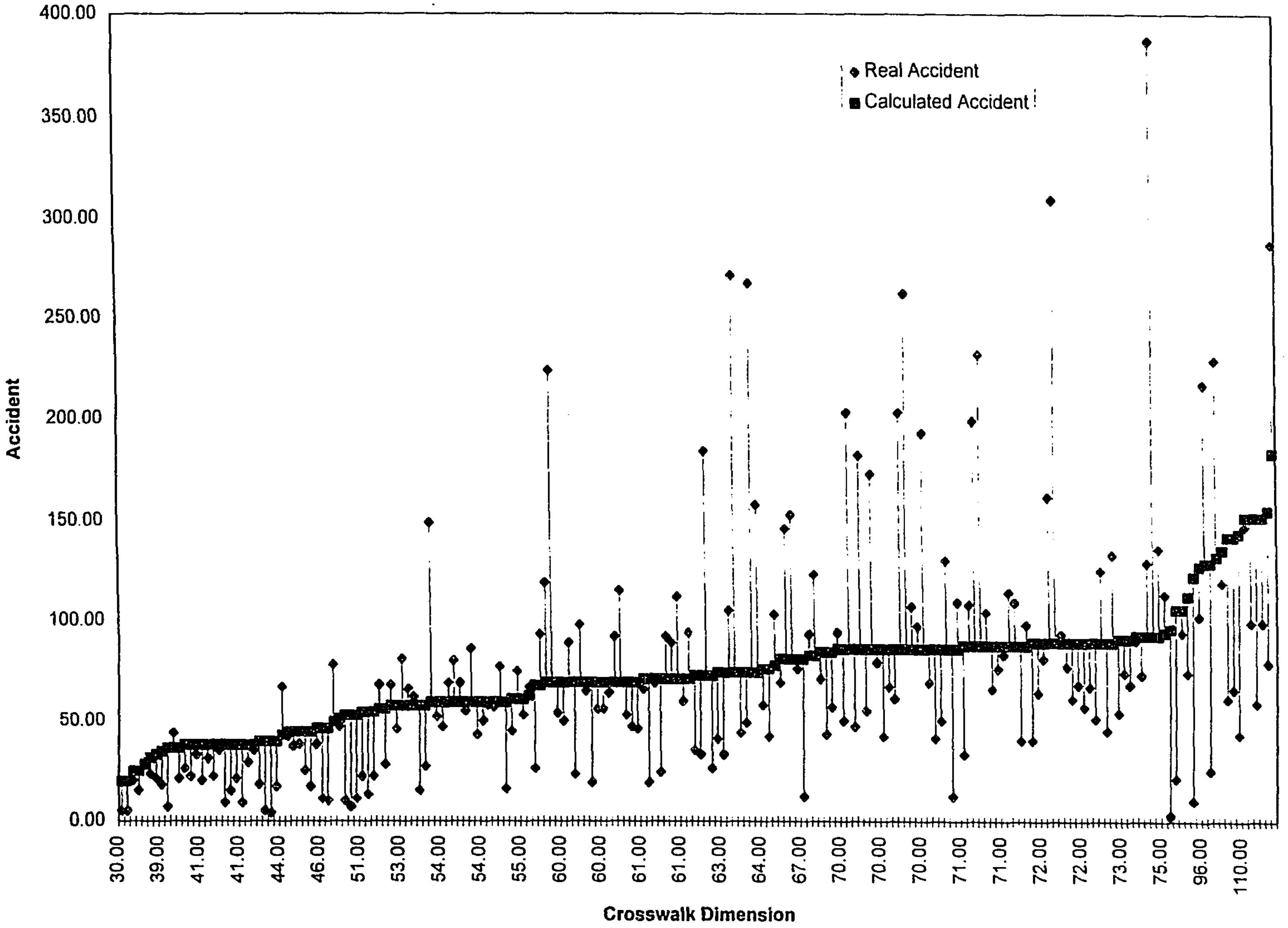


Figure 4.6 Crosswalk Dimension and Accidents

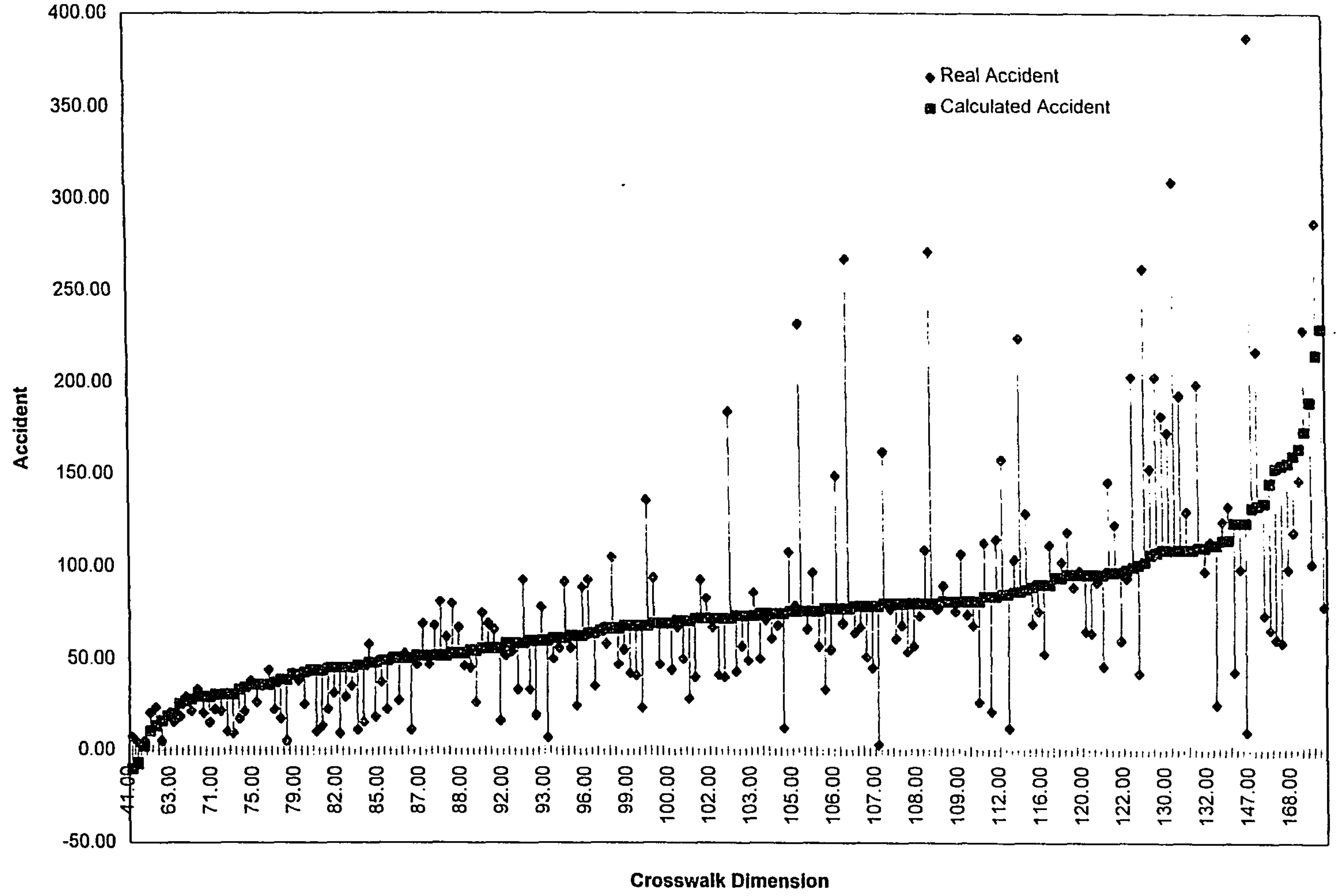


Figure 4.7 **Crosswalk Dimension and its Relationship with Traffic Volume and Accidents**

Table 4.9 Crosswalk Dimension and Accidents

Crosswalk Dimension	Average Dimension	Traffic Volume	Average Accident	# of Locations
<60	49.6	5686	11.8	5
<80	71.58	9474	22.58	24
<100	89.66	19372	47.79	59
<120	106.92	24887	82.85	70
<140	126.00	30393	130.32	28
<160	146.00	32184	128.00	7
<180	168.00	35508	119.00	6
>180	206.00	26197	156.00	3

As shown in Table 4.10, the end result of the analysis on actual crosswalk length is quite similar to that of the total crosswalk dimension. When the width of existing parking lanes is excluded from the calculation, the traffic volume per lane increases and the number of accidents increases as well.

Table 4.10 Actual Crosswalk Dimension and Accidents

Crosswalk Dimension	Average Dimension	Traffic Volume	Average Accident	# of Locations
<60	43.18	13051	33.57	61
<80	70.00	23506	69.50	80
<100	84.76	28186	104.32	34
<120	107.41	31950	125.00	12
<140	127.40	32706	121.70	10
>140	168.80	32681	214.40	5

4.2.5 Accident and Roadway Type

The roadways transversing the 202 study intersections have been classified into arterials and local roads. This involved three types of roadway junctions; arterial/local, arterial/arterial, or local/local. The relationship between the roadway types and accident frequency is shown in Table 4.11.

Table 4.11 Accident and Roadway Type

Roadway Type	Traffic Volume	Average Accident	Volume per Accident	Number of Locations
Arterial/Local	29527	130.18	226.81	95
Arterial/Arterial	23621	61.18	386.09	59
Local/Local	10686	30.14	354.54	48

The above analysis indicates that both traffic volume and accident frequency are high at the juncture of arterial/local facilities. When arterial/local intersections are compared with local/local intersections, the former experience three times the volume and 4.3 times the accident frequency of the latter; the former is 37 percent more dangerous in terms of volume per accident. The arterial/local intersections have the highest volume and accident rate. Arterial/arterial intersections are the least hazardous with a 386.09 ratio of volume per accident.

4.2.6 Severity Adjustment

Injury and fatal accidents have been converted into the simple frequency of PDO (property damage only) type accidents or EPDO (equivalent-property-damage-only) accidents. The National Safety Council (NSC) classification uses:

$$EPDO = 9.5(F + A) + 3.5(B + C) + PDO \tag{4.6}$$

where the letters indicate F for fatal, A, B, and C-type injury accidents.

New York State Department of Transportation defines the injury classes A as: severe lacerations, broken or distorted limbs, skull fractures, crushed chest, internal injuries, unconscious when taken from accident scene, unable to leave accident scene without assistance; B as: Limp or head abrasions or minor lacerations, and C as: momentary unconsciousness, limping, nausea, hysteria, complaint of pain but no visible injury. Injury-No Class in this study means unidentified injury class.

Non-reportable accidents are the incidents without police reports or those with damage estimates below $1,000. Non-reportable comprise approximately 20 percent of the total frequency. Non-reportable also include any property damage only (PDO) accidents reported through police, without estimate of damage. The Traffic Record Bureau of the New York State Department of Motor Vehicles waits 30 days after the date of an accident for the motorist's report or an estimate from any involved insurance company to match with the police report. As shown in the attached pages, non-reportable accidents have a date of accident occurrence and a Department of Motor Vehicles (DMV) case number.

Table 4.12 presents the logic behind the proposed severity factor developed for the project's safety index.

Table 4.12 Preliminary Accident Cost Per Accident Class

Abbreviation	Accident Class	Average Cost	Relative Weight
NR	Non-Reportable	700	1
PD	Property Damage	2,975	4
IC	Injury-Class C	53,000	76
IB	Injury-Class B	212,000	303
IA	Injury-Class A	850,000	1214
FA	Fatal Accident	1,910,000	2729
IN*	Injury-No Class	154,785	221

Each accident is multiplied by its relative weight (RW) and summed for a single total result. The natural log of the total yields the actual severity factor. A general chart is utilized to determine its level of severity. For example: 0.0 to 3.0 = acceptable, 3.0 to 6.0 = not severe, 6.0 to 9.0 = severe, and 9.0 & up = most severe. The severity rating will be further developed through computer processing of CLASS data, under different categories of Accident Type, Type of Collision, and Roadway Class.

4.2.7 Accident Frequency Factor and Severity

The relationship between the severity and accident frequency has been investigated. Table 4.13 shows the accident frequency against accident severity.

Table 4.13 Accident Frequency Per Accident Severity

Accident Severity	Accumulated Accident Frequency	Percentage
X0 (Fatal Accident)	11	0.07
X1 (Injury - A Class)	455	3.04
X2 (Injury - B Class)	762	5.10
X3 (Injury - C Class)	2512	16.80
X0_1 (Property Damage)	1094	7.32
X0_2 (Non-Reportable)	10114	67.66

The formula for accident severity is:

$$SF = \mathrm{Ln}\,(X0 * 2729 + X1 * 1214 + X2 * 303 + X3 * 76 + 4 * X0\_1 + X0\_2) \qquad (4.7)$$

Since the formula reflects accident frequency, the frequency has been adjusted by assigning a certain weight. As shown in the above table, non-reportable accidents are 67.66 percent, while fatal accidents are only 0.07 percent of the total fatal accident is, therefore, assigned the weight of 2,729 against a non-reportable accident.

The accident severity and accident frequency resulted in higher correlations, as shown in Table 4.14.

Table 4.14 Accident Severity Correlations

Accident Severity	Correlation Coefficient	Determination Coefficient	Error
X0 + X1	0.67138	0.4507	1.09
X2	0.59030	0.3484	1.46
X3	0.60034	0.3604	0.98
X0_1	0.51387	0.2640	0.91
X0_2	0.52117	0.2716	

4.2.8 Speed Variance and Taxi Involvement

Most accidents result from a combination of several contributing factors, such as unsafe human behavior, roadway condition, vehicular malfunction, and so on. Nationwide, about 80 percent of the total accidents were attributed to human behavior, roughly 15 percent to environmental factors, and the remaining 5 percent to vehicular malfunction.

In Manhattan, during the three year period of 1989-1991, the apparent accident contributing factors are 45.6 percent human, 5.6 percent environmental, 4.7 percent vehicular, and 44.1 percent none or unspecified. Unsafe speed averaged 3.1 percent out of the total 45.6 percent of accidents caused by human factors. Although it is known that several speed characteristics may affect accident rates, the CLASS summary indicates that speeding is not a major contributing factor in traffic accidents in Manhattan's grid system. According to New York City Department of Transportation's field speed survey, the combined avenue and street speed for the fall of 1993 was 6.5 mph. Speeds on avenues in Midtown Manhattan averaged 7.8 mph, and speeds on streets were 5.4 mph, which was lower than that of avenues. The actual approach speeds at intersections were observed to be stable; and the speed limit on the local roads in New York City is 30 mph.

The New York City taxi service has long a history, beginning 1907, and it plays an important role in paratransit, especially in Manhattan. As of 1989, 43,925 taxicabs were registered in New York City out of 2,015,629 total automobiles, or two percent of the total. New York City accidents involving taxis are roughly nine percent, and the proportion is considerably high compared to the number of registered vehicles. However, the higher proportion of taxi-involved accidents can be explained by higher VMT (vehicle miles traveled), or VIM (vehicle in motion) in comparison with automobiles. Since most cab drivers shun the outer boroughs, yellow cabs cruise around Manhattan contributing about 50% of the VMT. Therefore, a separate variable of taxi involvement in accidents was not included in the analysis.

4.3 Pedestrian Factors

As pedestrian activity in the CBD area constitutes a substantial portion of urban transportation, conflicts between pedestrians and vehicles occur at nodes or intersections of urban areas. In 1991, 4,284 pedestrian accidents, 25 percent of total accidents, were reported in Manhattan. The proportion of pedestrian-involved accidents is 17 percent citywide, and the lowest is in the borough of Staten Island with six percent. Out of 4,284 pedestrian accidents, 65 were fatal and the rest were injury accidents, indicating the high severity of pedestrian accidents. Safety variables related with pedestrian accidents have been investigated to analyze the accident contributing factors such as traffic volume, crosswalk length, floor area of adjacent buildings of the study intersections, signal timing, and conflict points.

4.3.1 Pedestrian Accident and Traffic Volume

During the three year period, the number of average pedestrian accidents at the 202 study intersections was 5.8, and there were 26 (12%) locations without any pedestrian accidents. Table 4.15 compares pedestrian accidents with traffic volume.

Table 4.15 Pedestrian Accident and Traffic Volume

Pedestrian Accident	Traffic Volume	# of Locations
0	12655	26
1	14240	22
2	16315	24
3	21351	22
4	23209	19
5-9	27229	49
10-14	28990	22
15-20	28474	9
20-over	37327	31

The correlation between pedestrian accidents and traffic volume is considerably high (0.53361), and the relationship is also shown in Figure 4.8. As Table 4.16 indicates, pedestrian accidents increase with traffic volume, and the type of intersection control does not significantly affect pedestrian safety.

Table 4.16 Pedestrian Accident and Type of Control

Type of Control	Traffic Volume	Pedestrian Accident (Avg.)	Number of Locations
Signal Control	25588	6.7	167
Stop Control	6729	1.22	35

Based on the accident data at 202 sample intersections, 20 intersections with high pedestrian accidents were selected for an in-depth analysis. Table 4.17 summarizes the pedestrian accidents and traffic data at those 20 intersections. The curve fitting analysis has

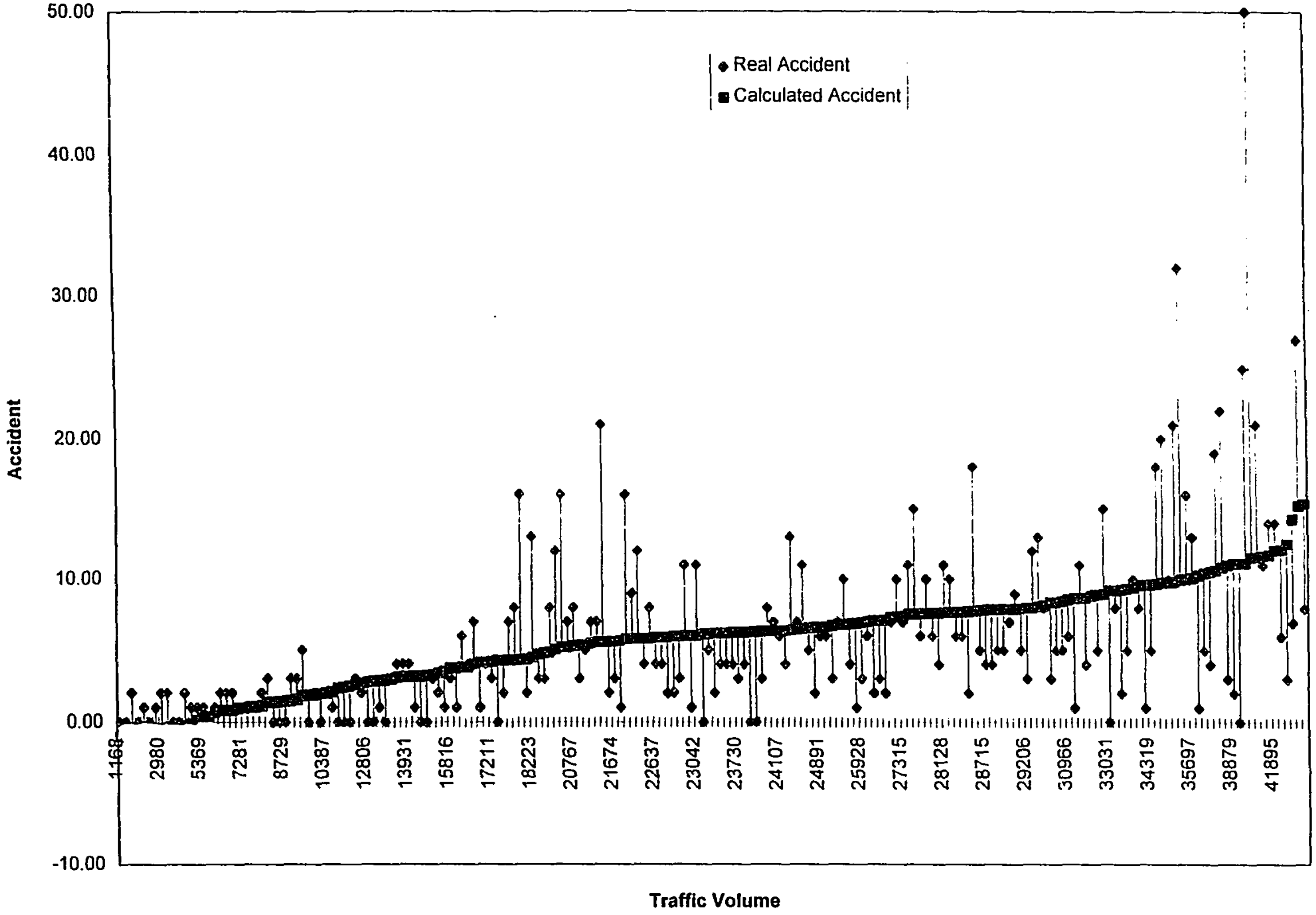


Figure 4.8 Traffic Volume and Pedestrian Accident

been used to find an adequate exposure measure for traffic volume and percentage of turning vehicles. Different exposure measures and their correlations are shown in Table 4.18.

Table 4.17 Traffic Data and Pedestrian Accident at Sample Intersections

Intersection No.	Ped. Volume	Vehicle Volume	Left Turn Vehicle	Thru Vehicle	Right Turn Vehicle	Ped. Accident
8	121	210	53	157	0	19
12	312	210	40	170	0	14
15	113	629	44	457	128	16
21	221	533	37	436	60	18
33	275	451	42	355	54	21
35	1409	335	0	330	5	27
44	419	410	0	303	107	14
47	905	409	0	402	7	21
51	178	365	39	283	43	25
54	250	435	23	361	51	32
57	243	482	0	428	54	21
59	336	532	29	462	41	50
72	185	184	64	120	0	16
73	201	214	0	194	20	20
100	89	272	63	190	19	22
118	44	223	78	113	32	16
126	282	223	36	151	36	15
134	702	108	13	85	10	18
157	173	420	56	302	62	15
177	96	130	28	85	17	16

Table 4.18 Pedestrian Accident and PV Factor

Exposure Measure	Correlation Coefficient	Determination Coefficient
Pedestrian Volume	0.18983	0.0360
Vehicle Volume	0.37247	0.13873
Ped*Veh/Turn	0.18032	0.03251
Ped*Veh	0.33245	0.11052
Veh/Ped	-0.10264	0.01053

Vehicle volume shows the best relationship among the exposure measures reviewed. The number of accidents increases as vehicle volume increases, and the multiplication of pedestrian volume by vehicle volume shows a high correlation as well. An equation to estimate the safety at intersection can be derived as follows:

$$\text{Accident Rate} = \frac{\text{Number of Acc. x } 10^8}{\text{Exposure Measure}} \qquad (4.8)$$

From Table 4.18, three different exposure measures have been selected to analyze a relationship with pedestrian accidents, and the result of the curve fitting analysis is shown in Table 4.19.

Table 4.19 Pedestrian Accident Rate

Accident Rate	Exposure Type	Correlation Coefficient	Determination Coefficient
1	Veh. Vol.	0.17419	0.0303
2	P x V	-0.15260	0.02328
3	P*V/Turns	-0.21952	0.048

The accident rate using P*V/Turns shows a better correlation than that using a pedestrian factor, vehicle factor, or PV factor. This means that the number of turning vehicles contributes more significantly to accident frequency. As a result, intersections with lower vehicle and pedestrian volume and higher proportion of turning vehicles generates a higher accident rate.

Table 4.19 shows that accident rates can be better determined by a matrix of variables. For example, accident rates are low at intersections 33, 44, 47, and 57, where the PV factor is comparatively high but the proportion of turning vehicles is low. At intersection 118, the multiplication of pedestrian and vehicle volume, PV factor, is low (9812), but the ratio of turning vehicles is high (97%), resulting in the highest accident rate. Due to difficulties in representing pedestrian activities, other pedestrian data such as pedestrian level of service, crosswalk marking conditions, and existence of mass transit facilities were not incorporated in the analysis.

4.3.2 Pedestrian Accident and Crosswalk Size

The analysis on pedestrian accident and crosswalk dimension investigates the influence of length of crosswalk on pedestrian accidents. As safety variables, the crosswalk lengths both at major and minor approaches are analyzed. Table 4.20 contains the curve fitting curve analysis on the correlations of pedestrian accident and crosswalk length.

Table 4.20 Pedestrian Accident and Crosswalk Size

Crosswalk Dimension	Correlation Coefficient	Determination Coefficient	Error
W1/W2	- 0.10463	0.010947	1.46
W1+W2	0.37446	0.140221	0.91

W1: the longest crosswalk, W2: longer crosswalk adjacent to W1

The above table indicates that the ratio of W1 (longest crosswalk) over W2 (longer crosswalk adjacent to W1) resulted in a negative correlation confirming the assumption that longer crosswalks are more exposed to pedestrian accidents. Instead, the sum of W1 and W2 shows a high correlation of 0.37446. However, the accident frequency decreases at intersections where crosswalk size is longer than 150, as shown in Figure 4.9.

4.3.3 Floor Area and Signal Timing

The total floor area of adjacent buildings to the study intersections has been investigated, to evaluate the concept that a pedestrian trip generation rate is a factor in accidents. The result of curve fitting analysis indicates that the correletation coefficient (-0.01362) and determination coefficient (0.00018) are too low to allow the variables to be included in the model.

The proportion of signal timing is an important environmental factor for pedestrian safety, generally dependent on crosswalk size. According to the curve fitting analysis, the correlation coefficient is - 0.35246. As shown in Figure 4.10, the number of pedestrian accidents decreases as signal timing increases at wider crosswalks. For example, the average crosswalk size is 86 feet at intersections with 35 seconds of pedestrian crossing time. This is the lowest proportion of pedestrian crossing time at the 202 study intersections. Technically, pedestrians should have enough time to complete the crossing at one time at the speed of 2.45 fps. However, the accident data indicate that these locations are more exposed to pedestrian hazards.

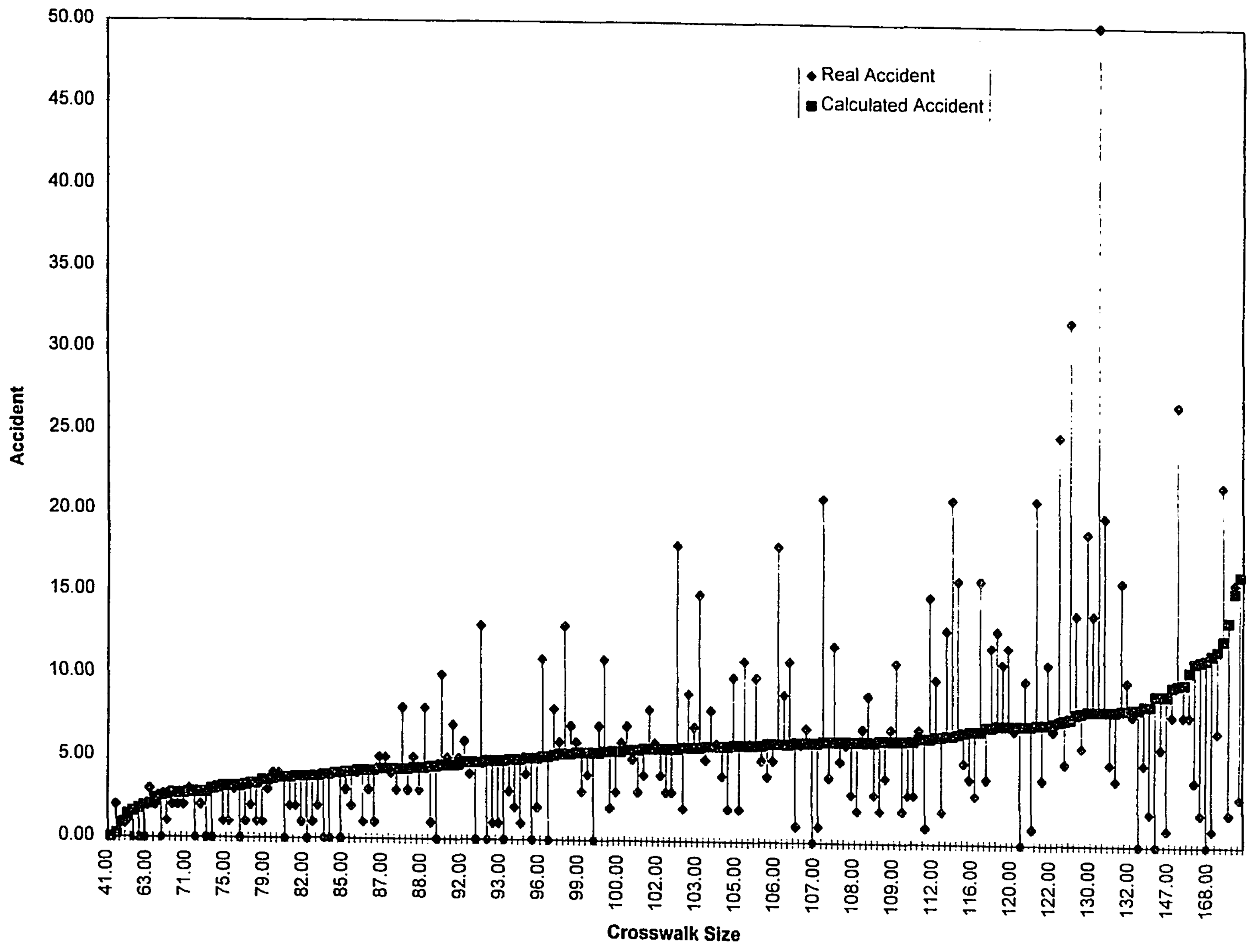


Figure 4.9 Pedestrian Accident and Crosswalk Dimension (W1 + W2)

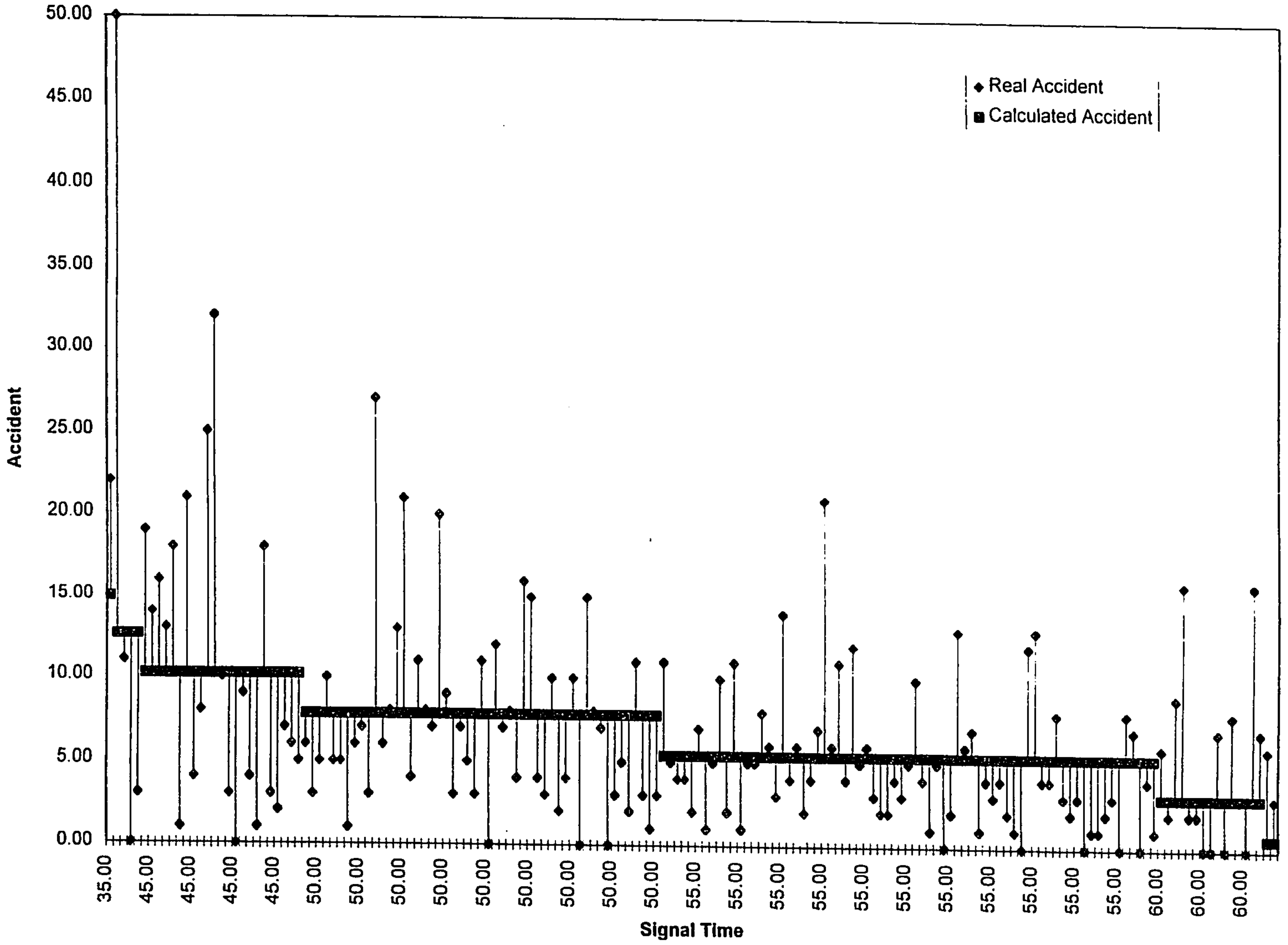


Figure 4.10 Pedestrian Accident and Signal Timing

4.3.4 Pedestrian Accident and Conflicts Points

The traffic conflicts technique (TCT) has been applied to estimate the relationship between traffic conflicts and pedestrian accidents. The frequency of pedestrian accidents correlates to some extent with the number of conflicts. However, as shown in Table 4.21 and Figure 4.11, the average accident frequency decreases as the number of conflicts gets beyond to 12. Between conflict points 6 and 8, traffic volume and the number of pedestrian accidents decrease, although crosswalk dimension increases gradually. Consequently, the relationship between pedestrian accidents and conflict points need to be analyzed in a more comprehensive way to include other factors such as traffic volume or crosswalk dimension.

Table 4.21 Pedestrian Accident and Conflict Points

Conflict	Average Accident	Crosswalk Dimension	Traffic Volume	# of Location
<4	1.1818	65.54	7148	11
<6	4.22	93.97	20827	100
<8	3.75	100.60	17496	33
< 10	11.18	118.79	29875	34
< 12	13.66	121.44	33102	9
>= 12	7.47	156.73	30425	15

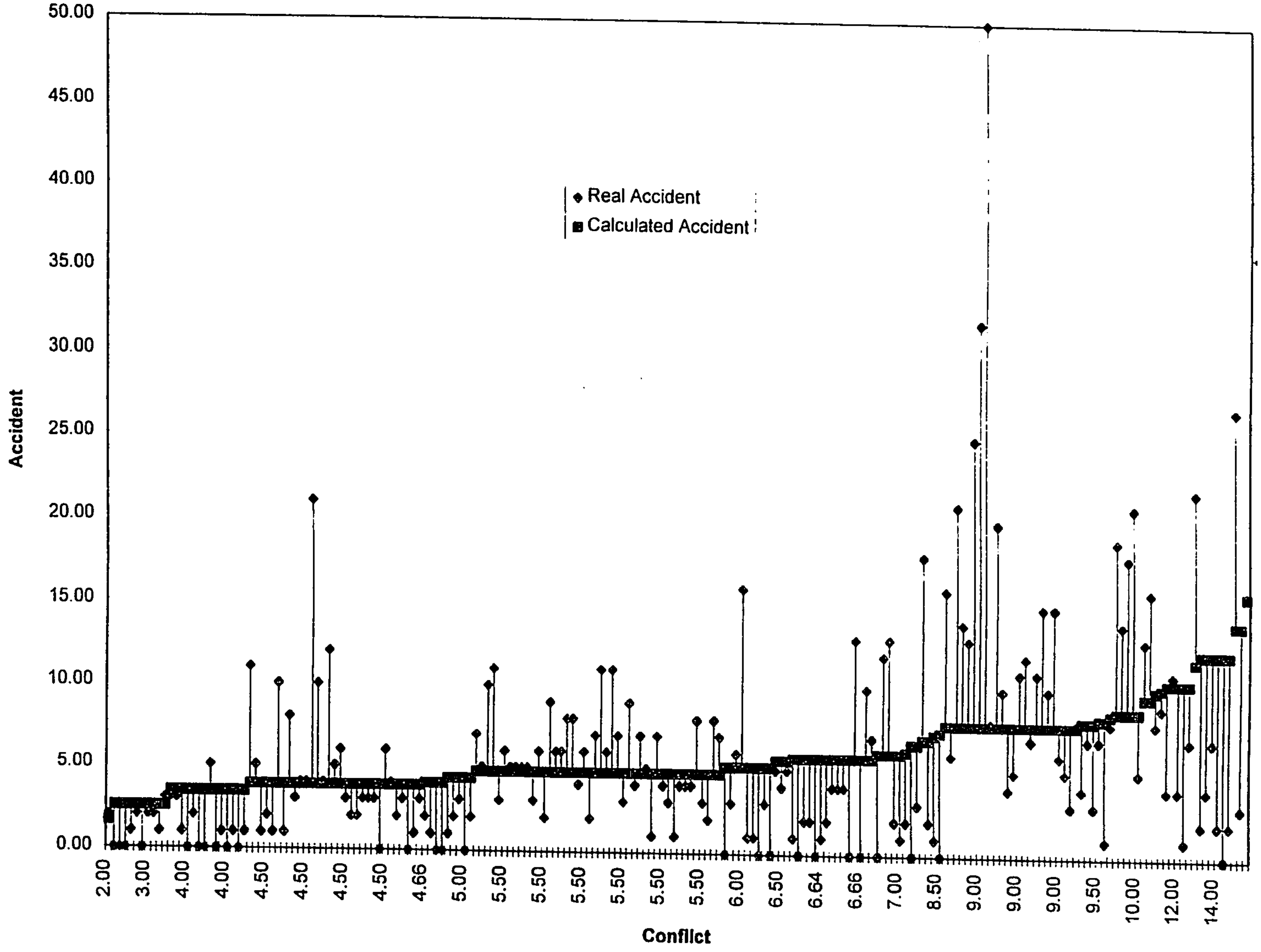


Figure 4.11 Pedestrian Accident and Traffic Conflict

CHAPTER V

DEVELOPMENT OF TRAFFIC SAFETY INDEX

5.1 Introduction

The final stage of this project is to create a user-friendly software program, which provides a safety index rating to illustrate the relative hazardousness for Manhattan intersections. CASIUS is an acronym for Computer-Aided Safety Index for Urban Streets. This computer program consists of a database module and an analysis module. The analysis module identifies locations with safety problems based on composite factors which consist of accident severity and accident frequency.

An existing similar computer program is Highway Safety Analysis & Monitoring (HISAM), developed by Harkey et al. in 1987, sponsored by USDOT's Federal Highway Administration (FHWA). Currently, the program is not widely used, and its major drawback is that the outcome of the calculation does not represent an evaluation of the study location's safety. The converted Equivalent Property Damage Only (EPDO) numbers do not provide any meaningful conclusion due to the lack of comparison of results with other study locations.

5.2 CASIUS Logic

The logic behind the CASIUS severity factor index development is presented in Tables 5.1 and 5.2. The average percentage of injury accidents for each class developed in Table 5.2 is used in CASIUS.

Table 5.1 Accident Cost Per Accident Class

Abbreviation	Accident Class	Average Cost	Relative Weight
NR	Non-Reportable	700	1
PD	Property Damage	2975	4
IC	Injury-Class C	53000	76
IB	Injury-Class B	212000	303
IA	Injury-Class A	850000	1214
FA	Fatal Accident	1910000	2729
IN	Injury-No Class	154785	221

Table 5.2 Injury Accident Class Statistics

YEAR	TOTAL	A	B	C
1989	116308	11285	22137	82886
1990	112245	11273	21731	89241
1991	118964	10466	20209	88289
TOTALS	357517	33024	64077	260416
AVERAGE	119172	11008	21359	86805
PERCENT	100%	9.2%	17.9%	72.9%

Each accident is multiplied by its relative weight (RW) and summed so that a single total results for the location under review. The natural log (Ln) of the total yields the actual severity factor. The procedure is demonstrated with examples in Table 5.3. To determine the severity level, the severity factor chart of Table 5.4 is used. Various levels of severity can be determimed primarily from the relative weights assigned to each accident class. For example, one can assume that combinations of non-reportable and property damage only accidents should indicate little or no severity. Likewise, if only one Class C injury accident was included, then the severity should rise to the next level. Continuing with this logic, the next severity level would require only one Class B injury accidents added to the previous level and so on to the highest level attainable.

Table 5.3 Examples on Determining Relative Weight and Severity Factor

<table>
<tr><th colspan="7">ACCIDENTS</th></tr>
<tr><th>TOTAL</th><th>FA</th><th>IA</th><th>IB</th><th>IC</th><th>PD</th><th>NR</th></tr>
<tr><td colspan="7">1. Boro: Manhattan, Intersection: Park Avenue at 33rd Street (3 year average)</td></tr>
<tr><td>65</td><td>0</td><td>3</td><td>25</td><td>12</td><td>4</td><td>21</td></tr>
<tr><td colspan="7">Relative Weight = 12,166; Severity Factor = 9.4 (highest)</td></tr>
<tr><td colspan="7">2. Boro: Manhattan, Intersection: Park Avenue at 40th Street (3 year average)</td></tr>
<tr><td>29</td><td>0</td><td>1</td><td>3</td><td>9</td><td>1</td><td>15</td></tr>
<tr><td colspan="7">Relative Weight = 2,826; Severity Factor = 7.9 (medium/high)</td></tr>
<tr><td colspan="7">3. Boro: Queens, Intersection: Cross Bay Blvd at S. Conduit Ave (1990 reports)</td></tr>
<tr><td>31</td><td>0</td><td colspan="3">IN = 10</td><td>4</td><td>17</td></tr>
<tr><td colspan="7">Relative Weight = 2,243; Severity Factor = 7.7 (medium)</td></tr>
<tr><td colspan="7">4. Boro: Queens, Intersection: Woodside Ave at 37th Ave (1990 reports)</td></tr>
<tr><td>9</td><td>0</td><td colspan="3">IN = 3</td><td>1</td><td>5</td></tr>
<tr><td colspan="7">Relative Weight = 672; Severity Factor = 6.5 (low)</td></tr>
</table>

Table 5.4 Severity Factor Chart

SEVERITY FACTOR [Ln (RW)]	DESCRIPTION SEVERITY LEVEL	RELATIVE WEIGHT (RW)
0.0 TO 3.0	NONE/NO SEVERITY	0 TO 20
3.0 TO 6.0	LOWEST SEVERITY	20 TO 400
6.0 TO 7.0	LOW SEVERITY	400 TO 1100
7.0 TO 8.0	MEDIUM SEVERITY	1100 TO 3000
8.0 TO 9.0	HIGH SEVERITY	3000 TO 8100
9.0 TO 9.9	HIGHEST SEVERITY	8100 TO 20000

Table 5.5 presents the logic behind the development of an intersection type factor which is a part of the CASIUS safety index development. It can be postulated that as a location becomes a more complex form, driver error and hence accident experience will increase. For example, a road link (assume all AASHTO design criteria are met), should experience fewer accidents than a “T” intersection, while a four-way intersection should experience a higher number of incidents than a “T”, and so on. If it is assumed that under perfect conditions, this relation is due solely to potential conflict points, then the number of conflict points should fairly reflect the change in complexity (and possibly accident experience) at a locations.

Table 5.5 Conflict Points Per Lane-Movement

MOVEMENT	NO. OF CONFLICTS
LEFT TURN	3
STRAIGHT	2
RIGHT TURN	1

Notes: A. Two-way link has 2 conflict points/lane

B. One-way link has 1 conflict point/lane

C. At intersections, add individual movements and multiply by table factor and lanes.

Given the above assumptions, conflict point analysis yielded the most efficient method of determining the number of conflict points (CP) for a given location type. Some typical examples of intersection conflict points are presented in Table 5.6.

Table 5.6 Typical Intersection Examples

Direction of Travel (DT)	Right (R)	Through (T)	Left (L)	Conflict Points (CPs)
Northbound	1	1	1	6
Southbound	1	1	1	6
Eastbound	1	1	1	6
Westbound	1	1	1	6
TOTAL				24

NB = 2-way, SB = 2-way, EB = 2-way, WB = 2-way

Table 5.6 (Continued)

DT	R	T	L	CPs
NB	1	1	1	6
SB	-	-	-	0
EB	-	1	1	5
WB	1	1	-	3
TOTAL				14

NB = 1-way, SB = n/a, EB = 2-way, WB = 2-way

DT	R	T	L	CPs
NB	1	1	-	3
SB	-	-	-	0
EB	-	1	1	5
WB	-	-	-	0
TOTAL				8

NB = 1-way, SB = n/a, EB = 1-way, WB = n/a

Non-reportable (NR) and property damage (PD) accident classes carry little weight in determining the severity factor. Yet they account for almost 70% of the total accidents in New York City. One of the primary purposes of the CASIUS safety index is to provide a tool to reduce accidents, regardless of class, type or location.

The accident frequency factor helps recognize the importance of the non-reportable and property damage accidents classes as indicators of unsafe conditions at specific locations. This factor ensures a proper safety evaluation where the accident experience is predominated by these two classes.

The preliminary basis for this factor are: percentage of total accidents which fall into these two classes, a minimum level of accidents, and the prevalence of certain accident types. The overriding purpose is to determine if the potential for more serious accidents exist.

An investigation of the overall average percentage of non reportable and property damage versus total accidents was conducted to get a sense of the normal range of expectation. This was joined by a similar review of average total accident experience. Then, a detailed analysis of accident types and their tendency towards certain levels of severity was integrated to form the basis of the accident frequency factor.

5.3 Application of CASIUS Program

The subject of this dissertation is unique for it deals with an urban area with complex traffic environments where pedestrian factors prevail. The CASIUS program, as an end result of the project, is a comprehensive safety analysis tool which includes possible accident variables at study locations. This user-friendly computer program provides a location-specific accident frequency factor to reflect the safety environment of the intersection.

The required input variables include roadway type, traffic volume at the designated intersection, signal timing, conflict points, and crosswalk size. These five variables can be converted into a multiple curve fitting equation to produce an expected number of accidents and frequency factor. The multiple curve fitting equations are as following:

$$\sum X1 = aN + b\sum X2 + c\sum X3 + d\sum X4 + e\sum X5 \tag{5.1}$$

$$\sum X1X2 = a\sum X2 + b\sum X2X2 + c\sum X2X3 + d\sum X2X4 + e\sum X2X5 \tag{5.2}$$

$$\sum X1X3 = a\sum X3 + b\sum X3X2 + c\sum X3X3 + d\sum X3X4 + e\sum X3X5 \tag{5.3}$$

$$\sum X1X4 = a\sum X4 + b\sum X4X2 + c\sum X4X3 + d\sum X4X4 + e\sum X4X5 \tag{5.4}$$

$$\sum X1X5 = a\sum X5 + b\sum X5X2 + c\sum X5X3 + d\sum X5X4 + e\sum X5X5 \tag{5.5}$$

Where,

X1: number of accidents

X2: roadway type (arterial/arterial, arterial/local, local/local)

X3: conflict point (refer to Tables 5.5 and 5.6)

X4: signal timing (green time for the approach - sec.)

X5: crosswalk size (feet)

N: total intersections

The value of a, b, c, d, and e can be obtained by solving equations 5.1 to 5.5. The final linear equation to produce an expected accident frequency X1 is:

$$X1 = a + bX2 + cX3 + dX4 + eX5 \tag{5.6}$$

A default value is assigned by CASIUS for unknown variables. For example, if number of accidents is unknown, the other four variables of conflict point, crosswalk size, signal timing, and roadway type are to be applied for the above equation. However, the roadway type is a required input variable. The equation for the 202 sample intersections is:

$$X1 = 5.6474 + -0.19763X2 + 0.21628\,X3 + 2.15198\,X4 + 0.0017X5 \tag{5.7}$$

A database file was made to accommodate the location data for the 202 study intersection, and Clipper 5 was used for programming. The end result of the study presents a good relationship between traffic volume and accident frequency. However, the roadway type does not show a strong relationship with the number of accidents. The CASIUS program has been applied to seven randomly-selected test locations, and the results are shown in Table 5.7.

Table 5.7 Application Results at Test Locations

		Conflict1[A]			Conflict2[A]			Daily	X1	
Int.	Crosswalk	L	T	R	L	T	R	Volume	Accidnt[B]	FF[C]
1	70:29	0	5	1	0	2	1	36753	79.82	7.31
2	70:29	1	3	0	0	3	1	32990	79.29	7.30
3	52:66	1	1	0	0	4	1	25624	57.20	6.75
4	31:26	0	2	1	1	2	1	7867	40.08	6.16
5	30:38	1	2	1	1	2	1	2021	29.05	5.62
6	45:30	0	2	1	1	5	0	7535	37.04	6.03
7	45:30	1	4	0	0	2	1	7484	34.81	5.92

[A] Conflict points (see Tables 5.5 and 5.6)
[B] Number of predicted accidents
[C] Accident frequency factor

In Table 5.7, the second column (crosswalk) is the footage showing crosswalk length at the major and minor roadways. Conflict1 is the sum of conflict points on the major roadway and Confilict2 is that of the minor roadway. For example, for intersection 1 at Second Avenue and East 52nd Street in Manhattan, the main roadway (Second Avenue) has 5 through and one right turn lanes and the minor roadway (East 52nd Street) has 2 through and one right turn lanes. Left turns are prohibited on both approaches. Second Avenue is an arterial running north to south, and E. 52 Street is an one-way local street running east. The signal timing split for the intersection is 55 by 35 seconds, and the crosswalk distance or roadway width is 70 feet for the major and 29 feet for the minor roadway. The sum of automatic traffic recorder (ATR) volume (average daily traffic) is 36,753, and the number of predicted accidents was 79.82. The frequency factor obtained from the CASIUS program is 7.31. Test location two is the intersection of 2nd Avenue and E. 56 Street, with a traffic environment similar to location one, and produces a similar result of 79.29 accidents and a frequency factor of 7.30.

Location three is the intersection of 6th Avenue and 14th Street, where both roadway types are arterials. Sixth Avenue is a four-lane one way arterial running south, and 14th Street is a four-lane arterial running east and west, with two lanes in each direction. The number of accident at this intersection is predicted to be 57.20 and the frequency factor is 6.75. At Bleeker and Thompson Streets (location 4), the frequency factor is 6.16, which is similar to that of the previous intersection. However, the predicted accidents were 40.08, and this an unsignalized juncture of two local streets. Intersection 5, Bradhurst Avenue and W.

151 Street is also a juncture of two local streets and has the smallest number of accidents and frequency factor among all of test locations. Intersection 6, Dyckman and Payson Avenues, is a juncture of an arterial and a local street. However, the volume is considerably low (7,535) and the number of predicted accidents is 37.04. Location 7 is the intersection of Whitehall and Water Streets, where two local streets intersect. Traffic volume is 7,484, and the number of predicted accidents is 34.81. Overall, the accident rate is closely related to the size of traffic volume, but is reversely affected by the width of the roadway.

5.4 Function of the CASIUS PROGRAM

The program was prepared to calculate the expected number of accidents and frequency factor based on roadway type, traffic volume, conflict value, signal time, and crosswalk size. Regression analysis was employed to calculate the expected number of accidents.

1. Main Program

The main program takes input values from the user and stores them in ARRAY INVAL. ARRAY INVAL consists of INVAL(1)--traffic volume, INVAL(2)--conflict value, INVAL(3)--maximum signal time, and INVAL(4)--total length of crosswalk, INVAL(5) roadway type. The input for INVAL should be four variables. However, a variable could be omitted. In that case, its value will be calculated from the other available variables. For example, if variables of traffic volume, signal timing, and crosswalk size were provided as input to the program, expected conflict value would be calculated with given variables.

After all the required input variables are available, subroutine EXPECT_ACC is called which calculates the expected number of accident.

2. **Functions**

CHECKRTYPE: Checks if the roadway type (AA, AL, LL) input is correct.

CHECKNUL: Checks and returns the number of input variables.

DEFAULT 1 (ARY, RTYPE): If the input data were three variables, these would be input as processing function, and ARY and RTYPE as input variables. Checks if variables of ARY are null. Stores the returned value in WHICH. Copies ARY value to XVAL and XVAL2.

DEFAULT-2 (ARY, RTYPE): This function is used to predict missing values when two input variables are null.

DEFAULT-3: This function is used to predict missing value when one input variable is null.

WHICHNULL: Checks which value is null, within ARRAY.

WHICHNULLM: Checks which value in sequence is null, and returns ARRAY WHICH.

WHICHNOT: Checks which value in sequence is not null.

EXPECT-ACC: Calculates and returns expected number of accidents.

MULTI: Is used for DEFAULT 1,2,3, and produces the remaining variables based on the given parameters.

MULTI FUNCTION: Called with WHICH, XVAL, RTYPE. Using ARRAY RETVAL returned from MULTI, calculates the value which is passed as NULL(X = A + BX1 + CX2 + DX3). Returns ARY.

SIGMA: Calculates summation of given ARRAYs.

$$\text{ARRAY}[1] + \text{ARRAY}[2] + \ldots \text{ARRAY}[N] \tag{5.8}$$

MSIGMA: Calculates multiplication of given ARRAYs.

$$\text{ARRAY}[1] * \text{ARRAY}[2] * \ldots \text{ARRAY}[N] \tag{5.9}$$

MYSIGMA: Multiplies the value of MULTI ARRAY with other given ARRAYs and returns the summation.

$$\text{ARRAY}[I,1] * Y[1] + \text{ARRAY}[I,2] * Y[2] + \ldots \text{ARRAY}[I,N] * Y[N] \tag{5.10}$$

MATRIX: Multiplies two given MATRICES.

CHANGE: Exchanges the values in two given ARRAYs.

$$X[R1,i] <-> X[R2,i] \tag{5.11}$$

CHANGEPM: Returns the field value which matches the given variable.

CHAPTER VI

SUMMARY AND CONCLUSIONS

6.1 Summary

The objective of this study was to develop a methodology for measuring intersection safety performance in Manhattan. The major product of the study is a Computer-Aided Safety Index for Urban Streets (CASIUS) program. With the required input variables of roadway type, traffic volume, signal timing, conflict points, and crosswalk size, the safety performance of the subject intersection can be determined. A comprehensive literature search was conducted by both a manual and National Safety Council (NSC) library database search of pertinent highway safety related literature published since 1965. The literature review was composed of three major categories: 1) safety evaluation method, 2) pedestrian safety, and 3) accident cost. The main findings from the literature search was that most traffic safety studies deal with very wide regional safety or location/corridor-specific issues. Also found from the literature review was that most pedestrian studies focus on analysis of accident data, rather than pedestrian accident parameters or pedestrian trip generation exposures. As for accident cost, it was evident that any standard or uniform cost data were non-existent because of the differences between the concepts of economic cost, and value concept.

Data were collected and contributing factors to accidents were analyzed. Accident experience, vehicle counts, and inventories of intersections were quantified for 202 study intersections. The analyses of contributing factors included the parameters of; vehicle volume, traffic conflict point, signal timing, crosswalk dimension, roadway type, severity factor, and speed variance. With the above safety variables applied, pedestrian accidents were reviewed as an independent category.

The CASIUS user-friendly software program was developed to provide safety evaluations of urban intersections. This computer program consists of a database module and an analysis module and identifies locations with safety problems based on accident severity and frequency. The required input variables include roadway type, traffic volume at the designated intersection, signal timing, conflict points, and crosswalk size.

6.2 Conclusions

The computer program identified a close relationship between location hazardousness, roadway capacity, and traffic volume. The roadway capacity is a static analysis, and the actual demand of traffic volume is a dynamic analysis. The frequency factor includes a scale of 0 to 10.

6.3 Transferability of the Model

The CASIUS program, as a comparative tool for analyzing traffic safety, can be applied to other geographical locations as well. For example, the model could be applied to Chicago. However, a model calibration will have to be performed based on local data. Since it is mandatory for all local governments to maintain an accident database, the areawide data could be obtained, arrayed in the required format, and incorporated in the model. Similarly, other required data such as roadway type, traffic volumes, signal timings, etc. could be obtained form the responsible offices or the local traffic agencies. Next, the CASIUS program can be adjusted according to the size and characteristics of the subject study area.

6.4 Limitations and Recommendations for Future Research

The project, a new and meaningful approach in the creation of an areawide safety index, may be limited in its ability to make safety predictions for Manhattan intersections. The 202 study intersections could be a biased sample because these are locations which were previously investigated and are likely to be affected by external factors more than randomly selected intersections.

Secondly, the accident-contributing factors such as the traffic conflict and or vehicle maneuvers, or the combination with traffic volume, are not very well represented in the computer program. Against its initial approach and analysis, the project could not include sufficiently all the factors associated with pedestrian exposure and involvement. Finally, the efficiency of the multiplication factor of accident and pedestrian severity is not well validated.

Currently, the transportation agencies of many local governments do not have a good access to general accident data of state governments. Henceforth, the existing accident data from State governments need to be either connected to local transportation agencies through on-line systems or periodically updated to optical drives. The CASIUS program needs to be further development to accommodate the accident characteristics of the local area. In that case, both groups of study intersections and total population of intersections can be compared with each other, through the scaling of the area total accident rate.

A computerized safety program is recommended for future development, which will be able to produce intersection simulations for safety and present an hourly variation of traffic demand of intersections.

APPENDIX A

NEW YORK STATE CLASS ACCIDENT DATA

TABLE 1 ACCIDENT SUMMARY TOTALS

CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD	CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD
TOTAL ACCIDENTS	22055	17139	22264	17217	PERSONS KILLED(3)	112	112	104	104
FATAL ACCIDENTS	109	109	100	100	DRIVERS KILLED	26	26	13	13
INJURY ACCIDENTS(1)	15731	14653	15799	14600	PASSENGERS KILLED	9	9	10	10
REPORTABLE PROP DAMAGE	6215	2377	6365	2517	PEDESTRIANS KILLED	73	73	79	79
					BICYCLISTS KILLED	4	4	2	2
DRIVERS INVOLVED(2)	37936	28854	38021	28677	PERSONS INJURED(1,3)	21807	20496	21736	20286
VEHICLES	40272	30481	40445	30410	DRIVERS INJURED(1,4)	XXXX	8214	XXXX	7826
PEDESTRIAN ACCIDENTS	4504	4406	4637	4512	PASSENGERS INJ.(1,4)	XXXX	6689	XXXX	6664
BICYCLE/MOTOR VEH ACC	1095	1073	1176	1154	PEDESTRIANS INJURED(1)	4608	4506	4756	4628
VEHICLE OCCUPANTS	58312	44575	59076	45255	BICYCLISTS INJURED(1)	1096	1075	1178	1156

1. EXCLUDES FATALS.
2. DOES NOT INCLUDE PARKED VEHICLES OR BICYCLES.
3. INCLUDES PEDESTRIANS. BICYCLISTS AND ALL OTHER NON-VEHICLE INVOLVED PERSONS AS WELL AS VEHICLE OCCUPANTS REGARDLESS OF SEATING POSITION.
4. DATA GATHERED ONLY FROM POLICE REPORTED ACCIDENTS.

NOTE*SOME OF THE TABLES ARE BASED UPON INFORMATION RECEIVED FROM POLICE AND MOTORIST REPORTS OF MOTOR VEHICLE ACCIDENTS. OTHERS ARE BASED ONLY ON THE POLICE REPORTS. THESE ARE INDICATED BY A "(P)".
*DATA ON NON-REPORTABLE ACCIDENTS ARE NOT INCLUDED UNLESS SPECIFICALLY INDICATED.
*THE TERM "VEHICLE" ALWAYS EXCLUDES BICYCLES.
*THE TERM "DRIVERS" ALWAYS EXCLUDES BICYCLISTS.
*PERCENTS MAY NOT TOTAL 100.0 DUE TO ROUNDING.

TABLE 2 STATEWIDE RATES	STATEWIDE STATISTICS THIS PERIOD	STATEWIDE STATISTICS LAST YR. SAME PER	STATEWIDE STATISTICS PERCENT CHANGE
MOTOR VEHICLE DEATHS	2263	2237	1.16
DEATH RATE/100 MIL VEH MI	2.13	2.16	-1.39
FATAL ACC/100 MIL VEH MI	1.96	1.98	-1.01
INJ RATE/100 MIL VEH MI	281.47	284.39	-1.03
DEATH RATE / 100,000 POP	12.59	12.48	0.88
INJURY RATE / 100,000 POP	1660.99	1640.12	1.27

RATES PER 100,000 POPULATION ARE BASED ON OFFICIAL UPDATED ESTIMATES OF THE NYS DEPT OF COMMERCE, 3/04/83.

TABLE 25

DAY	PEDESTRIAN ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC	BICYCLE ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC
TOTAL	4504	179	109	478	638	934	971	665	397	133	1095	19	12	86	190	255	282	143	79	29
SUNDAY	631	11	13	74	95	134	138	92	56	18	194	1	1	18	35	45	60	20	10	4
MONDAY	679	13	21	94	114	138	140	87	53	19	193	3	1	14	29	61	46	21	12	6
TUESDAY	705	15	15	107	94	155	167	91	44	17	199	1	2	15	48	40	47	24	17	5
WEDNESDAY	761	28	10	81	122	174	160	104	62	20	177	2	6	19	32	39	48	19	9	3
THURSDAY	750	25	13	74	120	155	173	107	64	27	173	3	1	11	28	38	46	27	13	6
FRIDAY	564	43	14	33	56	109	111	97	75	26	86	4		4	12	14	20	18	10	4
SATURDAY	406	44	23	15	37	69	82	87	43	6	73	5	1	5	6	18	15	14	8	1

TABLE 26

HOUR AND DAY OF OCCURRENCE	TOTAL ALL ACC.	TOTAL FATAL ACC.	DAY OF OCCURRENCE FOR TOTAL AND FATAL ACCIDENTS: SUNDAY TOTAL	SUNDAY FATAL	MONDAY TOTAL	MONDAY FATAL	TUESDAY TOTAL	TUESDAY FATAL	WEDNESDAY TOTAL	WEDNESDAY FATAL	THURSDAY TOTAL	THURSDAY FATAL	FRIDAY TOTAL	FRIDAY FATAL	SATURDAY TOTAL	SATURDAY FATAL
TOTAL	22055	109	2803	16	3231	13	3213	18	3472	17	3634	11	3093	21	2589	13
FROM 12 MIDNIGHT	677	3	67	1	73		74		100		96	1	140	1	127	
1 AM	563	6	51	1	48	2	61		71	1	81		125	1	126	1
2	413	4	30	1	36		34	1	44	1	72		96	1	101	
3	338	2	23	1	25		27		40	1	41		79		103	
4	302	10	21		23	2	29	1	30	1	38		74	2	87	4
5	261	2	22		32		31	1	31		29		52	1	64	
6	317	5	44	2	56	2	40		54		51		28		44	1
7	544	3	87	1	88		92		91		84		63	1	39	1
8	839	1	129		156		139		168		127		79	1	41	
9	985	5	140		170	1	176	2	185	1	150		95		69	1
10	1003	5	136	1	170		169	1	181	1	168		109	2	70	
11	1061	5	155	1	178	1	159		189	2	168	1	127		85	
12 NOON	1077	2	159		160	1	164		162		197		124	1	111	
1 PM	1243	7	185	1	175	1	184	1	216	1	187	1	164	2	132	
2	1342	4	174	1	213		198	3	222		228		161		146	
3	1392	5	179		215		200		211	2	243	1	173	2	171	
4	1460	2	197		225	1	219	1	235		252		166		166	
5	1290	4	162		197	1	225	3	198		221		156		131	
6	1217	3	173	1	176		187		182		223	1	130		146	1
7	1071	5	118	1	147		164	1	157	1	187	2	171		127	
8	875	6	100	1	120		128	1	133		157	1	142	2	95	1
9	834	8	103	1	123		113	1	115	2	148	1	125	1	107	2
10	861	1	111		122		105		130		147		150	1	96	
11	827	10	83	1	98	1	111	1	128	3	157	2	171	1	79	1
UNSPECIFIED	1263	1	154		205		184		199		202		193	1	126	

EFFECTIVE WITH SEPTEMBER 1, 1985 ACCIDENTS, THE PROPERTY DAMAGE REPORTING LEVEL WAS INCREASED FROM 400 DOLLARS TO 600 DOLLARS.

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MV-144A(01/79) SUMMARY OF MOTOR VEHICLE ACCIDENTS NEW YORK COUNTY JAN-DEC, 1969

TABLE 3	WEATHER	TOTAL ACC.		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL	22055	100.0	109	15731	6215
	CLEAR	12993	58.9	74	9635	3284
	CLOUDY	2771	12.6	18	2176	577
	RAIN	3842	17.4	14	2920	908
	SNOW	286	1.3		195	91
	SLEET/HAIL/FREEZING RAIN	69	0.3	1	43	25
	FOG/SMOG/SMOKE	29	0.1	1	16	12
	OTHER	41	0.2		25	16
	UNSPECIFIED	2024	9.2	1	721	1302
TABLE 4 ROWAY SURFACE CONDITION	TOTAL	22055	100.0	109	15731	6215
	DRY	14543	65.9	90	10874	3579
	WET	5031	22.8	15	3822	1194
	MUDDY	23	0.1		16	7
	SNOW/ICE	343	1.6	2	223	118
	SLUSH	55	0.2		41	14
	OTHER	51	0.2		34	17
	UNSPECIFIED	2009	9.1	2	721	1286
TABLE 5 JURISDICTIONAL ROAD SYSTEM	TOTAL	22055	100.0	109	15731	6215
	STATE ROUTES	10	0.0		8	2
	COUNTY ROUTES		0.0			
	TOWN ROUTES	6	0.0		6	
	MUNICIPAL STREETS	18879	85.6	86	13723	5070
	PARKWAYS	2077	9.4	21	1488	568
	THRUWAY	1	0.0		1	
	NORTHWAY		0.0			
	OTHER INTERSTATE	1014	4.6	2	483	529
	OTHER LIMITED ACCESS		0.0			
	UNSPECIFIED	68	0.3		22	46
TABLE 6 TRAFFIC CONTROL	TOTAL	22055	100.0	109	15731	6215
	NONE	7006	31.8	44	5168	1794
	TRAFFIC SIGNAL	10303	46.7	53	8010	2240
	STOP SIGN	524	2.4	2	385	137
	FLASHING LIGHT	33	0.1		26	7
	YIELD SIGN	37	0.2		26	11
	OFFICER/GUARD	65	0.3		46	19
	NO PASSING ZONE	38	0.2		25	13
	RR CROSSING CONTROL	7	0.0		6	1
	STOP SCH. BUS RED LT. FLASH	3	0.0		3	
	HIGHWAY WORK AREA	37	0.2	1	20	16
	OTHER	307	1.4	1	206	100
	UNSPECIFIED	3695	16.8	8	1810	1877
TABLE 7 ROADWAY CHARACTER	TOTAL	22055	100.0	109	15731	6215
	STRAIGHT AND LEVEL	16938	76.8	93	12962	3883
	STRAIGHT AND GRADE	1270	5.8	7	930	333
	STRAIGHT AT HILLCREST	321	1.5		271	50
	CURVE AND LEVEL	476	2.2	6	332	138
	CURVE AND GRADE	356	1.6		240	116
	CURVE AT HILLCREST	62	0.3	1	43	18
	UNSPECIFIED	2632	11.9	2	953	1677
TABLE 8 TIME OF DAY	TOTAL	22055	100.0	109	15731	6215
	1 AM - 4 AM	1314	6.0	12	1079	223
	4 - 7	880	4.0	17	670	193
	7 - 10	2368	10.7	9	1577	782
	10 AM - 1 PM	3141	14.2	12	2185	944
	1 - 4	3977	18.0	16	2898	1063
	4 - 7	3967	18.0	9	2862	1096
	7 - 10	2780	12.6	19	2101	660
	10 PM - 1 AM	2365	10.7	14	1841	510
	UNSPECIFIED	1263	5.7	1	518	744
TABLE 9(P) POLICE AGENCY INVESTIGATING	TOTAL	17139	100.0	109	14653	2377
	STATE POLICE		0.0			
	COUNTY POLICE		0.0			
	MUNICIPAL POLICE	17139	100.0	109	14653	2377
	OTHER		0.0			
	UNSPECIFIED		0.0			
TABLE 10(P) LOCATION OF FIRST EVENT	TOTAL	17139	100.0	109	14653	2377
	ON RDWAY AT INTERSECTION	10233	59.7	54	8983	1196
	ON RDWAY NOT AT INTERSECT	6540	38.2	45	5397	1098
	OFF ROADWAY	330	1.9	7	252	71
	UNSPECIFIED	36	0.2	3	21	12

TABLE 11	FIRST EVENT OF ACCIDENT	TOTAL ACC.		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL ACCIDENTS	22055	100.0	109	15731	6215
	COLLISION WITH	20997	95.2	96	14912	5989
	OTHER MOTOR VEHICLE	15389	69.8	19	9415	5955
	PEDESTRIAN	4335	19.7	71	4264	
	BICYCLIST	1073	4.9	4	1068	1
	ANIMAL	3	0.0		3	
	RAILROAD TRAIN		0.0			
	OTHER OBJECT(NOT FIXED)	197	0.9	2	162	33
	COLLISION WITH FIXED OBJECT	839	3.8	12	618	209
	LIGHT SUPPORT/UTILITY POLE	80	0.4	2	74	4
	GUIDE RAIL	155	0.7	1	123	31
	CRASH CUSHION	7	0.0		6	1
	SIGN POST	5	0.0		5	
	TREE	31	0.1	1	27	3
	BUILDING/WALL	109	0.5	1	81	27
	CURBING	59	0.3	2	38	19
	FENCE	16	0.1	2	11	3
	BRIDGE STRUCTURE	54	0.2		45	9
	CULVERT/HEAD WALL	9	0.0		7	2
	MEDIAN/BARRIER	134	0.6	1	98	35
	SNOW EMBANKMENT	1	0.0		1	
	EARTH EMBANK/ROCK CUT/DITCH	16	0.1		10	6
	FIRE HYDRANT	15	0.1	1	8	6
	OTHER FIXED OBJECT	148	0.7	1	84	63
	NON-COLLISION	219	1.0	1	201	17
	OVERTURNED	32	0.1		31	1
	FIRE/EXPLOSION	3	0.0		2	1
	SUBMERSION	1	0.0		1	
	RAN OFF ROADWAY ONLY		0.0			
	OTHER	183	0.8	1	167	15
	UNSPECIFIED		0.0			
TABLE 12 A MANNER AND LOCATION OF COLLISION	TOTAL ACCIDENTS	22055	100.0	109	15731	6215
	SINGLE VEH ACC AT INTERSECT	3886	17.6	47	3794	45
	SINGLE VEH ACC NOT AT INTER	2590	11.7	38	2360	192
	TWO VEHICLE ACC AT INTER *	7765	35.2	13	5035	2717
	TWO VEH ACC NOT AT INTER *	5787	26.2	9	2943	2835
	3 OR MORE VEH ACC AT INTER*	885	4.0		749	136
	3 OR MORE VEH NOT AT INTER*	1142	5.2	2	850	290
	TOTAL TWO VEHICLE ACCIDENTS	13552	100.0	22	7978	5552

TABLE 12 B TWO VEH ACCIDENTS * MANNER OF COLLISION (AT OR NOT AT INTER)			NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	REAR END	←←	4364	32.2	2	3030	1332
	OVERTAKING	← ←	3545	26.2	2	1381	2162
	LEFT TURN	↓↘	1190	8.8	1	803	386
	LEFT TURN	↖←	559	4.1		360	199
	RIGHT ANGLE	→↓	2125	15.7	7	1554	564
	RIGHT TURN	→↗	446	3.3		173	273
	RIGHT TURN	↗←	77	0.6		43	34
	HEAD ON	→←	117	0.9	1	103	13
	SIDESWIPE	← →	327	2.4	1	175	151
	ALL OTHER		802	5.9	8	356	438

*TWO OR MORE VEHICLE ACCIDENTS INCLUDE PARKED CARS.

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STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

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TABLE 13(P)

*A NO(NONE) FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR PER ACC MAY OCCUR.

APPARENT ACCIDENT CONTRIBUTING FACTORS*	TOTAL		SEVERITY CLASS OF ACC.		
	NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
TOTAL FACTORS	40763	100.0	255	34931	5577
NONE	13346	32.7	57	11541	1748
HUMAN	17808	43.7	173	15306	2329
ALCOHOL INVOLVEMENT	403	1.0	26	356	21
BACKING UNSAFELY	456	1.1	2	377	77
DRIVER INATTENTION	2572	6.3	2	2223	347
DRIVER INEXPERIENCE	235	0.6	1	210	24
DRUGS(ILLEGAL)	57	0.1	17	37	3
FAILURE TO YIELD R.O.W.	1733	4.3	9	1477	247
FELL ASLEEP	44	0.1		41	3
FOLLOWING TOO CLOSELY	1573	3.9		1346	227
ILLNESS	31	0.1	1	26	4
LOST CONSCIOUSNESS	25	0.1		24	1
PASSENGER DISTRACTION	103	0.3		92	11
PASSING/LANE USAGE IMPROPER	700	1.7	11	519	170
PEDESTRIAN ERROR/CONFUSION	1169	2.9	66	1103	
BICYCLIST ERROR/CONFUSION	227	0.6	2	225	
PHYSICAL DISABILITY	14	0.0		14	
PRESCIPTION MEDICATION	6	0.0		4	2
TRAFFIC CONTROL DISREGARDED	1071	2.6	6	967	98
TURNING IMPROPERLY	829	2.0	3	668	158
UNSAFE SPEED	1174	2.9	19	1058	97
UNSAFE LANE CHANGING	780	1.9	2	590	188
OTHER HUMAN	4606	11.3	6	3949	651
VEHICULAR	1943	4.8	5	1604	334
ACCELERATOR DEFECTIVE	69	0.2		52	17
BRAKES DEFECTIVE	221	0.5		205	16
HEADLIGHTS DEFECTIVE	7	0.0		6	1
OTHER LIGHTING DEFECTS	13	0.0	1	11	1
OVERSIZED VEHICLE	48	0.1	1	31	16
STEERING FAILURE	35	0.1		30	5
TIRE FAILURE/INADEQUATE	41	0.1		36	5
TOW HITCH DEFECTIVE	5	0.0		4	1
WINDSHIELD INADEQUATE	4	0.0		4	
OTHER VEHICULAR	1500	3.7	3	1225	272
ENVIRONMENTAL	2430	6.0	12	2135	283
ANIMAL'S ACTION	10	0.0		10	
GLARE	66	0.2		63	3
LANE MARK IMPROP/INADEQUATE	22	0.1		17	5
OBSTRUCTION/DEBRIS	114	0.3	1	88	25
PAVEMENT DEFECTIVE	80	0.2	1	74	5
PAVEMENT SLIPPERY	1484	3.6	6	1316	162
SHOULDER DEFECTIVE/IMPROPER	2	0.0		2	
TRAFF CNTL DEV IMP/NON-WORK	87	0.2		86	1
VIEW OBSTRUCTED/LIMITED	294	0.7	3	251	40
OTHER ENVIRONMENTAL	271	0.7	1	228	42
UNSPECIFIED	5236	12.8	8	4345	883

TABLE 14(P)
LIGHT CONDITIONS

	NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
TOTAL ACCIDENTS	17139	100.0	109	14653	2377
DAYLIGHT	9904	57.8	43	8434	1427
DAWN	380	2.2	5	316	59
DUSK	752	4.4	3	645	104
DARK - ROAD LIGHTED	5703	33.3	52	4953	698
DARK - ROAD UNLIGHTED	169	1.0	5	149	15
UNSPECIFIED	231	1.3	1	156	74

TABLE 15

DRIVER SEX AND AGE	TOTAL		SEVERITY CLASS OF ACC.		
	NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
TOTAL DRIVERS	37936	100.0	130	26108	11698
MALE	28866	76.1	106	20135	8625
UNDER 18	189	0.5	3	141	45
18 - 20	1203	3.2	5	921	277
21 - 24	2978	7.9	15	2246	717
25 - 29	4996	13.2	24	3716	1256
30 - 39	8363	22.0	28	6062	2273
40 - 49	4803	12.7	18	3261	1524
50 - 59	2789	7.4	7	1790	992
60 - 64	917	2.4	1	524	392
65 - 69	536	1.4	2	305	229
70 - 74	276	0.7	1	159	116
75 - 79	150	0.4		75	75
80 AND OVER	96	0.3	2	41	53
UNSPECIFIED AGE	1570	4.1		894	676
FEMALE	4941	13.0	5	3310	1626
UNDER 18	27	0.1		25	2
18 - 20	221	0.6		168	53
21 - 24	604	1.6	3	457	144
25 - 29	830	2.2		604	226
30 - 39	1399	3.7	2	957	440
40 - 49	929	2.4		580	349
50 - 59	429	1.1		259	170
60 - 64	146	0.4		77	69
65 - 69	97	0.3		52	45
70 - 74	45	0.1		19	26
75 - 79	19	0.1		10	9
80 AND OVER	17	0.0		8	9
UNSPECIFIED AGE	178	0.5		94	84
UNSPECIFIED SEX	4129	10.9	19	2663	1447

TABLE 16
VEHICLE TYPE*

	NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
TOTAL VEHICLES	40272	100.0	135	27418	12719
PASSENGER CAR	23803	59.1	72	15972	7759
MOTORCYCLE	383	1.0	5	360	18
BUS/TAXI/OTHER FOR HIRE	6722	16.7	17	5474	1231
SCHOOL BUS	45	0.1		31	14
EMERGENCY VEHICLE	339	0.8		302	37
TRUCK/TRACTOR TRAILER	5028	12.5	28	3052	1948
TOWING VEHICLE	51	0.1		38	13
MOPED	33	0.1	1	32	
ALL OTHER	3868	9.6	12	2157	1699
UNSPECIFIED		0.0			

TABLE 17

DIRECTION OF VEHICLE STRIKING PEDESTRIAN	SEVERITY CLASS OF PED. ACC.			
	NUMBER	PCT.	FATAL	PERS INJ
TOTAL VEHICLES	4504	100.0	73	4431
GOING STRAIGHT	2736	60.7	50	2686
TURNING RIGHT	312	6.9	8	304
TURNING LEFT	547	12.1	7	540
BACKING	397	8.8	2	395
OTHER	512	11.4	6	506

TABLE 18(P)

PEDESTRIAN CONTRIBUTING FACTOR**	SEVERITY CLASS OF PED. ACC.			
	NUMBER	PCT.	FATAL	PERS INJ
TOTAL FACTORS	4788	100.0	96	4692
NONE	2503	52.3	5	2498
TRAFF CNTL DEVICE DISREGARD	67	1.4	1	66
ALCOHOL INVOLVEMENT	102	2.1	11	91
DRUGS(ILLEGAL/MEDICATION)	15	0.3	11	4
ILLNESS	2	0.0		2
ERROR/CONFUSION	1167	24.4	66	1101
VIEW OBSTRUCTED/LIMITED	20	0.4		20
PHYSICAL DISABILITY	3	0.1		3
ALL OTHER	909	19.0	2	907

*BUS/TAXI/OTHER FOR HIRE INCLUDES BUSES, TAXIS, AND LIVERY, RENTAL AND OTHER FOR HIRE VEHICLES, BUT EXCLUDES SCHOOL BUSES WHICH ARE LISTED SEPARATELY.

**MORE THAN 1 CONTRIBUTING PEDESTRIAN FACTOR PER ACCIDENT MAY OCCUR.

TABLE 19 FIRST EVENT OF ACCIDENT	TOTAL CASUALTIES	AGE											SEX*		SEVERITY CL OF INJ.		
		0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	MALE	FEMALE	A	B	C
TOTAL INJURED	21807	293	506	532	1291	2969	6623	3876	2132	1309	1008	1263	13820	7963	2484	4051	15272
COLLISION WITH	20688	274	495	526	1193	2761	6286	3727	2043	1244	960	1179	13114	7550	2309	3727	14652
OTHER MOTOR VEHICLE	14844	191	240	198	794	2068	4791	2877	1524	878	485	798	9245	5576	1190	2304	11350
PEDESTRIAN	4528	80	240	265	226	442	1027	678	438	337	459	336	2732	1795	914	1036	2578
BICYCLIST	1094		12	61	150	226	386	140	57	15	14	33	979	115	166	334	594
ANIMAL	4				1		1					2	2	2			4
RAILROAD TRAIN																	
OTHER(NOT FIXED)	218	3	3	2	22	25	81	32	24	14	2	10	156	62	39	53	126
COLLISION WITH FIXED OBJECT	888	12	6	3	91	187	292	117	75	39	15	46	606	282	157	270	461
NON-COLLISION	231	7	5	3	7	21	45	32	14	26	33	38	100	131	18	54	159
OVERTURNED	42		1		4	7	23	5	1			1	36	6	4	12	26
FIRE/EXPLOSION	4					1	2	1					2	2		2	2
SUBMERSION	1						1							1			1
RAN OFF ROADWAY ONLY																	
OTHER	184	7	4	3	3	13	19	26	13	26	33	37	62	122	14	40	130
UNSPECIFIED																	
TOTAL KILLED	112		1	1	5	15	15	16	11	15	30	3	77	35			
COLLISION WITH	99		1		4	11	12	14	11	14	29	3	65	34			
OTHER MOTOR VEHICLE	20				2	4	2	6	3	1	2		16	4			
PEDESTRIAN	72		1		1	6	8	7	8	12	26	3	43	29			
BICYCLIST	4						1	1		1	1		3	1			
ANIMAL																	
RAILROAD TRAIN																	
OTHER(NOT FIXED)	3				1	1	1						3				
COLLISION WITH FIXED OBJECT	12				1	4	3	2		1	1		11	1			
NON-COLLISION	1			1									1				
OVERTURNED																	
FIRE/EXPLOSION																	
SUBMERSION																	
RAN OFF ROADWAY ONLY																	
OTHER	1			1									1				
UNSPECIFIED																	

*EXCLUDES UNSPECIFIED SEX.

TABLE 20 PEDESTRIAN LOCATION AND ACTIONS	TOT PEDESTRIANS KILLED OR INJ.		AGE											SEX			SEV. CLASS	
	NUMBER	PCT.	0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	MALE	FEMALE	UNSPEC	KILLED	INJ.
TOTAL PEDESTRIANS	4681	100.0	82	243	269	226	452	1043	707	459	356	492	352	2792	1889		73	4608
AT INTERSECTION	3091	66.0	44	119	146	156	311	687	489	313	253	354	219	1752	1339		37	3054
NOT AT INTERSECTION	1590	34.0	38	124	123	70	141	356	218	146	103	138	133	1040	550		36	1554
TOTAL ACTIONS	4681	100.0	82	243	269	226	452	1043	707	459	356	492	352	2792	1889		73	4608
CROSSING, WITH SIGNAL	1351	28.9	25	39	46	61	131	297	225	143	132	181	71	655	696		10	1341
CROSSING, AGAINST SIGNAL	774	16.5	2	36	62	44	82	161	111	72	54	84	66	482	292		12	762
CROSS, NO SIG, MARKED CROSSWALK	105	2.2	5	9	10	4	7	24	19	7	3	12	5	60	45		3	102
CROSSING, NO SIGNAL OR CROSSWALK	641	13.7	12	46	48	27	59	143	82	68	52	64	40	401	240		15	626
WALKING ALONG H/WAY WITH TRAFFIC	36	0.8		1	1	1	4	8	5	4	3	4	5	26	10		2	34
WALK ALONG H/WAY AGAINST TRAFFIC	15	0.3		2	1		1	5	2	2	1		1	15			1	14
EMERG FROM FRONT/BEHIND PARK VEH	326	7.0	17	45	40	17	34	58	41	16	16	29	13	214	112		4	322
GOING TO/FROM STOPPED SCHOOL BUS	4	0.1		2	1							1		3	1			4
GET ON/OFF OTHER VEH NOT SCH BUS	75	1.6	2		1	2	9	26	15	7	5	5	3	40	35			75
PUSHING/WORKING ON CAR	10	0.2					1	3	3			2	1	9	1			10
WORKING IN ROADWAY	76	1.6	1	1		1	11	20	15	12	9	1	5	63	13		1	75
PLAYING IN ROADWAY	47	1.0	1	20	13	5	2	4					2	40	7			47
OTHER ACTIONS IN ROADWAY	430	9.2	8	20	13	20	46	114	55	40	26	37	51	290	140		8	422
NOT IN ROADWAY	158	3.4	5	2	7	7	12	41	32	24	11	9	8	90	68		2	156
UNSPECIFIED	633	13.5	4	20	26	37	53	139	102	64	44	63	81	404	229		15	618

TABLE 21 PRE-ACCIDENT BICYCLE ACTION	TOT BICYCLISTS KILLED OR INJ																	
	NUMBER	PCT																
TOTAL	1100	100.0		12	62	152	230	388	141	53	16	14	32	991	109		4	1096
GOING STRAIGHT AHEAD	825	75.0		5	44	106	176	295	117	37	12	11	22	749	76		2	823
MAKING RIGHT/LEFT U TURN	70	6.4		1	5	14	13	29	2	4	2			59	11		1	69
START STOPPING STOP IN TRAFFIC	19	1.7			1	2	5	6	2	1			2	15	4			19
CHANGING LANES	22	2.0			2	1	7	6	3	1	1		1	19	3			22
OTHER	71	6.5		2	4	15	14	18	8	7		2	1	62	9			71
UNSPECIFIED	93	8.5		4	6	14	15	34	9	3	1	1	6	87	6		1	92

STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

JAN-DEC, 1989

TABLE 22(P) APPARENT DRIVER CONTRIBUTING FACTOR	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		MALE DRIVERS							FEMALE DRIVERS						
	NUMBER	PERCENT	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	28856	100.0	22378	161	1018	2491	10236	5601	1303	3769	27	170	505	1749	973	299
NO DRIVER CONTRIB FACTOR	16119	55.9	12567	66	495	1333	6102	3294	765	2339	8	101	303	1115	612	124
	CONTRIB FACTOR															
		PERCENT OF TOTAL DRIVERS*														
TOTAL CONTRIBUTING FACTORS	15126		11619	122	641	1320	5473	2686	628	1671	25	90	231	732	424	99
ALCOHOL INVOLVEMENT	295	1.0	253	2	12	28	118	73	7	16		2	2	5	5	2
BACKING UNSAFELY	448	1.6	301	1	15	32	136	73	12	39	1	3	1	17	12	2
DRIVER INATTENTION	2449	8.5	1898	20	104	240	900	435	104	295	4	15	44	124	77	19
DRIVER INEXPERIENCE	225	0.8	168	20	31	25	70	17	1	46	4	3	7	24	6	1
DRUGS(ILLEGAL)	41	0.1	36		3	7	19	5	1	3				2	1	
FAILURE TO YIELD R.O.W.	1633	5.7	1229	8	64	149	552	294	84	171	5	12	20	75	37	12
FELL ASLEEP	44	0.2	39		3	9	19	5	3	4		1		2	1	
FOLLOWING TOO CLOSELY	1561	5.4	1233	10	65	161	564	289	66	139	1	8	16	72	29	5
ILLNESS	29	0.1	25			2	8	7	8	2				2		
LOST CONSCIOUSNESS	24	0.1	20		1		10	5	4	4			1	2		
PASSING/LANE USAGE IMPROPER	657	2.3	458	3	17	47	210	104	29	63		1	13	23	17	4
PHYSICAL DISABILITY	11	0.0	10				1	4	5	1				1		
PRESCRIPTION MEDICATION	5	0.0	4			1	2		1	1			1			
TRAFFIC CONTROL DISREGARDED	947	3.3	718	6	35	91	345	154	26	87	3	6	14	34	19	5
TURNING IMPROPERLY	811	2.8	604	5	39	62	295	148	29	123	2	7	16	53	36	4
UNSAFE SPEED	1155	4.0	887	26	65	120	428	158	33	81	2	7	11	27	23	4
UNSAFE LANE CHANGING	749	2.6	552	4	25	55	269	118	25	70		4	11	29	19	5
OTHER	4092	14.2	3184	22	162	341	1529	795	190	526	3	21	74	240	142	36

*SINCE THERE MAY BE NO CONTRIBUTING FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR, PERCENTS MAY NOT TOTAL TO 100.0

TABLE 23(P) VIOLATION CHARGED	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	28856	100.0	22378	161	1018	2491	10236	5601	1303	3769	27	170	505	1749	973	299
WITH NO VIOLATION	26494	91.8	20297	129	813	2153	9653	5246	1244	3499	21	159	463	1619	908	202
	VIOLATIONS															
		PERCENT OF TOTAL DRIVERS*														
TOTAL VIOLATIONS	3349		2970	62	304	482	1527	507	80	368	9	23	61	172	89	13
SPEEDING	4	0.0	4	1	1	2										
DWI(INTOXICATION)	94	0.3	88		5	12	43	25	2	4			1		3	
DWAI(ABILITY IMPAIRED-ALCH)	3	0.0	3				1	2								
DWAI(ABILITY IMPAIRED-DRUG)	4	0.0	3				2	1		1			1			
UNSAFE TIRES	4	0.0	4				2	1	1							
INSUFFICIENT LIGHTS	14	0.0	14				8	6								
OTHER EQUIPMENT VIOLATIONS	18	0.1	17	3	1	1	6	6		1				1		
PASSED STOP SIGN	1	0.0	1				1									
PASSED RED LIGHT	29	0.1	27		4	6	12	4	1	2			1	1		
IMPROPER PASSING/LANE USAGE	7	0.0	6				5	1		1				1		
ILLEGAL TURN	8	0.0	8	1		1	5	1								
FAILED TO YIELD R.O.W.	19	0.1	18		2		9	7		1					1	
FOLLOWING TOO CLOSELY	4	0.0	4				2	2								
BACKING UNSAFELY	5	0.0	5		1		2	2								
PASSED STOPPED SCHOOL BUS		0.0														
RECKLESS DRIVING	13	0.0	12		3	2	4	3		1					1	
ALL OTHER	2903	10.3	2632	57	272	442	1353	429	73	342	9	22	57	166	74	13
UNSPECIFIED	139	0.5	124		15	16	72	17	3	15		1	1	3	10	

*SINCE THERE MAY BE NO VIOLATION OR MORE THAN ONE VIOLATION, PERCENTS MAY NOT TOTAL TO 100.0

TABLE 24 TIME OF DAY	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	37936	100.0	28866	189	1203	2970	13359	7592	1975	4941	27	221	604	2229	1358	324
1 AM - 4 AM	2323	6.1	1837	26	141	263	929	345	49	225	3	39	54	88	30	8
4 - 7	1521	4.0	1226	5	69	154	605	276	72	132	3	8	24	72	20	1
7 - 10	4173	11.0	3204	10	81	250	1436	991	268	559		12	40	278	181	33
10 AM - 1 PM	5381	14.2	4199	15	129	397	1864	1259	330	684	3	21	52	299	222	68
1 - 4	6744	17.8	5125	25	200	514	2286	1387	432	949	4	33	97	418	278	76
4 - 7	6723	17.7	5054	35	188	498	2310	1356	353	982	6	37	126	433	277	64
7 - 10	4732	12.5	3527	25	159	345	1694	881	219	658	4	33	88	309	168	30
10 PM - 1 AM	4241	11.2	3274	35	167	422	1641	714	139	484	3	29	99	217	101	17
UNSPECIFIED	2098	5.5	1420	13	69	127	594	383	113	268	1	9	24	115	81	27

STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

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TABLE 27 PRE-ACCIDENT VEHICLE ACTION	TOTAL VEHICLES INVOLVED		TRAFFIC CONTROL										
	NUMBER	PCT.	NONE	TRAFFIC SIGNAL	STOP SIGN	FLASH. LIGHT	YIELD SIGN	OFFICER /GUARD	NO PASS ZONE	RR XING CONTROL	HIGHWAY WK AREA	OTHER	UNSPEC
TOTAL	40272	100.0	12710	18364	1033	54	73	106	70	12	63	583	7204
GOING STRAIGHT AHEAD	22076	54.8	7323	10544	720	31	30	52	38	7	32	302	2997
MAKING RIGHT TURN	1661	4.1	259	1129	38	3	3	8	1		2	13	205
MAKING LEFT TURN	2988	7.4	354	2287	63	9	3	6	3	1	3	28	231
MAKING U TURN	305	0.8	133	123	5							16	28
STARTING FROM PARKING	562	1.4	284	142	6				1		1	7	121
STARTING IN TRAFFIC	336	0.8	72	208	11		3	2			1	4	35
SLOWING OR STOPPING	1505	3.7	573	536	37	2	3	5	1		3	19	326
STOPPED IN TRAFFIC	2814	7.0	708	1375	41	3	5	8	2	2	3	50	617
ENTER PARKED POSITION	165	0.4	92	26	2							3	42
PARKED	2336	5.8	1065	619	59		1	3	7			32	550
AVOID OBJECT IN RDWAY	192	0.5	89	49	1			1			4	4	44
CHANGING LANES	1143	2.8	514	302	3		1	5	5		6	25	282
OVERTAKING	489	1.2	156	141	4	2		2	6	1	4	9	164
MERGING	340	0.8	116	33	1	3	16	7			4	13	147
BACKING	819	2.0	413	222	10	1	2	3	2			13	153
TURNING RIGHT ON RED	25	0.1	1	24									
TURNING LEFT ON RED	64	0.2		64									
OTHER	790	2.0	274	233	21		5	2	3	1		28	223
UNSPECIFIED	1662	4.1	284	307	11		1	2	1			17	1039

TABLE 28(P) INJURY DESCRIPTION	TOTAL PERSONS KILLED OR INJ.	
	KILLED	INJURED
LOCATION OF MOST SEV PHYSICAL COMPLAINT	112	20496
HEAD	38	4533
FACE	1	942
EYE		66
NECK	2	3306
CHEST	3	476
BACK		2006
SHOULDER/UPPER ARM	1	849
ELBOW/LOWER ARM/HAND	2	972
ABDOMEN/PELVIS		265
HIP/UPPER LEG	1	983
KNEE/LOWER LEG/FOOT	1	2833
ENTIRE BODY	32	1124
UNSPECIFIED	31	2141
MOST SEVERE PHYSICAL COMPLAINT	112	20496
AMPUTATION		47
CONCUSSION	5	421
INTERNAL	18	359
MINOR BLEEDING	4	1727
SEVERE BLEEDING	23	379
MINOR BURN		92
MODERATE BURN		17
SEVERE BURN	1	10
FRACTURE/DISLOCATION	8	677
CONTUSION/BRUISE		1350
ABRASION		696
COMPLAINT OF PAIN	8	10596
NONE VISIBLE	1	2074
UNSPECIFIED	44	2051
VICTIM'S PHYSICAL AND EMOTIONAL STATUS	112	20496
DECEASED	112	XXX
UNCONSCIOUS	XXX	154
SEMICONSCIOUS	XXX	385
INCOHERENT	XXX	152
SHOCK	XXX	618
CONSCIOUS	XXX	16335
UNSPECIFIED	XXX	2852

TABLE 29(P) SAFETY EQUIPMENT USED	TOTAL VEHICLE OCCUPANTS		SEVERITY CLASS OF VEHICLE OCCUPANTS				
	NUMBER	PCT.	KILLED	A	B	C	UNINJ.
TOTAL	44575	100.0	35	1321	2462	11120	29637
NO RESTRAINT USED	9727	21.8	18	492	796	3003	5418
LAP BELT	8285	18.6	3	255	444	2386	5197
HARNESS	2787	6.3		71	183	913	1620
LAP BELT AND HARNESS	6726	15.1	2	174	404	2216	3930
CHILD RESTRAINT	127	0.3			7	25	95
HELMET	192	0.4	3	49	54	69	17
OTHER	3	0.0				1	2
UNSPECIFIED	16728	37.5	9	280	574	2507	13358

"A" INJURIES INCLUDE SEVERE LACERATIONS, BROKEN OR DISTORTED LIMBS, SKULL FRACTURES, CRUSHED CHEST, INTERNAL INJURIES, UNCONSCIOUS WHEN TAKEN FROM THE ACCIDENT SCENE, UNABLE TO LEAVE ACCIDENT SCENE WITHOUT ASSISTANCE.

"B" INJURIES INCLUDE LUMP ON HEAD, ABRASIONS, MINOR LACERATIONS.

"C" INJURIES INCLUDE MOMENTARY UNCONSCIOUSNESS, LIMPING, NAUSEA, HYSTERIA, COMPLAINT OF PAIN(NO VISIBLE INJURY).

TABLE 30(P) METHOD OF TRANSPORT, KILLED OR INJURED TO A MEDICAL FACILITY	TOTAL KILLED AND INJURED		SEVERITY CLASS OF INJURED			
	NUMBER	PCT.	KILLED	A	B	C
TOTAL	11580	100.0	107	1953	2417	7103
AMBULANCE	9144	79.0	89	1527	1933	5595
POLICE AMBULANCE	33	0.3		3	4	26
POLICE CAR	205	1.8	1	23	48	133
FIRE VEHICLE	548	4.7	6	110	106	326
INVALID COACH/FUNERAL	1	0.0		1		
COR VAN MULT EMERG EQ	1	0.0			1	
PRIVATE VEHICLE	239	2.1	1	43	56	139
UNSPECIFIED	1409	12.2	10	246	269	884

*THERE MAY BE MORE THAN 1 CONTRIBUTING FACTOR OR EQUIPMENT VIOLATION CHARGED PER VEHICLE.

**SINCE VEHICLE MAY HAVE MORE THAN ONE CONTRIBUTING FACTOR, PERCENTS WILL NOT NECESSARILY TOTAL TO 100.0

***CURRENT YEAR MODEL INCLUDES PRESENT CALENDAR YEAR AND NEWER MODELS.

TABLE 31(P) APPARENT VEHICULAR ACCIDENT CONTRIBUTING FACTORS*	TOTAL		VEHICLE TYPE										VEHICLE AGE					
	NUMBER	PCT.	PASS. CAR	MOTOR-CYCLE	BUS/ TAXI	SCHOOL BUS	EMERG. VEH.	TRUCK/ TR TRL	TOWING VEH.	MOPED	ALL OTHER	UNSPEC	CUR YR MOD***	1-2 YR OLD	3-5 YRS OLD	6-9 YR OLD	10 OR MORE	UNSPEC
TOTAL VEHICLES	30481	100.0	18182	365	5686	33	318	3586	45	33	2233		1733	4602	4881	3717	3019	12529
WITH NO DEFECT	28671	94.1	16980	355	5408	31	296	3376	40	31	2146		1618	4334	4592	3475	2774	11876
	DEFECTS																	
		PCT. OF TOT VEH **																
TOTAL DEFECTS	1832		1207	10	282	2	22	212	5	2	90		117	269	291	245	250	660
ACCELERATOR DEFECTIVE	69	0.2	47		13	1	3	4			1		7	17	13	7	9	16
BRAKES DEFECTIVE	213	0.7	117	1	33	1	2	47	1		11		15	22	23	34	43	76
LIGHTING DEFECTS	19	0.1	15		2		1	1					2	3		6	2	6
STEERING FAILURE	35	0.1	23		3			8			1		1	2	7	6	6	13
TIRE FAILURE INADEQUATE	40	0.1	27		6		1	5			1		2	6	7	6	4	15
OTHER	1456	4.8	978	9	225		15	147	4	2	76		90	219	241	186	186	534
ANY EQUIP VIOL CHARGED	36	100.0	11	1	2			18		2	2			6	2	2	10	16

STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS   NEW YORK COUNTY   JAN-DEC.1990

TABLE 1 ACCIDENT SUMMARY TOTALS

CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD
TOTAL ACCIDENTS	22197	17396	22111	17180
FATAL ACCIDENTS	132	132	109	109
INJURY ACCIDENTS(1)	16110	15092	15756	14683
REPORTABLE PROP DAMAGE	5955	2172	6246	2388
DRIVERS INVOLVED(2)	38099	29198	38056	28758
VEHICLES	40458	30866	40397	30589
PEDESTRIAN ACCIDENTS	4529	4455	4513	4414
BICYCLE MOTOR VEH ACC	1159	1146	1096	1073
VEHICLE OCCUPANTS	58405	45738	58463	44697

CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD
PERSONS KILLED(3)	138	138	112	112
DRIVERS KILLED	26	26	26	26
PASSENGERS KILLED	14	14	9	9
PEDESTRIANS KILLED	93	93	73	73
BICYCLISTS KILLED	5	5	4	4
PERSONS INJURED(1.3)	22500	21255	21871	20571
DRIVERS INJURED(1.4)	XXXX	8498	XXXX	8264
PASSENGERS INJ.(1.4)	XXXX	7016	XXXX	6705
PEDESTRIANS INJURED(1)	4655	4581	4618	4515
BICYCLISTS INJURED(1)	1154	1142	1097	1075

1 EXCLUDES FATALS.
2 DOES NOT INCLUDE PARKED VEHICLES OR BICYCLES.
3 INCLUDES PEDESTRIANS. BICYCLISTS AND ALL OTHER NON-VEHICLE INVOLVED PERSONS AS WELL AS VEHICLE OCCUPANTS REGARDLESS OF SEATING POSITION
4 DATA GATHERED ONLY FROM POLICE REPORTED ACCIDENTS.

NOTE-SOME OF THE TABLES ARE BASED UPON INFORMATION RECEIVED FROM POLICE AND MOTORIST REPORTS OF MOTOR VEHICLE ACCIDENTS. OTHERS ARE BASED ONLY ON THE POLICE REPORTS THESE ARE INDICATED BY A "(P)".
- DATA ON NON-REPORTABLE ACCIDENTS ARE NOT INCLUDED UNLESS SPECIFICALLY INDICATED
- THE TERM "VEHICLE" ALWAYS EXCLUDES BICYCLES.
- THE TERM "DRIVERS" ALWAYS EXCLUDES BICYCLISTS
- PERCENTS MAY NOT TOTAL 100.0 DUE TO ROUNDING.

TABLE 2 STATEWIDE RATES

TABLE 2 STATEWIDE RATES	STATEWIDE STATISTICS THIS PERIOD	LAST YR. SAME PER	PERCENT CHANGE
MOTOR VEHICLE DEATHS	2211	2263	-2.30
DEATH RATE 100 MIL VEH MI	2.07	2.13	-2.82
FATAL ACC 100 MIL VEH MI	1.90	1.96	-3.06
INJ RATE 100 MIL VEH MI	275.55	282.14	-2.34
DEATH RATE / 100.000 POP	12.27	12.59	-2.54
INJURY RATE / 100.000 POP	1634.36	1663.97	-1.78

RATES PER 100.000 POPULATION ARE BASED ON OFFICIAL UPDATED ESTIMATES OF THE NYS DEPT OF COMMERCE. 3 04 83

TABLE 25

DAY	PEDESTRIAN ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC	BICYCLE ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC
TOTAL	4529	179	121	515	712	940	960	698	321	33	1159	13	8	85	191	303	311	160	80	8
SUNDAY	348	35	20	15	35	64	76	54	44	5	73	4	2	1	10	20	22	17	17	
MONDAY	631	14	9	76	115	139	140	92	39	3	176	1		11	26	43	65	21	7	2
TUESDAY	717	15	17	93	127	182	157	83	40	3	194		2	15	32	62	55	23	5	
WEDNESDAY	683	15	11	103	112	156	133	105	43	5	199	2	1	13	44	56	42	20	18	3
THURSDAY	709	17	9	102	109	153	164	95	53	7	195	3	1	15	31	53	48	31	13	
FRIDAY	826	24	25	93	140	142	172	145	81	6	210	1	1	23	39	44	57	32	10	3
SATURDAY	615	59	30	33	70	104	118	126	71	4	92	2	1	7	8	25	22	16	10	

TABLE 26

HOUR AND DAY OF OCCURRENCE	TOTAL ALL ACC	TOTAL FATAL ACC.	DAY OF OCCURRENCE FOR TOTAL AND FATAL ACCIDENTS SUNDAY TOTAL	SUNDAY FATAL	MONDAY TOTAL	MONDAY FATAL	TUESDAY TOTAL	TUESDAY FATAL	WEDNESDAY TOTAL	WEDNESDAY FATAL	THURSDAY TOTAL	THURSDAY FATAL	FRIDAY TOTAL	FRIDAY FATAL	SATURDAY TOTAL	SATURDAY FATAL
TOTAL	22197	132	2599	26	2901	13	3130	21	3109	19	3297	15	3802	19	3359	19
FROM 12 MIDNIGHT	656	6	101	3	64		75	1	79		80		121	2	136	
1 AM	648	7	129	4	66	1	57		61		60		109		158	2
2	471	7	101	2	37		42	1	35	1	49	1	67		140	2
3	402	6	99		35	1	35	1	30		39	2	52	1	114	1
4	391	2	122	1	35		21		30	1	41		48		95	
5	284	4	73	1	37		22	1	20		33		45	1	57	1
6	355	3	44	1	37		59		43	2	47		61		64	
7	559	7	43	1	85	2	95	1	90	1	106	2	69		81	
8	954	3	47		127	1	166		155	2	188		176		94	
9	952	7	65	1	147		153	3	151		149		157	1	110	2
10	983	6	66		140	1	154	2	166	1	174	2	166		115	
11	1020	2	88	1	151		149		183		164		186	1	119	
12 NOON	1112	6	105	1	161	1	192		157	1	147	2	203	1	147	
1 PM	1142	7	117	2	154		185	1	177	2	174		181	1	154	1
2	1320	5	112		195		207	1	201	1	221	2	205	1	182	
3	1409	7	177	2	167		231	1	205		200		215	3	184	1
4	1431	2	153		203	1	237		201		222	1	246		169	
5	1396	6	154	1	217		215	3	191		225		227		159	2
6	1281	6	131	2	189	1	186		175		202	1	225	2	172	
7	1055	3	124		130		137		132	1	138		208		166	2
8	942	7	131	1	116	1	111		131	3	119		194	1	140	1
9	871	8	118		101		114	3	108	1	133	2	155	1	132	1
10	824	7	112	1	115	3	95		126	1	121		149	1	145	1
11	902	8	95	1	108		88	2	124	1	131		197	2	159	2
UNSPECIFIED	847		92		122		107		136		124		140		125	

EFFECTIVE WITH SEPTEMBER 1. 1985 ACCIDENTS. THE PROPERTY DAMAGE REPORTING LEVEL WAS INCREASED FROM 400 DOLLARS TO 600 DOLLARS

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STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

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23101

TABLE 3	WEATHER	TOTAL ACC.		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL	22197	100.0	132	16110	5955
	CLEAR	13444	60.6	80	10173	3191
	CLOUDY	2618	11.8	20	2093	505
	RAIN	3818	17.2	29	2936	853
	SNOW	180	0.8	2	130	48
	SLEET HAIL FREEZING RAIN	41	0.2		28	13
	FOG SMOG SMOKE	30	0.1		21	9
	OTHER	35	0.2		22	13
	UNSPECIFIED	2031	9.1	1	707	1323
TABLE 4 ROWAY SURFACE CONDITION	TOTAL	22197	100.0	132	16110	5955
	DRY	14975	67.6	93	11379	3503
	WET	4912	22.1	37	3815	1060
	MUDDY	20	0.1		15	5
	SNOW ICE	178	0.8	1	118	59
	SLUSH	27	0.1		19	8
	OTHER	54	0.2		40	14
	UNSPECIFIED	2011	9.1	1	704	1306
TABLE 5 JURISDICTIONAL ROAD SYSTEM	TOTAL	22197	100.0	132	16110	5955
	STATE ROUTES	8	0.0		6	2
	COUNTY ROUTES		0.0			
	TOWN ROUTES	6	0.0		4	2
	MUNICIPAL STREETS	18982	85.5	110	14064	4808
	PARKWAYS	2121	9.6	18	1489	614
	THRUWAY	2	0.0		1	1
	NORTHWAY		0.0			
	OTHER INTERSTATE	969	4.4	4	510	455
	OTHER LIMITED ACCESS		0.0			
	UNSPECIFIED	109	0.5		36	73
TABLE 6 TRAFFIC CONTROL	TOTAL	22197	100.0	132	16110	5955
	NONE	7011	31.6	51	5245	1715
	TRAFFIC SIGNAL	10762	48.5	71	8569	2122
	STOP SIGN	440	2.0	2	318	120
	FLASHING LIGHT	37	0.2		26	11
	YIELD SIGN	30	0.1		19	11
	OFFICER GUARD	58	0.3		41	17
	NO PASSING ZONE	33	0.1		24	9
	RR CROSSING CONTROL	5	0.0		4	1
	STOP SCH. BUS RED LT. FLASH	7	0.0		6	1
	HIGHWAY WORK AREA	44	0.2		24	20
	OTHER	324	1.5		222	102
	UNSPECIFIED	3446	15.5	8	1612	1826
TABLE 7 ROADWAY CHARACTER	TOTAL	22197	100.0	132	16110	5955
	STRAIGHT AND LEVEL	17224	77.6	103	13389	3732
	STRAIGHT AND GRADE	1114	5.0	10	849	255
	STRAIGHT AT HILLCREST	320	1.4	1	248	71
	CURVE AND LEVEL	512	2.3	6	370	136
	CURVE AND GRADE	391	1.8	8	276	107
	CURVE AT HILLCREST	82	0.4	1	68	13
	UNSPECIFIED	2554	11.5	3	910	1641
TABLE 8 TIME OF DAY	TOTAL	22197	100.0	132	16110	5955
	1 AM - 4 AM	1521	6.9	20	1220	281
	4 - 7	1030	4.6	9	792	229
	7 - 10	2475	11.2	17	1729	729
	10 AM - 1 PM	3115	14.0	14	2261	840
	1 - 4	3871	17.4	13	2886	972
	4 - 7	4108	18.5	14	3011	1083
	7 - 10	2843	12.8	13	2216	614
	10 PM - 1 AM	2382	10.7	21	1832	529
	UNSPECIFIED	[illegible]	3.8		163	678
TABLE 9(P) POLICE AGENCY INVESTIGATING	TOTAL	17396	100.0	132	15092	2172
	STATE POLICE		0.0			
	COUNTY POLICE	1	0.0		1	
	MUNICIPAL POLICE	17395	100.0	132	15091	2172
	OTHER		0.0			
	UNSPECIFIED		0.0			
TABLE 10(P) LOCATION OF FIRST EVENT	TOTAL	17396	100.0	132	15092	2172
	ON ROADWAY AT INTERSECTION	11094	63.8	81	9809	1204
	ON ROADWAY NOT AT INTERSECT	[illegible]	34.2	46	[illegible]	625
	OFF ROADWAY	306	1.8	[illegible]	[illegible]	[illegible]
	UNSPECIFIED	42	0.2	[illegible]	[illegible]	5

TABLE 11	FIRST EVENT OF ACCIDENT	TOTAL ACC.		SEVERITY CLASS OF ACC		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL ACCIDENTS	22197	100.0	132	16110	5955
	COLLISION WITH	21094	95.0	122	15239	5733
	OTHER MOTOR VEHICLE	15471	69.7	30	9735	[illegible]
	PEDESTRIAN	4320	19.5	86	4234	
	BICYCLIST	1140	5.1	5	1134	1
	ANIMAL	2	0.0		2	
	RAILROAD TRAIN		0.0			
	OTHER OBJECT-NOT FIXED	161	0.7	1	136	24
	COLLISION WITH FIXED OBJECT	899	4.1	10	686	203
	LIGHT SUPPORT UTILITY POLE	79	0.4		71	[illegible]
	GUIDE RAIL	158	0.7		146	[illegible]
	CRASH CUSHION	11	0.0		9	[illegible]
	SIGN POST	12	0.1		9	[illegible]
	TREE	25	0.1	1	23	[illegible]
	BUILDING WALL	91	0.4		65	[illegible]
	CURBING	67	0.3		43	[illegible]
	FENCE	17	0.1		15	[illegible]
	BRIDGE STRUCTURE	63	0.3	2	46	15
	CULVERT/HEAD WALL	21	0.1		14	[illegible]
	MEDIAN BARRIER	147	0.7	4	114	[illegible]
	SNOW EMBANKMENT	1	0.0		1	
	EARTH EMBANK ROCK CUT DITCH	18	0.1	1	7	[illegible]
	FIRE HYDRANT	14	0.1		14	
	OTHER FIXED OBJECT	175	0.8	2	108	[illegible]
	NON-COLLISION	204	0.9		185	19
	OVERTURNED	48	0.2		46	2
	FIRE EXPLOSION	4	0.0		1	
	SUBMERSION		0.0			
	RAN OFF ROADWAY ONLY	1	0.0			1
	OTHER	151	0.7		139	[illegible]
	UNSPECIFIED		0.0			
TABLE 12 A MANNER AND LOCATION OF COLLISION	TOTAL ACCIDENTS	22197	100.0	132	16110	5955
	SINGLE VEH ACC AT INTERSECT	4210	19.0	61	4088	61
	SINGLE VEH ACC NOT AT INTER	2306	10.4	31	2106	[illegible]
	TWO VEHICLE ACC AT INTER *	8455	38.1	14	5634	2807
	TWO VEH ACC NOT AT INTER *	5272	23.8	10	2741	2521
	3 OR MORE VEH ACC AT INTER*	908	4.1	8	748	152
	3 OR MORE VEH NOT AT INTER*	1046	4.7	8	793	245
	TOTAL TWO VEHICLE ACCIDENTS	13727	100.0	24	8375	5328
TABLE 12 B TWO VEH ACCIDENTS - MANNER OF COLLISION (AT OR NOT AT INTER)	REAR END ←←	4520	32.9	3	3266	1251
	OVERTAKING ← ←	3499	25.5	4	1400	2095
	LEFT TURN ↓ ↘	1136	8.3	1	794	341
	LEFT TURN ↖ ←	672	4.9		436	236
	RIGHT ANGLE → ↓	2217	16.2	7	1694	516
	RIGHT TURN → ↗	388	2.8		149	239
	RIGHT TURN ↗ ←	69	0.5		35	34
	HEAD ON → ←	91	0.7	2	79	10
	SIDESWIPE → ←	315	2.3	1	152	162
	ALL OTHER	820	6.0	6	370	444

*TWO OR MORE VEHICLE ACCIDENTS INCLUDE PARKED CARS

TABLE 13(P) APPARENT ACCIDENT CONTRIBUTING FACTORS*	TOTAL NUMBER	TOTAL PCT	SEVERITY CLASS OF ACC FATAL	PERS INJ	PROP DAM
TOTAL FACTORS	42096	100.0	371	36532	5193
NONE	13385	31.8	125	11677	1583
HUMAN	19402	46.1	210	16862	2329
ALCOHOL INVOLVEMENT	395	0.9	33	338	24
BACKING UNSAFELY	485	1.2	6	424	55
DRIVER INATTENTION	2884	6.9	16	2516	351
DRIVER INEXPERIENCE	291	0.7	2	268	21
DRUGS (ILLEGAL)	61	0.1	31	29	1
FAILURE TO YIELD R.O.W.	1848	4.4	11	1588	249
FELL ASLEEP	31	0.1	1	26	4
FOLLOWING TOO CLOSELY	1700	4.0	1	1503	196
ILLNESS	22	0.1		21	1
LOST CONSCIOUSNESS	30	0.1		30	
PASSENGER DISTRACTION	84	0.2		78	6
PASSING LANE USAGE IMPROPER	773	1.8	15	584	174
PEDESTRIAN ERROR CONFUSION	1059	2.5	49	1010	
BICYCLIST ERROR CONFUSION	276	0.7	2	274	
PHYSICAL DISABILITY	24	0.1		23	1
PRESCRIPTION MEDICATION	7	0.0		7	
TRAFFIC CONTROL DISREGARDED	1210	2.9	9	1102	99
TURNING IMPROPERLY	847	2.0	2	671	174
UNSAFE SPEED	1338	3.2	24	1185	129
UNSAFE LANE CHANGING	735	1.7	3	583	149
OTHER HUMAN	5305	12 6	5	4606	694
VEHICULAR	2039	4.8	15	1716	308
ACCELERATOR DEFECTIVE	50	0.1	1	45	4
BRAKES DEFECTIVE	228	0.5	1	201	26
HEADLIGHTS DEFECTIVE	5	0.0		3	2
OTHER LIGHTING DEFECTS	18	0.0		15	3
OVERSIZED VEHICLE	47	0.1		33	14
STEERING FAILURE	39	0.1	4	32	3
TIRE FAILURE INADEQUATE	39	0.1		34	5
TOW HITCH DEFECTIVE	3	0.0		3	
WINDSHIELD INADEQUATE	6	0.0		4	2
OTHER VEHICULAR	1604	3 8	9	1346	249
ENVIRONMENTAL	2319	5.5	11	2052	256
ANIMAL'S ACTION	7	0.0		7	
GLARE	64	0.2		63	1
LANE MARK IMPROP/INADEQUATE	14	0.0		10	4
OBSTRUCTION DEBRIS	81	0.2		70	11
PAVEMENT DEFECTIVE	98	0.2	1	90	7
PAVEMENT SLIPPERY	1427	3.4	7	1259	161
SHOULDER DEFECTIVE IMPROPER	4	0.0		4	
TRAFF CNTL DEV IMP NON-WORK	70	0.2		62	8
VIEW OBSTRUCTED LIMITED	279	0.7	2	246	31
OTHER ENVIRONMENTAL	275	0.7	1	241	33
UNSPECIFIED	4946	11 7	10	4218	718

*A NO (NONE) FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR PER ACC MAY OCCUR

TABLE 14(P) LIGHT CONDITIONS	TOTAL NUMBER	TOTAL PCT	SEVERITY CLASS OF ACC FATAL	PERS INJ	PROP DAM
TOTAL ACCIDENTS	17396	100.0	132	15092	2172
DAYLIGHT	9935	57.1	59	8544	1333
DAWN	371	2.1	3	317	51
DUSK	755	4.3	1	659	95
DARK - ROAD LIGHTED	5942	34.2	64	5269	609
DARK - ROAD UNLIGHTED	172	1.0	4	148	20
UNSPECIFIED	220	1 3	1	155	64

TABLE 15 DRIVER SEX AND AGE	TOTAL NUMBER	TOTAL PCT	SEVERITY CLASS OF ACC FATAL	PERS INJ	PROP DAM
TOTAL DRIVERS	38099	100 0	179	26757	11172
MALE	28935	75.9	131	20762	8042
UNDER 18	157	0.4	1	126	30
18 - 20	1189	3.1	12	910	267
21 - 24	2853	7.5	9	2203	641
25 - 29	5057	13.3	25	3809	1223
30 - 39	8594	22.6	39	6338	2197
40 - 49	[illegible]	13.0	24	3442	1453
50 - 59	2700	7.1	13	1816	871
60 - 64	870	2.3	2	552	316
65 - 69	519	1.4	3	300	216
70 - 74	286	0.8	1	162	123
75 - 79	130	0.3	1	73	56
80 AND OVER	134	0.4		82	52
UNSPECIFIED AGE	1507	4 0	1	809	547
FEMALE	4953	13.0	9	3365	1579
UNDER 18	33	0.1	1	22	10
18 - 20	230	0.6		181	49
21 - 24	547	1.4	1	402	144
25 - 29	821	2.2	1	600	220
30 - 39	1444	3.8	3	1000	441
40 - 49	940	2.5	2	621	317
50 - 59	442	1.2	1	271	170
60 - 64	134	0.4		101	33
65 - 69	69	0.2		44	25
70 - 74	46	0.1		27	19
75 - 79	27	0.1		15	12
80 AND OVER	14	0.0		9	5
UNSPECIFIED AGE	156	0.4		62	94
UNSPECIFIED SEX	4211	11 1	30	2630	1551

TABLE 16 VEHICLE TYPE*	TOTAL NUMBER	TOTAL PCT	SEVERITY CLASS OF ACC FATAL	PERS INJ	PROP DAM
TOTAL VEHICLES	40458	100.0	199	28091	12168
PASSENGER CAR	24671	61.0	101	16996	7574
MOTORCYCLE	452	1.1	12	425	15
BUS TAXI OTHER FOR HIRE	6115	15.1	23	4977	1115
SCHOOL BUS	30	0.1		12	18
EMERGENCY VEHICLE	329	0.8	1	291	37
TRUCK TRACTOR TRAILER	4675	11.6	34	2967	1674
TOWING VEHICLE	53	0.1	2	38	13
MOPED	36	0.1	1	34	1
ALL OTHER	4098	10.1	20	2357	1721
UNSPECIFIED	1	0 0		1	

TABLE 17 DIRECTION OF VEHICLE STRIKING PEDESTRIAN	SEVERITY CLASS OF PED ACC NUMBER	PCT	FATAL	PERS INJ
TOTAL VEHICLES	4529	100.0	91	4438
GOING STRAIGHT	2631	58.1	64	2567
TURNING RIGHT	338	7.5	2	336
TURNING LEFT	583	12.9	6	577
BACKING	429	9.5	6	423
OTHER	548	12 1	13	535

TABLE 18(P) PEDESTRIAN CONTRIBUTING FACTOR**	SEVERITY CLASS OF PED ACC NUMBER	PCT	FATAL	PERS INJ
TOTAL FACTORS	4899	100.0	126	4773
NONE	2692	54.9	31	2661
TRAFF CNTL DEVICE DISREGARD	74	1.5	1	73
ALCOHOL INVOLVEMENT	97	2.0	18	79
DRUGS (ILLEGAL MEDICATION)	32	0.7	25	7
ILLNESS		0.0		
ERROR CONFUSION	1055	21.6	45	1010
VIEW OBSTRUCTED LIMITED	17	0.3		17
PHYSICAL DISABILITY	6	0.1		6
ALL OTHER	922	18 8	2	920

*BUS/TAXI/OTHER FOR HIRE INCLUDES BUSES, TAXIS, AND LIVERY, RENTAL AND OTHER FOR HIRE VEHICLES, BUT EXCLUDES SCHOOL BUSES WHICH ARE LISTED SEPARATELY

**MORE THAN 1 CONTRIBUTING PEDESTRIAN FACTOR PER ACCIDENT MAY OCCUR.

TABLE 19 FIRST EVENT OF ACCIDENT	TOTAL CASUALTIES	AGE 0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	SEX* MALE	FEMALE	SEVERITY CL OF INJ A	B	C
TOTAL INJURED	22500	297	478	545	1280	3095	6929	4169	2221	1375	1014	1097	14108	8376	2396	3962	16142
COLLISION WITH	21286	279	465	529	1164	2897	6569	3965	2130	1296	951	1041	13322	7952	2195	3615	15476
OTHER MOTOR VEHICLE	15352	210	237	210	779	2146	4988	3054	1592	922	467	745	9395	5948	1154	2205	11993
PEDESTRIAN	4538	67	212	260	203	453	1106	736	463	338	457	243	2734	1803	832	995	2711
BICYCLIST	1184		14	56	161	253	413	148	52	30	12	45	1040	137	171	361	652
ANIMAL	2							1	1				2			1	1
RAILROAD TRAIN																	
OTHER (NOT FIXED)	210	2	2	3	21	45	62	26	22	6	15	8	145	64	38	53	119
COLLISION WITH FIXED OBJECT	994	13	10	15	106	174	315	179	67	53	34	28	678	313	166	291	537
NON-COLLISION	220	5	3	1	10	24	45	25	24	26	29	28	109	111	35	56	129
OVERTURNED	59				7	14	24	10	2	2			43	16	15	20	24
FIRE EXPLOSION	1					1							1			1	
SUBMERSION																	
RAN OFF ROADWAY ONLY																	
OTHER	160	5	3	1	3	9	21	15	22	24	29	28	64	65	19	55	86
UNSPECIFIED																	
TOTAL KILLED	138	2	1	1	8	14	28	12	17	12	39	4	103	35			
COLLISION WITH	128	2	1	1	6	11	26	10	16	12	39	4	94	34			
OTHER MOTOR VEHICLE	33			1	5	4	8	2	4	3	6		25	8			
PEDESTRIAN	89	2	1			5	16	8	12	8	33	4	63	26			
BICYCLIST	5				1	1	2			1			5				
ANIMAL																	
RAILROAD TRAIN																	
OTHER (NOT FIXED)	1					1							1				
COLLISION WITH FIXED OBJECT	10				2	3	2	2	1				9	1			
NON-COLLISION																	
OVERTURNED																	
FIRE EXPLOSION																	
SUBMERSION																	
RAN OFF ROADWAY ONLY																	
OTHER																	
UNSPECIFIED																	

*EXCLUDES UNSPECIFIED SEX

TABLE 20 PEDESTRIAN LOCATION AND ACTIONS	TOT PEDESTRIANS KILLED OR INJ NUMBER	PCT.	AGE 0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	SEX MALE	FEMALE	UNSPEC	SEV CLASS KILLED	INJ
TOTAL PEDESTRIANS	4748	100.0	79	215	266	205	454	1131	770	485	365	508	270	2825	1923		93	4655
AT INTERSECTION	3343	70.4	43	109	169	139	293	792	565	358	279	409	187	1909	1434		68	3275
NOT AT INTERSECTION	1405	29.6	36	106	97	66	161	339	205	127	86	99	83	916	489		25	1380
TOTAL ACTIONS	4748	100.0	79	215	266	205	454	1131	770	485	365	508	270	2825	1923		93	4655
CROSSING. WITH SIGNAL	1394	29.4	18	25	61	45	111	328	245	175	134	197	54	689	705		17	1377
CROSSING. AGAINST SIGNAL	717	15.1	4	41	55	37	71	154	109	67	55	78	48	459	258		22	695
CROSS. NO SIG. MARKED CROSSWALK	120	2.5	3	7	6	3	10	34	23	10	9	11	4	65	55		3	117
CROSSING. NO SIGNAL OR CROSSWALK	600	12.6	13	54	51	35	59	133	90	48	39	52	26	398	202		16	584
WALKING ALONG HYWAY WITH TRAFFIC	37	0.8				2	4	13	6	4	2	3	3	26	11		1	36
WALK ALONG HYWAY AGAINST TRAFFIC	23	0.5					2	9	3	5	1	2	1	18	5		2	21
EMERG FROM FRONT BEHIND PARK VEH	338	7.1	19	44	37	22	30	63	29	31	22	24	17	203	135		2	336
GOING TO FROM STOPPED SCHOOL BUS	5	0.1						2	1	1	1			1	4			5
GET ON OFF OTHER VEH NOT SCH BUS	82	1.7	2		1	7	11	16	13	7	7	15	3	39	43			82
PUSHING WORKING ON CAR	19	0.4			1			8	5	1			4	14	5			19
WORKING IN ROADWAY	87	1.8					12	37	16	10	3	3	6	73	14		1	86
PLAYING IN ROADWAY	45	0.9		15	14	6	3	2	2			1	2	33	12			45
OTHER ACTIONS IN ROADWAY	569	12.0	7	15	20	29	74	152	93	64	35	41	32	377	192		11	558
NOT IN ROADWAY	223	4.7	9	4	4	8	17	60	56	14	15	21	15	135	88		2	221
UNSPECIFIED	489	10.3	4	7	18	12	50	110	79	50	44	60	55	294	195		16	473

TABLE 21 PRE-ACCIDENT BICYCLE ACTION	TOT BICYCLISTS KILLED OR INJ. NUMBER	PCT.	0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	MALE	FEMALE	UNSPEC	KILLED	INJ
TOTAL	1159	100.0		14	56	163	259	404	139	44	29	8	43	1032	122		5	1154
GOING STRAIGHT AHEAD	869	75.0		11	42	122	197	312	98	33	24	4	26	765	104		5	864
MAKING RIGHT, LEFT, U TURN	78	6.7			2	16	19	22	10	5	1	1	2	73	5			78
START STOPPING. STOP IN TRAFFIC	22	1.9				4	5	8	2	1	1		1	20	2			22
CHANGING LANES	37	3.2		1	1	2	8	11	8	1	1	1	2	35	2			37
OTHER	90	7.8		1	7	11	19	34	9	3	1	2	3	82	8			90
UNSPECIFIED	63	5.4		1	4	5	10	17	13	1	1		9	57	6			63

STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

JAN-DEC-1990

TABLE 22(P) APPARENT DRIVER CONTRIBUTING FACTOR	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		MALE DRIVERS							FEMALE DRIVERS						
	NUMBER	PERCENT	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	29195	100.0	22856	133	1009	2413	11144	5793	1323	3709	24	194	428	1737	999	213
NO DRIVER CONTRIB FACTOR	15447	52.9	12082	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2231	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	CONTRIB FACTOR															
		PERCENT OF TOTAL DRIVERS*														
TOTAL CONTRIBUTING FACTORS	16212		13063	114	664	1496	6281	3081	654	1723	18	110	217	259	545	116
ALCOHOL INVOLVEMENT	292	1.0	256		13	[illegible]	122	[illegible]	8	15		1	[illegible]	7	[illegible]	
BACKING UNSAFELY	477	1.6	[illegible]	3	12	[illegible]	[illegible]	[illegible]	19	35		1	5	13	[illegible]	[illegible]
DRIVER INATTENTION	2775	9.5	[illegible]	14	100	[illegible]	[illegible]	[illegible]	[illegible]	283	5	13	40	110	[illegible]	23
DRIVER INEXPERIENCE	285	1.0	231	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	8	5	[illegible]	[illegible]	
DRUGS (ILLEGAL)	31	0.1	[illegible]		1	[illegible]	[illegible]	[illegible]	1	2				2		
FAILURE TO YIELD R.O.W.	1755	6.0	1350	10	71	136	[illegible]	[illegible]	[illegible]	[illegible]	2	13	19	[illegible]	[illegible]	8
FELL ASLEEP	27	0.1	23		2	[illegible]	1	[illegible]	1	5				1	[illegible]	1
FOLLOWING TOO CLOSELY	1684	5.8	1369	8	[illegible]	[illegible]	671	[illegible]	57	155		6	23	[illegible]	[illegible]	9
ILLNESS	21	0.1	17			2	[illegible]	[illegible]	[illegible]	2				[illegible]	1	
LOST CONSCIOUSNESS	27	0.1	21		1	1	11	[illegible]	[illegible]	[illegible]				[illegible]		
PASSING LANE USAGE IMPROPER	710	2.4	536	5	18	[illegible]	253	[illegible]	21	62		3	6	[illegible]	15	[illegible]
PHYSICAL DISABILITY	15	0.1	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	1						[illegible]
PRESCRIPTION MEDICATION	[illegible]	0.0	[illegible]				[illegible]	[illegible]	1							
TRAFFIC CONTROL DISREGARDED	1063	3.6	810	8	[illegible]	108	[illegible]	[illegible]	[illegible]	99	1	8	15	[illegible]	21	8
TURNING IMPROPERLY	836	2.9	[illegible]	2	[illegible]	53	[illegible]	160	33	108	2	5	15	42	[illegible]	[illegible]
UNSAFE SPEED	1310	4.5	1013	16	[illegible]	[illegible]	[illegible]	[illegible]	32	84		6	12	41	[illegible]	[illegible]
UNSAFE LANE CHANGING	714	2.4	548	3	[illegible]	[illegible]	[illegible]	131	27	66		1	[illegible]	21	[illegible]	2
OTHER	4684	16.0	3621	24	163	354	[illegible]	[illegible]	200	585	4	39	64	[illegible]	141	[illegible]

*SINCE THERE MAY BE NO CONTRIBUTING FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR. PERCENTS MAY NOT TOTAL TO 100 0

TABLE 23(P) VIOLATION CHARGED	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	29198	100.0	22856	133	1009	2413	11144	5793	1323	3709	24	194	428	1737	999	213
WITH NO VIOLATION	26658	91.3	20567	101	823	2029	9943	5401	1256	3450	19	170	394	1601	[illegible]	[illegible]
	VIOLATIONS															
		PERCENT OF TOTAL DRIVERS*														
TOTAL VIOLATIONS	3639		3271	61	291	575	1218	536	83	354	6	32	45	192	62	12
SPEEDING	12	0.0	12		1	6	4		1							
DWI (INTOXICATION)	95	0.3	90		6	10	45	25	3	5				3	2	
DWAI (ABILITY IMPAIRED-ALCH)	6	0.0	5			2	2	1		1				1		
DWAI (ABILITY IMPAIRED-DRUG)	1	0.0								1				1		
UNSAFE TIRES	3	0.0	3		1	1	1									
INSUFFICIENT LIGHTS	9	0.0	9			3	2	4								
OTHER EQUIPMENT VIOLATIONS	28	0.1	27		[illegible]	3	15	2		1					1	
PASSED STOP SIGN		0.0														
PASSED RED LIGHT	39	0.1	37	2	4	4	21	6		2				1		1
IMPROPER PASSING LANE USAGE	13	0.0	13		1	2	5	2	3							
ILLEGAL TURN	12	0.0	12			2	3	6	1							
FAILED TO YIELD R.O.W.	12	0.0	10		1		4	3	1	1				1		
FOLLOWING TOO CLOSELY	1	0.0	1				1									
BACKING UNSAFELY	2	0.0	2		1	1										
PASSED STOPPED SCHOOL BUS		0.0														
RECKLESS DRIVING	7	0.0	7		2	2	2	1								
ALL OTHER	3329	11.4	2980	55	[illegible]	533	1576	474	74	336	6	37	45	179	58	11
UNSPECIFIED	70	0.2	63	4	4	6	33	11		7				6	1	

*SINCE THERE MAY BE NO VIOLATION OR MORE THAN ONE VIOLATION. PERCENTS MAY NOT TOTAL TO 100 0

TABLE 24 TIME OF DAY	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	38099	100.0	28935	157	1189	2853	13651	7639	1939	4953	33	230	547	2265	1382	330
1 AM - 4 AM	2692	7.1	2139	30	185	321	1084	373	45	262	3	32	24	125	37	2
4 - 7	1818	4.8	1501	6	72	183	757	361	[illegible]	138	2	11	19	68	30	3
7 - 10	4326	11.4	3302	7	85	278	1547	969	242	649	4	13	52	305	203	52
10 AM - 1 PM	5229	13.7	4053	17	121	347	1874	1142	335	667		20	62	318	195	55
1 - 4	6513	17.1	4925	17	167	445	2176	1423	402	894	4	35	66	378	281	77
4 - 7	6999	18.4	5227	26	201	475	2384	1447	392	1066	3	39	109	495	310	70
7 - 10	4848	12.7	3666	28	145	365	1819	910	224	625	6	40	84	274	175	28
10 PM - 1 AM	4252	11.2	3277	24	185	369	1645	761	151	461	8	32	65	225	97	15
UNSPECIFIED	1422	3.7	840	2	25	74	364	228	81	190	3	10	16	76	53	25

TABLE 27 PRE-ACCIDENT VEHICLE ACTION	TOTAL VEHICLES INVOLVED		TRAFFIC CONTROL											
	NUMBER	PCT	NONE	TRAFFIC SIGNAL	STOP SIGN	FLASH LIGHT	YIELD SIGN	OFFICER GUARD	NO PASS ZONE	RR XING CONTROL	HIGHWAY WK AREA	OTHER	UNSPEC
TOTAL	40458	100.0	12735	19149	861	68	63	105	64	12	82	614	6703
GOING STRAIGHT AHEAD	22124	54.7	7182	11174	570	27	[illegible]	47	40	7	[illegible]	313	2896
MAKING RIGHT TURN	1616	4.0	256	1097	54	[illegible]	[illegible]	6				2	144
MAKING LEFT TURN	3039	7.5	336	2359	[illegible]	6	[illegible]	5	1		1	[illegible]	220
MAKING U TURN	379	0.9	159	142	3	1	1					16	57
STARTING FROM PARKING	535	1.4	294	116	2	1		3	1		1	6	129
STARTING IN TRAFFIC	317	0.8	82	197	7						2	2	27
SLOWING OR STOPPING	1536	3.8	608	574	17	3	5	6	4		13	22	287
STOPPED IN TRAFFIC	2840	7.0	816	1472	31	6	5	6	3	1	8	5	455
ENTER PARKED POSITION	179	0.4	95	35				1				1	7
PARKED	2359	5.8	1034	603	50	5		7	1	3	2	41	613
AVOID OBJECT IN RDWAY	180	0.4	83	40			1	1	1		2	2	50
CHANGING LANES	1130	2.8	471	322	4	4		6	5		6	31	251
OVERTAKING	485	1.2	169	130	5	6	1		5		5	11	155
MERGING	265	0.7	107	37	4		[illegible]	12			4	4	93
BACKING	889	2.2	426	351	11	1		1	2		2	18	177
TURNING RIGHT ON RED	35	0.1		35									
TURNING LEFT ON RED	54	0.1		54									
OTHER	876	2.2	367	224	10	1	3	3	3		1	34	221
UNSPECIFIED	1570	3.9	250	255	13	1	2	1		1	2	20	1025

TABLE 28(P) INJURY DESCRIPTION	TOTAL PERSONS KILLED OR INJ	
	KILLED	INJURED
LOCATION OF MOST SEV PHYSICAL COMPLAINT	138	21255
HEAD	50	[illegible]
FACE	3	[illegible]
EYE		84
NECK	4	[illegible]
CHEST	5	1481
BACK		[illegible]
SHOULDER UPPER ARM		861
ELBOW LOWER ARM HAND	1	1052
ABDOMEN PELVIS	3	[illegible]
HIP UPPER LEG	2	[illegible]
KNEE LOWER LEG FOOT	6	2894
ENTIRE BODY	38	1210
UNSPECIFIED	27	[illegible]
MOST SEVERE PHYSICAL COMPLAINT	138	21255
AMPUTATION	1	51
CONCUSSION	10	407
INTERNAL	13	308
MINOR BLEEDING	1	1657
SEVERE BLEEDING	51	367
MINOR BURN		95
MODERATE BURN		20
SEVERE BURN	3	12
FRACTURE DISLOCATION	6	650
CONTUSION BRUISE		1342
ABRASION		661
COMPLAINT OF PAIN	11	11488
NONE VISIBLE	2	2056
UNSPECIFIED	40	2141
VICTIM'S PHYSICAL AND EMOTIONAL STATUS	138	21255
DECEASED	138	XXX
UNCONSCIOUS	XXX	155
SEMICONSCIOUS	XXX	395
INCOHERENT	XXX	144
SHOCK	XXX	464
CONSCIOUS	XXX	17156
UNSPECIFIED	XXX	2995

TABLE 29(P) SAFETY EQUIPMENT USED	TOTAL VEHICLE OCCUPANTS		SEVERITY CLASS OF VEHICLE OCCUPANTS				
	NUMBER	PCT	KILLED	A	B	C	UNINJ
TOTAL	45738	100.0	40	1304	2392	11818	30184
NO RESTRAINT USED	10060	22.0	22	450	792	3261	5535
LAP BELT	7976	17.4	2	237	418	2373	4946
HARNESS	2687	5.9	1	85	155	887	1559
LAP BELT AND HARNESS	7239	15.8	1	162	402	2436	4238
CHILD RESTRAINT	145	0.3		3	4	30	108
HELMET	228	0.5	2	36	58	107	25
OTHER	2	0.0				2	
UNSPECIFIED	17401	38.0	12	331	563	2722	13773

"A" INJURIES INCLUDE SEVERE LACERATIONS. BROKEN OR DISTORTED LIMBS. SKULL FRACTURES. CRUSHED CHEST. INTERNAL INJURIES. UNCONSCIOUS WHEN TAKEN FROM THE ACCIDENT SCENE. UNABLE TO LEAVE ACCIDENT SCENE WITHOUT ASSISTANCE.

"B" INJURIES INCLUDE LUMP ON HEAD. ABRASIONS. MINOR LACERATIONS

"C" INJURIES INCLUDE MOMENTARY UNCONSCIOUSNESS. LIMPING. NAUSEA. HYSTERIA. COMPLAINT OF PAIN/NO VISIBLE INJURY

TABLE 30(P) METHOD OF TRANSPORT KILLED OR INJURED TO A MEDICAL FACILITY	TOTAL KILLED AND INJURED		SEVERITY CLASS OF INJURED			
	NUMBER	PCT	KILLED	A	B	C
TOTAL	11732	100.0	130	1858	2346	7398
AMBULANCE	9483	80.8	112	1512	1889	5970
POLICE AMBULANCE	24	0.2			7	17
POLICE CAR	191	1.6		22	50	119
FIRE VEHICLE	529	4.5	5	88	110	325
INVALID COACH/FUNERAL	1	0.0				1
COR VEH MUNI EMERG EQ	9	0.1		1	1	7
PRIVATE VEHICLE	224	1.9		38	45	141
UNSPECIFIED	1272	10.8	13	197	244	818

*THERE MAY BE MORE THAN 1 CONTRIBUTING FACTOR OR EQUIPMENT VIOLATION CHARGED PER VEHICLE

**SINCE VEHICLE MAY HAVE MORE THAN ONE CONTRIBUTING FACTOR. PERCENTS WILL NOT NECESSARILY TOTAL TO 100.0

***CURRENT YEAR MODEL INCLUDES PRESENT CALENDAR YEAR AND NEWER MODELS

TABLE 31(P) APPARENT VEHICULAR ACCIDENT CONTRIBUTING FACTORS*	TOTAL		VEHICLE TYPE										VEHICLE AGE					
	NUMBER	PCT	PASS CAR	MOTORCYCLE	BUS/TAXI	SCHOOL BUS	EMERG VEH	TRUCK TR TRL	TOWING VEH	MOPED	ALL OTHER	UNSPEC	CUR YR MOD***	1-2 YR OLD	3-5 YRS OLD	6-9 YR OLD	10 OR MORE	UNSPEC
TOTAL VEHICLES	30866	100.0	19106	431	5088	15	305	3436	45	35	2404	1	1141	3822	4593	3933	3151	14221
WITH NO DEFECT	28967	93.8	17841	408	4813	15	290	3231	43	34	2291	1	1075	3608	4315	3547	2919	13402
	DEFECTS																	
		PCT. OF TOT VEH **																
TOTAL DEFECTS	1919		1225	24	279		17	202	2	1	114		69	220	278	289	233	831
ACCELERATOR DEFECTIVE	50	0.2	39	1	5		1	2			2		2	10	11	3	4	20
BRAKES DEFECTIVE	225	0.7	145		30		3	36	1		10		5	21	24	37	46	92
LIGHTING DEFECTS	22	0.1	14		2			3			3		1		3	5	4	9
STEERING FAILURE	39	0.1	27	2	5			4			1			4	6	8	4	17
TIRE FAILURE/INADEQUATE	39	0.1	30	1	4			3			1			2	7	8	6	16
OTHER	1544	5.0	1020	20	233		13	159	1	1	97		60	183	227	228	169	677
ANY EQUIP VIOL CHARGED	40	100.0	24	3	1			11	1					1	7	8	10	14

PAGE 1 OF 6 STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES 00002
MV-144A(01/79) SUMMARY OF MOTOR VEHICLE ACCIDENTS NEW YORK COUNTY JAN-DEC,1991

TABLE 1 ACCIDENT SUMMARY TOTALS

CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD
TOTAL ACCIDENTS	20603	16728	22446	17669
FATAL ACCIDENTS	95	95	133	133
INJURY ACCIDENTS(1)	15917	14881	16219	15212
REPORTABLE PROP DAMAGE	4591	1752	6094	2324
DRIVERS INVOLVED(2)	35271	28051	38608	29766
VEHICLES	37223	29485	40977	31443
PEDESTRIAN ACCIDENTS	4364	4284	4541	4465
BICYCLE/MOTOR VEH ACC	1200	1263	1163	1149
VEHICLE OCCUPANTS	53840	43578	50591	45999

CATEGORY TOTALS	CURRENT YEAR REPORTING PER. ALL ACC.	CURRENT YEAR REPORTING PER. POLICE REPORTD	LAST YEAR SAME PERIOD ALL ACC.	LAST YEAR SAME PERIOD POLICE REPORTD
PERSONS KILLED(3)	100	100	139	139
DRIVERS KILLED	21	21	26	26
PASSENGERS KILLED	11	11	14	14
PEDESTRIANS KILLED	65	65	94	94
BICYCLISTS KILLED	3	3	5	5
PERSONS INJURED(1,3)	22109	20858	22685	21443
DRIVERS INJURED(1,4)	XXXX	8421	XXXX	8596
PASSENGERS INJ.(1,4)	XXXX	6739	XXXX	7093
PEDESTRIANS INJURED(1)	4497	4415	4667	4591
BICYCLISTS INJURED(1)	1281	1264	1158	1145

1. EXCLUDES FATALS.
2. DOES NOT INCLUDE PARKED VEHICLES OR BICYCLES.
3. INCLUDES PEDESTRIANS, BICYCLISTS AND ALL OTHER NON-VEHICLE INVOLVED PERSONS AS WELL AS VEHICLE OCCUPANTS REGARDLESS OF SEATING POSITION.
4. DATA GATHERED ONLY FROM POLICE REPORTED ACCIDENTS.

NOTE*SOME OF THE TABLES ARE BASED UPON INFORMATION RECEIVED FROM POLICE AND MOTORIST REPORTS OF MOTOR VEHICLE ACCIDENTS. OTHERS ARE BASED ONLY ON THE POLICE REPORTS. THESE ARE INDICATED BY A "(P)".
*DATA ON NON-REPORTABLE ACCIDENTS ARE NOT INCLUDED UNLESS SPECIFICALLY INDICATED.
*THE TERM "VEHICLE" ALWAYS EXCLUDES BICYCLES.
*THE TERM "DRIVERS" ALWAYS EXCLUDES BICYCLISTS.
*PERCENTS MAY NOT TOTAL 100.0 DUE TO ROUNDING.

TABLE 2 STATEWIDE RATES

TABLE 2 STATEWIDE RATES	STATEWIDE STATISTICS THIS PERIOD	LAST YR. SAME PER	PERCENT CHANGE
MOTOR VEHICLE DEATHS	1988	2211	-10.09
DEATH RATE/100 MIL VEH MI	1.85	2.07	-10.63
FATAL ACC/100 MIL VEH MI	1.68	1.90	-11.58
INJ RATE/100 MIL VEH MI	260.36	276.03	-5.68
DEATH RATE / 100,000 POP	11.03	12.29	-10.25
INJURY RATE / 100,000 POP	1554.44	1640.20	-5.23

RATES PER 100,000 POPULATION ARE BASED ON OFFICIAL UPDATED ESTIMATES OF THE NYS DEPT OF COMMERCE, 3/04/83.

TABLE 25

DAY	PEDESTRIAN ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC
TOTAL	4364	165	90	481	609	896	968	691	379	85
SUNDAY	350	30	8	17	38	69	81	64	31	12
MONDAY	628	9	15	79	98	124	146	94	46	17
TUESDAY	706	22	8	80	112	156	148	117	51	12
WEDNESDAY	672	22	11	82	94	149	150	96	61	7
THURSDAY	692	22	11	92	92	138	154	118	56	9
FRIDAY	773	24	16	92	111	165	177	111	63	14
SATURDAY	543	36	21	39	64	95	112	91	71	14

DAY	BICYCLE ACCIDENTS BY TIME OF DAY TOTAL	1-4AM	4-7	7-10	10-1PM	1-4	4-7	7-10	10-1AM	UNSPEC
TOTAL	1280	23	9	90	241	293	318	206	85	15
SUNDAY	99	5	2	4	16	21	27	18	5	1
MONDAY	214	3	3	24	49	43	52	27	11	2
TUESDAY	218	3		16	51	58	49	32	9	
WEDNESDAY	222	2	1	17	40	46	58	38	18	2
THURSDAY	230	3		10	40	54	73	33	14	3
FRIDAY	194	2	2	13	32	49	42	37	14	3
SATURDAY	103	5	1	6	13	22	17	21	14	4

TABLE 26

HOUR AND DAY OF OCCURRENCE	TOTAL ALL ACC.	TOTAL FATAL ACC.	DAY OF OCCURRENCE FOR TOTAL AND FATAL ACCIDENTS SUNDAY TOTAL	SUNDAY FATAL	MONDAY TOTAL	MONDAY FATAL	TUESDAY TOTAL	TUESDAY FATAL	WEDNESDAY TOTAL	WEDNESDAY FATAL	THURSDAY TOTAL	THURSDAY FATAL	FRIDAY TOTAL	FRIDAY FATAL	SATURDAY TOTAL	SATURDAY FATAL
TOTAL	20603	95	2398	13	2908	14	3010	16	2996	14	3047	10	3442	15	2802	13
FROM 12 MIDNIGHT	481	6	74	2	49	2	53	1	64		65		73	1	103	
1 AM	520	4	104		60		44	2	61		62		78	1	111	1
2	443	5	106	1	43	1	36		44		52		63	1	99	2
3	343	8	83	3	25	1	31	2	35		31		43	1	95	1
4	284	3	93	1	21		22	1	23		22	1	34		69	
5	258	2	65		33		33	1	22		26	1	37		42	
6	315	3	32	1	54	1	41		46		38		49		55	1
7	528	3	46		97		91	1	94		72		79	1	49	1
8	844	5	64		140		149	1	114	2	152	1	141	1	84	
9	911		54		157		133		143		165		158		101	
10	933	1	86		171		161		128	1	145		142		100	
11	1020	4	90		165		162	1	144	1	164	1	161	1	142	
12 NOON	1019	2	112		167	1	164	1	151		136		167		122	
1 PM	1133	7	128		163	2	192	1	170	1	170	1	179	2	131	
2	1220	4	129		193	1	181	1	196	1	174		213		142	1
3	1323	3	136		175	1	197		201	1	207		254	1	153	
4	1328	3	130	1	172		175		219	1	221	1	268		143	
5	1241	2	123		193		194		188		174		229		140	2
6	1144	1	132		164	1	172		170		168		184		154	
7	1026	9	125	2	131		161	1	163	2	146		171	4	129	
8	877	2	99	1	117		114		126		148		154		119	1
9	842	7	99		110	2	141	2	111		134	1	119	1	128	1
10	811	4	75		97	1	117		130	1	124	1	150		118	1
11	821	7	98	1	88		107		125	3	137	2	130		136	1
UNSPECIFIED	922		115		123		139		128		114		166		137	

EFFECTIVE WITH SEPTEMBER 1, 1985 ACCIDENTS, THE PROPERTY DAMAGE REPORTING LEVEL WAS INCREASED FROM 400 DOLLARS TO 600 DOLLARS.

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MV-144A(01/79)

STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

JAN-DEC.1991

00002

TABLE 3	WEATHER	TOTAL ACC.		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL	20603	100.0	95	15917	4591
	CLEAR	13120	63.7	70	10499	2551
	CLOUDY	2346	11.4	8	1973	365
	RAIN	3163	15.4	15	2516	632
	SNOW	192	0.9	1	138	53
	SLEET/HAIL/FREEZING RAIN	47	0.2		38	9
	FOG/SMOG/SMOKE	29	0.1	1	21	7
	OTHER	20	0.1		13	7
	UNSPECIFIED	1686	8.2		719	967
TABLE 4 RDWAY SURFACE CONDITION	TOTAL	20603	100.0	95	15917	4591
	DRY	14521	70.5	72	11700	2749
	WET	4128	20.0	22	3306	800
	MUDDY	16	0.1		7	9
	SNOW/ICE	196	1.0		134	62
	SLUSH	42	0.2		29	13
	OTHER	46	0.2	1	33	12
	UNSPECIFIED	1654	8.0		708	946
TABLE 5 JURISDICTIONAL ROAD SYSTEM	TOTAL	20603	100.0	95	15917	4591
	STATE ROUTES	7	0.0		6	1
	COUNTY ROUTES	1	0.0			1
	TOWN ROUTES	5	0.0		2	3
	MUNICIPAL STREETS	18040	87.6	81	14159	3800
	PARKWAYS	1721	8.4	12	1297	412
	THRUWAY	1	0.0			1
	NORTHWAY		0.0			
	OTHER INTERSTATE	770	3.7	2	428	340
	OTHER LIMITED ACCESS		0.0			
	UNSPECIFIED	58	0.3		25	33
TABLE 6 TRAFFIC CONTROL	TOTAL	20603	100.0	95	15917	4591
	NONE	6554	31.8	31	5164	1359
	TRAFFIC SIGNAL	10124	49.1	57	8491	1576
	STOP SIGN	398	1.9	1	307	90
	FLASHING LIGHT	25	0.1		21	4
	YIELD SIGN	29	0.1		19	10
	OFFICER/GUARD	29	0.1		19	10
	NO PASSING ZONE	29	0.1		21	8
	RR CROSSING CONTROL	9	0.0		6	3
	STOP SCH. BUS RED LT. FLASH	4	0.0		4	
	HIGHWAY WORK AREA	78	0.4	1	46	31
	OTHER	284	1.4	2	206	76
	UNSPECIFIED	3040	14.8	3	1613	1424
TABLE 7 ROADWAY CHARACTER	TOTAL	20603	100.0	95	15917	4591
	STRAIGHT AND LEVEL	16178	78.5	81	13173	2924
	STRAIGHT AND GRADE	1081	5.2	5	876	200
	STRAIGHT AT HILLCREST	318	1.5	1	271	46
	CURVE AND LEVEL	451	2.2	6	330	115
	CURVE AND GRADE	349	1.7	2	265	82
	CURVE AT HILLCREST	74	0.4		52	22
	UNSPECIFIED	2152	10.4		950	1202
TABLE 8 TIME OF DAY	TOTAL	20603	100.0	95	15917	4591
	1 AM - 4 AM	1306	6.3	17	1090	199
	4 - 7	857	4.2	8	694	155
	7 - 10	2283	11.1	8	1731	544
	10 AM - 1 PM	2980	14.5	7	2240	733
	1 - 4	3684	17.9	14	2878	792
	4 - 7	3713	18.0	6	2901	806
	7 - 10	2745	13.3	18	2249	478
	10 PM - 1 AM	2113	10.3	17	1719	377
	UNSPECIFIED	922	4.5		415	507
TABLE 9(P) POLICE AGENCY INVESTIGATING	TOTAL	16728	100.0	95	14881	1752
	STATE POLICE		0.0			
	COUNTY POLICE		0.0			
	MUNICIPAL POLICE	16728	100.0	95	14881	1752
	OTHER		0.0			
	UNSPECIFIED		0.0			
TABLE 10(P) LOCATION OF FIRST EVENT	TOTAL	16728	100.0	95	14881	1752
	ON RDWAY AT INTERSECTION	10667	63.8	59	9663	945
	ON RDWAY NOT AT INTERSECT	5741	34.3	33	4939	769
	OFF ROADWAY	285	1.7	2	252	31
	UNSPECIFIED	35	0.2	1	27	7

TABLE 11	FIRST EVENT OF ACCIDENT	TOTAL ACC.		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL ACCIDENTS	20603	100.0	95	15917	4591
	COLLISION WITH	19650	95.4	81	15149	4420
	OTHER MOTOR VEHICLE	14020	68.0	15	9615	4390
	PEDESTRIAN	4200	20.4	61	4139	
	BICYCLIST	1257	6.1	4	1253	
	ANIMAL	8	0.0		5	3
	RAILROAD TRAIN	1	0.0			1
	OTHER OBJECT(NOT FIXED)	164	0.8	1	137	26
	COLLISION WITH FIXED OBJECT	774	3.8	12	601	161
	LIGHT SUPPORT/UTILITY POLE	61	0.3	1	54	6
	GUIDE RAIL	142	0.7	5	111	26
	CRASH CUSHION	11	0.1		10	1
	SIGN POST	7	0.0		6	1
	TREE	33	0.2		32	1
	BUILDING/WALL	89	0.4	3	66	20
	CURBING	63	0.3	1	43	19
	FENCE	9	0.0		7	2
	BRIDGE STRUCTURE	44	0.2		40	4
	CULVERT/HEAD WALL	19	0.1		14	5
	MEDIAN/BARRIER	130	0.6		104	26
	SNOW EMBANKMENT	1	0.0		1	
	EARTH EMBANK/ROCK CUT/DITCH	12	0.1		8	4
	FIRE HYDRANT	17	0.1		14	3
	OTHER FIXED OBJECT	136	0.7	2	91	43
	NON-COLLISION	179	0.9	2	167	10
	OVERTURNED	36	0.2	2	32	2
	FIRE/EXPLOSION		0.0			
	SUBMERSION		0.0			
	RAN OFF ROADWAY ONLY	3	0.0		2	1
	OTHER	140	0.7		133	7
	UNSPECIFIED		0.0			
TABLE 12 A MANNER AND LOCATION OF COLLISION	TOTAL ACCIDENTS	20603	100.0	95	15917	4591
	SINGLE VEH ACC AT INTERSECT	4131	20.1	46	4042	43
	SINGLE VEH ACC NOT AT INTER	2263	11.0	25	2098	140
	TWO VEHICLE ACC AT INTER *	7614	37.0	12	5535	2067
	TWO VEH ACC NOT AT INTER *	4754	23.1	4	2727	2023
	3 OR MORE VEH ACC AT INTER*	867	4.2	4	743	120
	3 OR MORE VEH NOT AT INTER*	974	4.7	4	772	198
	TOTAL TWO VEHICLE ACCIDENTS	12368	100.0	16	8262	4090

TABLE 12 B TWO VEH ACCIDENTS * MANNER OF COLLISION (AT OR NOT AT INTER)							
	REAR END	← ←	4183	33.8		3206	977
	OVERTAKING	← ←	2944	23.8	1	1353	1590
	LEFT TURN	↓ ↖	1082	8.7	1	797	284
	LEFT TURN	↖ ←	648	5.2		448	200
	RIGHT ANGLE	→ ↓	2047	16.6	5	1679	363
	RIGHT TURN	→ ↗	355	2 9	1	165	189
	RIGHT TURN	↗ ←	71	0.6		43	28
	HEAD ON	→ ←	104	0.8		89	15
	SIDESWIPE	← →	245	2.0	2	148	95
	ALL OTHER		689	5.6	6	334	349

*TWO OR MORE VEHICLE ACCIDENTS INCLUDE PARKED CARS.

TABLE 13(P)	APPARENT ACCIDENT CONTRIBUTING FACTORS*	TOTAL		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
*A NO(NONE) FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR PER ACC MAY OCCUR.	TOTAL FACTORS	40308	100.0	245	35910	4153
	NONE	12280	30.5	79	10950	1251
	HUMAN	18875	46.8	152	16861	1862
	ALCOHOL INVOLVEMENT	375	0.9	30	330	15
	BACKING UNSAFELY	462	1.1	2	414	46
	DRIVER INATTENTION	2612	6.5	8	2342	262
	DRIVER INEXPERIENCE	234	0.6	1	213	20
	DRUGS(ILLEGAL)	58	0.1	26	28	4
	FAILURE TO YIELD R.O.W.	1902	4.7	6	1669	227
	FELL ASLEEP	46	0.1		41	5
	FOLLOWING TOO CLOSELY	1740	4.3		1580	160
	ILLNESS	30	0.1		29	1
	LOST CONSCIOUSNESS	28	0.1		28	
	PASSENGER DISTRACTION	123	0.3		114	9
	PASSING/LANE USAGE IMPROPER	708	1.8	26	550	132
	PEDESTRIAN ERROR/CONFUSION	991	2.5	22	969	
	BICYCLIST ERROR/CONFUSION	257	0.6	1	256	
	PHYSICAL DISABILITY	15	0.0		14	1
	PRESCIPTION MEDICATION	8	0.0		8	
	TRAFFIC CONTROL DISREGARDED	1236	3.1	9	1149	78
	TURNING IMPROPERLY	867	2.2	1	720	146
	UNSAFE SPEED	1271	3.2	15	1172	84
	UNSAFE LANE CHANGING	780	1.9	2	611	167
	OTHER HUMAN	5132	12.7	3	4624	505
	VEHICULAR	1851	4.6	2	1636	213
	ACCELERATOR DEFECTIVE	54	0.1		51	3
	BRAKES DEFECTIVE	206	0.5		190	16
	HEADLIGHTS DEFECTIVE	5	0.0		5	
	OTHER LIGHTING DEFECTS	10	0.0		9	1
	OVERSIZED VEHICLE	47	0.1		37	10
	STEERING FAILURE	43	0.1	1	37	5
	TIRE FAILURE/INADEQUATE	34	0.1		33	1
	TOW HITCH DEFECTIVE	1	0.0		1	
	WINDSHIELD INADEQUATE	4	0.0		4	
	OTHER VEHICULAR	1447	3.6	1	1269	177
	ENVIRONMENTAL	2133	5.3	7	1905	221
	ANIMAL'S ACTION	6	0.0		6	
	GLARE	57	0.1		52	5
	LANE MARK IMPROP/INADEQUATE	18	0.0		16	2
	OBSTRUCTION/DEBRIS	106	0.3	1	100	5
	PAVEMENT DEFECTIVE	65	0.2		61	4
	PAVEMENT SLIPPERY	1317	3.3	4	1167	146
	SHOULDER DEFECTIVE/IMPROPER	3	0.0		3	
	TRAFF CNTL DEV IMP/NON-WORK	57	0.1		56	1
	VIEW OBSTRUCTED/LIMITED	261	0.6	1	228	32
	OTHER ENVIRONMENTAL	243	0.6	1	216	26
	UNSPECIFIED	5161	12.8	5	4550	606

TABLE 14(P) LIGHT CONDITIONS		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL ACCIDENTS	16728	100.0	95	14881	1752
	DAYLIGHT	9727	58.1	35	8575	1117
	DAWN	317	1.9	3	269	45
	DUSK	663	4.0	2	580	81
	DARK - ROAD LIGHTED	5615	33.6	51	5106	458
	DARK - ROAD UNLIGHTED	181	1.1	4	164	13
	UNSPECIFIED	225	1.3		187	38

TABLE 15	DRIVER SEX AND AGE	TOTAL		SEVERITY CLASS OF ACC.		
		NUMBER	PCT.	FATAL	PERS INJ	PROP DAM
	TOTAL DRIVERS	35221	100.0	118	26544	8609
	MALE	26728	75.9	96	20489	6193
	UNDER 18	135	0.4		106	29
	18 - 20	943	2.7	2	779	162
	21 - 24	2498	7.1	17	2015	466
	25 - 29	4589	13.0	23	3681	885
	30 - 39	8223	23.3	31	6484	1708
	40 - 49	4744	13.5	11	3551	1182
	50 - 59	2578	7.3	7	1845	726
	60 - 64	769	2.2	1	526	242
	65 - 69	427	1.2	2	278	147
	70 - 74	285	0.8		177	108
	75 - 79	143	0.4		83	60
	80 AND OVER	105	0.3		71	34
	UNSPECIFIED AGE	1339	3.8	2	893	444
	FEMALE	4539	12.9	5	3366	1168
	UNDER 18	28	0.1		23	5
	18 - 20	191	0.5		154	37
	21 - 24	485	1.4		374	111
	25 - 29	778	2.2		605	173
	30 - 39	1298	3.7	3	1014	281
	40 - 49	880	2.5	1	633	246
	50 - 59	437	1.2	1	287	149
	60 - 64	123	0.3		81	42
	65 - 69	92	0.3		52	40
	70 - 74	46	0.1		27	19
	75 - 79	16	0.0		9	7
	80 AND OVER	20	0.1		13	7
	UNSPECIFIED AGE	145	0.4		94	51
	UNSPECIFIED SEX	3954	11.2	17	2689	1246
TABLE 16 VEHICLE TYPE*	TOTAL VEHICLES	37223	100.0	129	27209	9385
	PASSENGER CAR	22875	61.5	61	16969	5845
	MOTORCYCLE	464	1.2	9	443	12
	BUS/TAXI/OTHER FOR HIRE	5731	15.4	17	4866	848
	SCHOOL BUS	29	0.1		21	8
	EMERGENCY VEHICLE	348	0.9		312	36
	TRUCK/TRACTOR TRAILER	4098	11.0	30	2782	1286
	TOWING VEHICLE	47	0.1		36	11
	MOPED	37	0.1		36	1
	ALL OTHER	3594	9.7	12	2244	1338
	UNSPECIFIED		0.0			

TABLE 17	DIRECTION OF VEHICLE STRIKING PEDESTRIAN	SEVERITY CLASS OF PED. ACC.			
		NUMBER	PCT.	FATAL	PERS INJ
	TOTAL VEHICLES	4364	100.0	64	4300
	GOING STRAIGHT	2497	57.2	47	2450
	TURNING RIGHT	324	7.4	4	320
	TURNING LEFT	585	13.4	6	579
	BACKING	395	9.1	1	394
	OTHER	563	12.9	6	557

TABLE 18(P)	PEDESTRIAN CONTRIBUTING FACTOR**	SEVERITY CLASS OF PED. ACC.			
		NUMBER	PCT.	FATAL	PERS INJ
	TOTAL FACTORS	4704	100.0	85	4619
	NONE	2504	53.2	28	2476
	TRAFF CNTL DEVICE DISREGARD	81	1.7	1	80
	ALCOHOL INVOLVEMENT	83	1.8	12	71
	DRUGS(ILLEGAL/MEDICATION)	22	0.5	20	2
	ILLNESS	2	0.0		2
	ERROR/CONFUSION	990	21.0	22	968
	VIEW OBSTRUCTED/LIMITED	18	0.4		18
	PHYSICAL DISABILITY	1	0.0		1
	ALL OTHER	1003	21.3	2	1001

*BUS/TAXI/OTHER FOR HIRE INCLUDES BUSES, TAXIS, AND LIVERY, RENTAL AND OTHER FOR HIRE VEHICLES, BUT EXCLUDES SCHOOL BUSES WHICH ARE LISTED SEPARATELY.

**MORE THAN 1 CONTRIBUTING PEDESTRIAN FACTOR PER ACCIDENT MAY OCCUR.

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STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

JAN-DEC.1991

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TABLE 19 FIRST EVENT OF ACCIDENT	TOTAL CASUALTIES	AGE											SEX*		SEVERITY CL OF INJ.		
		0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	MALE	FEMALE	A	B	C
TOTAL INJURED	22109	288	463	537	1100	2902	6839	4252	2242	1257	1028	1201	13831	8263	2169	3844	16096
COLLISION WITH	21084	275	452	519	1022	2748	6499	4071	2156	1204	987	1151	13161	7908	2014	3552	15518
OTHER MOTOR VEHICLE	15172	210	213	220	656	2044	4897	3142	1621	836	505	828	9267	5892	1020	2131	12021
PEDESTRIAN	4422	59	221	240	212	399	1042	745	453	328	468	255	2599	1822	779	976	2667
BICYCLIST	1294	3	18	59	137	268	495	152	68	25	10	59	1153	140	177	392	725
ANIMAL	7				3		2	2					6	1		1	6
RAILROAD TRAIN																	
OTHER(NOT FIXED)	189	3			14	37	63	30	14	15	4	9	136	53	38	52	99
COLLISION WITH FIXED OBJECT	834	8	9	12	69	129	300	153	72	34	21	27	571	263	126	245	463
NON-COLLISION	191	5	2	6	9	25	40	28	14	19	20	23	99	92	29	47	115
OVERTURNED	40				3	9	15	8	2	1		2	37	3	7	13	20
FIRE/EXPLOSION																	
SUBMERSION																	
RAN OFF ROADWAY ONLY	2							1		1			2				2
OTHER	149	5	2	6	6	16	25	19	12	17	20	21	60	89	22	34	93
UNSPECIFIED																	
TOTAL KILLED	100	2		2	1	15	19	10	9	15	24	3	69	31			
COLLISION WITH	85	2		2		8	16	10	8	13	23	3	56	29			
OTHER MOTOR VEHICLE	18			1		4	7	3	1	1	1		16	2			
PEDESTRIAN	62	2		1		4	8	5	6	12	21	3	36	26			
BICYCLIST	4						1	2			1		3	1			
ANIMAL																	
RAILROAD TRAIN																	
OTHER(NOT FIXED)	1								1				1				
COLLISION WITH FIXED OBJECT	13					6	3		1	2	1		11	2			
NON-COLLISION	2				1	1							2				
OVERTURNED	2				1	1							2				
FIRE/EXPLOSION																	
SUBMERSION																	
RAN OFF ROADWAY ONLY																	
OTHER																	
UNSPECIFIED																	

*EXCLUDES UNSPECIFIED SEX.

TABLE 20 PEDESTRIAN LOCATION AND ACTIONS	TOT PEDESTRIANS KILLED OR INJ.		AGE											SEX			SEV. CLASS	
	NUMBER	PCT.	0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65 AND OVER	UNSPEC	MALE	FEMALE	UNSPEC	KILLED	INJ.
TOTAL PEDESTRIANS	4562	100.0	67	224	243	214	408	1042	776	467	354	500	267	2657	1905		65	4497
AT INTERSECTION	3195	70.0	39	105	144	144	301	737	557	333	252	394	189	1789	1406		46	3149
NOT AT INTERSECTION	1367	30.0	28	119	99	70	107	305	219	134	102	106	78	868	499		19	1348
TOTAL ACTIONS	4562	100.0	67	224	243	214	408	1042	776	467	354	500	267	2657	1905		65	4497
CROSSING, WITH SIGNAL	1381	30.3	12	35	44	58	124	328	241	162	111	211	55	662	719		10	1371
CROSSING, AGAINST SIGNAL	651	14.3	4	39	46	39	58	138	103	62	46	78	38	417	234		17	634
CROSS, NO SIG, MARKED CROSSWALK	101	2.2	2	6	7	1	9	30	15	10	6	12	3	55	46		1	100
CROSSING, NO SIGNAL OR CROSSWALK	603	13.2	7	48	52	36	48	124	98	65	54	51	20	360	243		6	597
WALKING ALONG HYWAY WITH TRAFFIC	34	0.7				2	7	9	7	5	2	1	1	23	11		1	33
WALK ALONG HYWAY AGAINST TRAFFIC	12	0.3		1		1	1	4		1	3		1	9	3		2	10
EMERG FROM FRONT/BEHIND PARK VEH	316	6.9	15	42	34	17	22	52	34	33	25	25	17	195	121		1	315
GOING TO/FROM STOPPED SCHOOL BUS	3	0.1								1	1	1		2	1			3
GET ON/OFF OTHER VEH NOT SCH BUS	78	1.7	1	2	1	1	5	23	13	8	4	13	7	30	48			78
PUSHING/WORKING ON CAR	26	0.6				2	5	7	6	4	1		1	24	2			26
WORKING IN ROADWAY	71	1.6					10	29	13	7	4	3	5	62	9		2	69
PLAYING IN ROADWAY	47	1.0	3	19	19	2		3					1	35	12		1	46
OTHER ACTIONS IN ROADWAY	557	12.2	7	14	22	29	53	131	124	42	44	44	47	366	191		8	549
NOT IN ROADWAY	202	4.4	7	2	2	10	14	54	36	23	16	24	14	129	73		3	199
UNSPECIFIED	480	10.5	9	16	16	16	52	110	86	44	37	37	57	288	192		13	467

TABLE 21 PRE-ACCIDENT BICYCLE ACTION	TOT BICYCLISTS KILLED OR INJ.																	
	NUMBER	PCT.																
TOTAL	1284	100.0	2	18	62	139	269	496	151	60	20	9	58	1150	134		3	1281
GOING STRAIGHT AHEAD	983	76.6	1	10	33	105	215	387	125	47	16	7	37	884	99		3	980
MAKING RIGHT/LEFT/U TURN	75	5.8			6	11	12	30	6	4	1	1	4	68	7			75
START/STOPPING/STOP IN TRAFFIC	18	1.4		1	1	2	5	6	1	1		1		17	1			18
CHANGING LANES	37	2.9		2	1	1	9	16	5	1			2	35	2			37
OTHER	73	5.7			10	8	11	29	5	4	1		5	67	6			73
UNSPECIFIED	98	7.6	1	5	11	12	17	28	9	3	2		10	79	19			98

TABLE 22(P) APPARENT DRIVER CONTRIBUTING FACTOR	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		MALE DRIVERS							FEMALE DRIVERS						
	NUMBER	PERCENT	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	28051	100.0	21864	114	823	2144	10814	5759	1251	3554	26	164	408	1691	956	204
NO DRIVER CONTRIB FACTOR	14749	52.6	11496	43	385	1076	5690	3196	696	2150	14	78	241	1026	617	126
	CONTRIB FACTOR															
		PERCENT OF TOTAL DRIVERS*														
TOTAL CONTRIBUTING FACTORS	16210		12577	97	528	1304	6215	3054	658	1634	17	102	196	762	395	92
ALCOHOL INVOLVEMENT	278	1.0	259		6	39	136	59	13	7			2	5		
BACKING UNSAFELY	448	1.6	330	1	17	25	162	71	22	33	1		2	13	9	
DRIVER INATTENTION	2508	8.9	1973	10	69	200	962	513	119	250		15	26	126	66	9
DRIVER INEXPERIENCE	231	0.8	186	26	19	26	84	23	1	34	4	7	6	14	2	1
DRUGS(ILLEGAL)	37	0.1	36			5	24	6		1				1		
FAILURE TO YIELD R.O.W.	1802	6.4	1344	7	52	137	639	335	77	184	3	12	20	84	49	9
FELL ASLEEP	45	0.2	39		2	7	19	8	2	4		1	1	1	1	
FOLLOWING TOO CLOSELY	1716	6.1	1379	1	51	142	699	347	56	159	2	8	21	75	39	8
ILLNESS	25	0.1	19				11	6	2	3		2		1		
LOST CONSCIOUSNESS	22	0.1	20		1	2	7	5	5	2			1		1	
PASSING/LANE USAGE IMPROPER	657	2.3	499	4	15	38	259	124	19	51		2	8	20	10	9
PHYSICAL DISABILITY	11	0.0	10				2	6	2							
PRESCRIPTION MEDICATION	6	0.0	5				5			1				1		
TRAFFIC CONTROL DISREGARDED	1064	3.8	799	5	37	99	408	164	37	92	1	7	11	39	21	8
TURNING IMPROPERLY	850	3.0	638	7	28	51	295	179	34	102		9	15	43	22	10
UNSAFE SPEED	1247	4.4	952	16	58	139	464	169	24	72	3	7	12	35	11	1
UNSAFE LANE CHANGING	755	2.7	567	3	24	49	269	144	37	73		8	12	26	16	5
OTHER	4508	16.1	3522	17	149	345	1770	895	208	566	3	24	59	278	148	32

*SINCE THERE MAY BE NO CONTRIBUTING FACTOR OR MORE THAN ONE CONTRIBUTING FACTOR, PERCENTS MAY NOT TOTAL TO 100.0

TABLE 23(P) VIOLATION CHARGED	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	28051	100.0	21864	114	823	2146	10814	5759	1251	3554	26	164	408	1691	956	204
WITH NO VIOLATION	25745	91.8	19809	82	689	1822	9697	5377	1189	3320	19	143	373	1569	914	197
	VIOLATIONS															
		PERCENT OF TOTAL DRIVERS*														
TOTAL VIOLATIONS	3347		3004	54	232	504	1605	524	79	326	12	31	59	163	53	8
SPEEDING	8	0.0	8		1	2	3	2								
DWI(INTOXICATION)	97	0.3	96		2	15	52	23	4	1			1			
DWAI(ABILITY IMPAIRED-ALCH)	3	0.0	3				1	2								
DWAI(ABILITY IMPAIRED-DRUG)	4	0.0	4				4									
UNSAFE TIRES	2	0.0	2					2								
INSUFFICIENT LIGHTS	14	0.0	14		2	2	8	1	1							
OTHER EQUIPMENT VIOLATIONS	32	0.1	30	1	8	5	14	2		2	1			1		
PASSED STOP SIGN	1	0.0	1				1									
PASSED RED LIGHT	39	0.1	36		6	6	16	8		3					2	1
IMPROPER PASSING/LANE USAGE	9	0.0	8		1	1	5	1		1				1		
ILLEGAL TURN	5	0.0	5			1	2	1	1							
FAILED TO YIELD R.O.W.	17	0.1	17		2	6	6	2	1							
FOLLOWING TOO CLOSELY	7	0.0	6			1	3	2		1				1		
BACKING UNSAFELY	3	0.0	3				2		1							
PASSED STOPPED SCHOOL BUS		0.0														
RECKLESS DRIVING	6	0.0	6		1		2	3								
ALL OTHER	3026	10.8	2703	52	207	453	1447	469	70	309	11	30	58	155	48	7
UNSPECIFIED	74	0.3	62	1	2	12	39	6	1	9		1		5	3	

*SINCE THERE MAY BE NO VIOLATION OR MORE THAN ONE VIOLATION, PERCENTS MAY NOT TOTAL TO 100.0

TABLE 24 TIME OF DAY	TOTAL DRIVERS (INCLUDES UNSPECIFIED SEX)		TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER	TOTAL (INC UNSPEC AGE)	UNDER 18	18-20	21-24	25-39	40-59	60 AND OVER
TOTAL DRIVERS	35271	100.0	26778	135	943	2498	12812	7322	1729	4539	28	191	485	2076	1317	297
1 AM - 4 AM	2347	6.7	1856	19	116	263	971	357	48	210	3	25	47	98	28	3
4 - 7	1540	4.4	1227	6	56	154	600	308	53	132		9	22	69	26	3
7 - 10	3990	11.3	3055	6	70	225	1395	1005	228	558	2	12	41	274	177	32
10 AM - 1 PM	5036	14.3	3926	6	91	298	1835	1160	330	648	3	16	59	276	209	61
1 - 4	6227	17.7	4745	21	155	400	2157	1390	379	845	5	33	72	358	262	78
4 - 7	6188	17.5	4597	32	153	413	2135	1283	320	908	7	34	80	423	280	56
7 - 10	4612	13.1	3474	24	132	332	1771	853	173	590	3	28	72	288	161	28
10 PM - 1 AM	3754	10.6	2096	15	136	314	1502	700	123	422	3	28	72	200	94	15
UNSPECIFIED	1577	4.5	1002	6	34	99	446	266	75	226	2	6	20	90	80	21

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STATE OF NEW YORK DEPARTMENT OF MOTOR VEHICLES
SUMMARY OF MOTOR VEHICLE ACCIDENTS

NEW YORK COUNTY

JAN-DEC.1991

00002

TABLE 27 PRE-ACCIDENT VEHICLE ACTION	TOTAL VEHICLES INVOLVED		TRAFFIC CONTROL										
	NUMBER	PCT.	NONE	TRAFFIC SIGNAL	STOP SIGN	FLASH. LIGHT	YIELD SIGN	OFFICER /GUARD	NO PASS ZONE	RR XING CONTROL	HIGHWAY WK AREA	OTHER	UNSPEC
TOTAL	37223	100.0	11034	17857	773	44	58	47	36	16	145	534	5859
GOING STRAIGHT AHEAD	20632	55.4	6718	10558	499	26	24	19	32	9	72	273	2402
MAKING RIGHT TURN	1412	3.8	215	949	40	1	1	2			1	16	187
MAKING LEFT TURN	2913	7.8	335	2260	50	6	5	5	1	1	2	22	226
MAKING U TURN	348	0.9	172	113	3							9	51
STARTING FROM PARKING	514	1.4	266	136	2					1		11	100
STARTING IN TRAFFIC	281	0.8	74	159	12		2		2		4	4	24
SLOWING OR STOPPING	1410	3.8	560	555	28	3	3	2	4		14	25	216
STOPPED IN TRAFFIC	2650	7.1	730	1339	38	5	2	3	5	3	15	35	467
ENTER PARKED POSITION	163	0.4	94	24				1				3	41
PARKED	1952	5.2	939	490	49		1	2	1		5	28	437
AVOID OBJECT IN RDWAY	191	0.5	73	55					1		4	7	51
CHANGING LANES	1074	2.9	479	303	3			2	2		9	24	252
OVERTAKING	365	1.0	119	116	3	1					6	9	111
MERGING	305	0.8	123	35	4	1	18	5			8	13	98
BACKING	795	2.1	408	207	9			1	2	1		16	151
TURNING RIGHT ON RED	29	0.1		29									
TURNING LEFT ON RED	59	0.2		59									
OTHER	826	2.2	295	237	16	1	2	4	2	1	4	27	237
UNSPECIFIED	1304	3.5	226	235	17			1	4		1	12	808

TABLE 28(P) INJURY DESCRIPTION	TOTAL PERSONS KILLED OR INJ	
	KILLED	INJURED
LOCATION OF MOST SEV PHYSICAL COMPLAINT	100	20850
HEAD	32	4341
FACE		843
EYE		88
NECK	2	3411
CHEST	5	523
BACK		2072
SHOULDER/UPPER ARM		955
ELBOW/LOWER ARM/HAND		1051
ABDOMEN/PELVIS	2	268
HIP/UPPER LEG		937
KNEE/LOWER LEG/FOOT	4	2830
ENTIRE BODY	35	1393
UNSPECIFIED	20	2138
MOST SEVERE PHYSICAL COMPLAINT	100	20850
AMPUTATION	3	37
CONCUSSION	2	299
INTERNAL	18	293
MINOR BLEEDING	4	1585
SEVERE BLEEDING	30	352
MINOR BURN		90
MODERATE BURN		13
SEVERE BURN		4
FRACTURE/DISLOCATION	9	591
CONTUSION/BRUISE		1289
ABRASION	1	708
COMPLAINT OF PAIN	4	11436
NONE VISIBLE	3	2078
UNSPECIFIED	26	2083
VICTIM'S PHYSICAL AND EMOTIONAL STATUS	100	20850
DECEASED	100	XXX
UNCONSCIOUS	XXX	132
SEMICONSCIOUS	XXX	387
INCOHERENT	XXX	156
SHOCK	XXX	575
CONSCIOUS	XXX	16909
UNSPECIFIED	XXX	2699

TABLE 29(P) SAFETY EQUIPMENT USED	TOTAL VEHICLE OCCUPANTS		SEVERITY CLASS OF VEHICLE OCCUPANTS				
	NUMBER	PCT.	KILLED	A	B	C	UNINJ.
TOTAL	43570	100.0	32	1135	2209	11736	28386
NO RESTRAINT USED	9291	21.3	20	403	767	3061	5040
LAP BELT	7607	17.5	1	203	380	2411	4612
HARNESS	2720	6.2		58	151	945	1566
LAP BELT AND HARNESS	7470	17.1	2	183	395	2561	4329
CHILD RESTRAINT	149	0.3		2	4	30	113
HELMET	235	0.5	2	42	72	92	27
OTHER	1	0.0				1	
UNSPECIFIED	16105	37.0	7	244	520	2635	12699

"A" INJURIES INCLUDE SEVERE LACERATIONS, BROKEN OR DISTORTED LIMBS, SKULL FRACTURES, CRUSHED CHEST, INTERNAL INJURIES, UNCONSCIOUS WHEN TAKEN FROM THE ACCIDENT SCENE, UNABLE TO LEAVE ACCIDENT SCENE WITHOUT ASSISTANCE.

"B" INJURIES INCLUDE LUMP ON HEAD, ABRASIONS, MINOR LACERATIONS.

"C" INJURIES INCLUDE MOMENTARY UNCONSCIOUSNESS, LIMPING, NAUSEA, HYSTERIA, COMPLAINT OF PAIN(NO VISIBLE INJURY).

TABLE 30(P) METHOD OF TRANSPORT. KILLED OR INJURED TO A MEDICAL FACILITY	TOTAL KILLED AND INJURED		SEVERITY CLASS OF INJURED			
	NUMBER	PCT.	KILLED	A	B	C
TOTAL	10929	100.0	96	1583	2152	7096
AMBULANCE	8747	80.0	82	1271	1765	5629
POLICE AMBULANCE	18	0.2			3	15
POLICE CAR	195	1.8		11	39	145
FIRE VEHICLE	513	4.7	6	93	84	330
INVALID COACH/FUNERAL	1	0.0		1		
COR VAN/MUNI EMERG EQ	14	0.1		4	1	9
PRIVATE VEHICLE	217	2.0		36	45	136
UNSPECIFIED	1224	11.2	8	169	215	832

*THERE MAY BE MORE THAN 1 CONTRIBUTING FACTOR OR EQUIPMENT VIOLATION CHARGED PER VEHICLE.

**SINCE VEHICLE MAY HAVE MORE THAN ONE CONTRIBUTING FACTOR, PERCENTS WILL NOT NECESSARILY TOTAL TO 100.0

***CURRENT YEAR MODEL INCLUDES PRESENT CALENDAR YEAR AND NEWER MODELS.

TABLE 31(P) APPARENT VEHICULAR ACCIDENT CONTRIBUTING FACTORS*	TOTAL		VEHICLE TYPE										VEHICLE AGE					
	NUMBER	PCT.	PASS. CAR	MOTOR-CYCLE	BUS/ TAXI	SCHOOL BUS	EMERG. VEH.	TRUCK/ TR TRL	TOWING VEH.	MOPED	ALL OTHER	UNSPEC	CUR YR MOD***	1-2 YR OLD	3-5 YRS OLD	6-9 YR OLD	10 OR MORE	UNSPEC
TOTAL VEHICLES	29485	100.0	18425	457	4890	21	321	3121	41	37	2172		930	3317	4644	4022	2743	13829
WITH NO DEFECT	27800	94.3	17331	426	4640	18	302	2950	37	36	2060		884	3138	4402	3774	2547	13055
	DEFECTS																	
		PCT. OF TOT VEH **																
TOTAL DEFECTS	1711		1110	31	253	4	20	173	5	1	114		46	180	248	252	198	787
ACCELERATOR DEFECTIVE	54	0.2	39		3		4	5	1		2		1	4	6	4	4	35
BRAKES DEFECTIVE	200	0.7	128	3	24	1		37	1		6		4	14	29	31	36	86
LIGHTING DEFECTS	14	0.0	9		2			3								2	5	7
STEERING FAILURE	43	0.1	30		6		1	4	1		1		1	4	7	10	4	17
TIRE FAILURE/INADEQUATE	34	0.1	21	2	3	1	1	4	1		1		1	5	7	5	4	12
OTHER	1366	4.6	883	26	215	2	14	120	1	1	104		39	153	197	200	145	630
ANY EQUIP VIOL CHARGED	48	100.0	17	12	8	1		9			1			2	8	10	7	21

APPENDIX B

CASIUS SAFETY-EVALUATION PROGRAM

```
#Include "box.ch"
#Include "inkey.ch"



Local V : =Space(6)
Local L1 : =Space(6),R1 : =Space(6),T1 : =Space(6)
Local L2 : =Space(6),R2 : =Space(6),T2 : =Space(6)
Local L3 : =Space(6),R3 : =Space(6),T3 : =Space(6)
Local L4 : =Space(6),R4 : =Space(6),T4 : =Space(6)

Local P1 : =Space(6),P2 : =Space(6),P3 : =Space(6)
Local S1 : =Space(6),S2 : =Space(6)
Local Rtype : =Space(2)

Local inval[4], nullnum
Local Eaccident,Errnul : = .f.
Local i

Use trfvol New

Set Confirm On

While .T.

        Cls
        @ 1,1,24,79BOX B_DOUBLE
        @ 3,17 SAY " Computer-Aided Safety Index for Urban Streets"
        @ 6,10 SAY " Rtype : " Get Rtype  Valid Checkrtype(rtype)
        @ 7,10 Say " Traffic Volume : " Get V

        @ 9,10 Say  "Conflict Value"
        @ 10,10 Say "Left : " Get L1
        @ 10,30 Say "Thru : " Get T1
        @ 10,50 Say "Right: " Get R1
        @ 11,10 Say "Left : " Get L2
        @ 11,30 Say "Thru : " Get T2
        @ 11,50 Say "Right: " Get R2
        @ 12,10 Say "Left : " Get L3
        @ 12,30 Say "Thru : " Get T3
        @ 12,50 Say "Right: " Get R3
        @ 13,10 Say "Left : " Get L4
        @ 13,30 Say "Thru : " Get T4
        @ 13,50 Say "Right: " Get R4

        @ 15,10 Say "Signal Time :"
```

```
@ 16.10 Say "Ph 1 : " Get P1
@ 16.30 Say "Ph 2 : " Get P2
@ 16.50 Say "Ph 3 : " Get P3

@ 18.10 Say "Crosswalk Size"
@ 19.10 Say "Size1: " Get S1
@ 19.50 Say "Size2: " Get S2
@ 22.10 Say "Expected Accident : "
@ 23.10 Say "Frequency Factor   : "
Read

If Lastkey() =K_ESC
        Return Nil
Endif

inval[1]  =Val(V)

inval[2]  =Val(L1) * 2 +Val(T1) +Val(R1) +;
                Val(L2) * 2 +Val(T2) +Val(R2) +;
                   Val(L3) * 2 +Val(T3) +Val(R3) +;
                   Val(L4) * 2 +Val(T4) +Val(R4)

inval[3] :=Max (Val(P1),Val(P2))
inval[3] :=Max (inval[3],Val(P3))

inval[4] :=Val(S1) +Val(S2)


nullnum  =CheckNul(inval)

Do Case

        Case nullnum =1
                Default_1(inval,Rtype)

        Case nullnum =2
                Default_2(inval,Rtype)

        Case nullnum =3
                Default_3(inval,Rtype)

        Case nullnum =4
                Errnul :=.T.

EndCase
```

```
    If ! Errnul

        Eaccident : =Expact_Acc(inval)

    Endif


    @ 22.34 Say Eaccident

    If Eaccident =1
        @ 23.24 Say "1"
    Else
        @ 23.34 Say 1.67 * Log(Eaccident)
    Endif

    inkey(0)



    AFill(inval,0)

    V : =space(6)

    R1 : =space(6)
    L1 : =Space(6)
    T1 : =Space(6)
    R2 : =space(6)
    L2 : =Space(6)
    T2 : =Space(6)
    R3 : =space(6)
    L3 : =Space(6)
    T3 : =Space(6)
    R4 : =space(6)
    L4 : =Space(6)
    T4 : =Space(6)
    p1 : =Space(6)
    P2 : =Space(6)
    P3 : =Space(6)
    S1 : =Space(6)
    S2 : =Space(6)
    Rtype : =Space(2)
    Errnul : =.f.
Enddo

//=========================================
Function Checkrtype(Rtype)
```

```
//========================================
local Ret :=.F.

Do Case
        case rtype ="AA"
                Ret :=.T.
        Case Rtype ="AL"
                Ret :=.T.
        Case Rtype ="LL"
                Ret :=.T.
Endcase


Return Ret

//========================================
Function CheckNul(Ary)
//========================================

Local Nullnum :=0,i

For i:=1 to Len(ary)

        If Ary[i] =0
                Nullnum +=1
        Endif

Next

Return Nullnum

//=======================================
Function Default_1(Ary,Rtype)
//=======================================

Local Which,Retval[6]
Local Xval[3],Xval2[3],Xpos:=1


Which :=WhichNull(Ary)

For i:=1to Len(Ary)

        If Ary[i] !=0
                Xval[xpos] :=i
                Xval2[xpos] :=i
```

```
                Xpos +=1
        Endif

    Next

    Retval :=Multi(Which,xval,Rtype)

    Ary[Which] :=Retval[1] +retval[2] * Ary[Xval2[1]] +Retval[3] *;
               Ary[Xval2[2]] +Retval[4] * Ary[Xval2[3]]


    Return Ary

    //======================================
    Function Default_2(Ary,Rtype)
    //======================================

    Local Which[2],Notnul[2]
    Local Xval1[2],Xval2[2],Xval3[3],Temp[3]
    Local Retary1[2],Retary2[2],retx1[6],Retx2[6]
    Local i,Xpos :=1,nul

    Which :=WhichNullM(Ary)

    For i:= 1to Len(Ary)

        If Ary[i] !=0
                Xval1[xpos] :=i
                Xval2[xpos] :=i
                Xval3[xpos] :=i
                Xpos +=1
        Endif

    Next

    For i:=1 to 2

        Nul :=Which[i]
        Retx1 :=Multi(Nul,Xval1,Rtype)
        Retary1[i] :=Retx1[1] +Retx1[2] * Ary[Xval2[1]] +;
                              Retx1[3] * Ary[Xval2[2]]
        Asize(Xval1,2)
        Afill(Xval1,0)
        Acopy(Xval2,Xval1)

    Next
```

```
Asize(Xval2,3)
Notnul :=Whichnot(ary)

For i:=2 to 1 Step -1

        Nul :=Which[3-i]
        Xval2[3] :=Which[i]
        Acopy(Xval2,Temp)
        Retx2 :=Multi(Nul,Temp,Rtype)
        Retary2[3-i] :=Retx2[1] +Retx2[4] * Retary1[i] +;
                                    Retx2[2] * Ary[Xval2[1]] +;
                                        Retx2[3] * Ary[Xval2[2]]
        Afill(Xval2,0)
        Acopy(Xval3,Xval2)
        Asize(temp,3)
        Afill(temp,3)

Next

Ary[Which[1]] :=(Retary1[1] +Retary2[1]) / 2
Ary[Which[2]] :=(retary1[2] +Retary2[2]) / 2

Return Ary

//=====================================
Function Default_3(Ary,Rtype)
//=====================================

Local Xval[1]
Local Temary[4]
Local Which[3]
Local Result[3,4]
Local retary1[3]
Local Retx1[6],retx2[6]
Local Retary[3]
Local Xval1[1],xval2[1]

Local Xtotal :=0
Local i,j,k
Local Xpos :=1
Local Nul,Xv1,xv2

Which :=WhichNullM(Ary)

For i:=1to Len(Ary)
```

```
    If Ary[i] !=0
        Xv1 :=i
    Endif

Next

For i:=1 to 3

    Nul :=Which[i]
    Xv2 :=Xv1
    Retx1 :=Multi(Nul,Xv2,Rtype)
    Retary[i] :=retx1[1] +Retx1[2] * Ary[Xv1]
    Afill(Retx1,0)

Next

For i:=1 to 3

    Acopy(ary,temary)
    Temary[Which[i]] :=Retary[i]
    Temary :=Default_2(Temary,Rtype)

    For k:=1 to 4
        Result[i,k] :=Temary[k]
    Next

Next

Afill(tempary,0)

For i:=1 to 4

    For j:=1 to 3
        Xtotal +=Result[j,i]
    Next

    Temary[i] :=Xtotal/3

    Xtotal :=0

Next

For i:=1 to 3
    Ary[Which[i]] :=Temary[Which[i]]
Next
```

```
Return Ary


//========================================
Function Whichnull(Ary)
//========================================

For i:=1 to 4

        If Ary[i] =0
                Exit
        Endif

Next

return i

//========================================
Function WhichnullM(Ary)
//========================================
Local Which :={}

For i:=1 to 4

        If Ary[i] =0
                Asize(which,Len(Which) +1)
                Which[Len(Which)] :=i
        Endif

Next

Return Which
//========================================
Function WhichNot(ary)
//========================================
Local Which :={}

For i:=1 to 4

        If Ary[i] !=0
                Asize(which,Len(Which) +1)
                Which[Len(Which)] :=i
        Endif

Next
```

```
Return Which


//========================================
Function Expact_acc(val)
//========================================
Local Ret

ret :=5.6474 +val[4] * -0.19763 +val[3] * 0.21628 +;
          val[2] * 2.15198 +val[1] * 0.0017

If Ret <0
       Ret :=1
Endif

Return Ret

//========================================
Function Multi(Which,Xval,Rtype)
//========================================


Local y:={},x[4,300],temp:={},pam :={0,0,0,0}
Local yy[6],xv
Local typ :=tp :=acc :=recont1 :=recont2 :=terr :=0,totalpam
Local p1:=space(1),p2:=space(1),p3 :=space(1),p4 :=space(1)
Local yval:=space(1)
Local rt,err,i,j


Do case

       Case Rtype ="AA"
                    rt :=29
       Case Rtype ="AL"
                    rt :=48
       Case Rtype ="LL"
                    rt :=24

Endcase

If Valtype(Xval) ="N"
       xv :=xval
Endif

pam :=changepm(Xval)
```

```
yval :=changepm(Which)

If Valtype(Xval)= "N"
   totalpam :=1
   typ :=1
Else
   totalpam :=len(pam)
Endif

trfvol->(DBGOTOP())
For i:=1 to trfvol->(reccount())

  If Rt =trfvol->Rtype
             aadd(y,trfvol->(fieldget(yval)))
             recont1 +=1
  Endif

       trfvol->(dbskip(1))

next


For j:=1 to totalpam

       trfvol->(dbgotop())

       For i:=1 to trfvol->(RecCount())

             If typ =1 .And. Rt =Trfvol->rtype
                    x[j,recont2 +1] :=trfvol->(fieldget(PAM))
                    recont2 +=1
             Else

                    IF typ !=1 .and. Rt =trfvol->rtype
                           x[j,recont2 +1] :=trfvol->(fieldget(pam[j]))
                    recont2 +=1
                    Endif

             Endif

             trfvol->(dbskip(1))

       Next

       asize(x[j],recont2)
       Recont2 :=0
```

```
Next

yy :=static(x,y,totalpam)



acc :=0

yval :=space(1)
p1 :=space(1)
p2 :=space(1)
p3 :=space(1)
p4 :=space(1)

Asize(pam,4)
Afill(pam,0)
Asize(y,0)
terr :=0
tp :=0
acc :=0
Return yy

//=========================================
Function static(xx,yy,pemleng)
//=========================================

Local x[5][5],y:={},tmp:={}
Local total :=0,i,j

Asize(y,pemleng+1)
Afill(y,0)
/*For i:=1 to pemleng+1
        aadd(y,0)
Next*/

Asize(x,pemleng+1)

For i:=1 to pemleng+1
        asize(x[i],pemleng+1)
Next

x[1,1] :=len(xx[1])
Aeval(yy,{|a|total +=a})
y[1] :=total

For i :=1 to pemleng
```

```
        x[i+1,1]:=sigma(xx,i)
        x[1,i+1]:=sigma(xx,i)
        y[i+1]:=mYsigma(xx,yy,i)
Next

For i:=1 to pemleng

        For j:=1 to pemleng
                x[i+1,j+1]=msigma(xx,i,j)
        Next

Next

matrix(x,y)

return y

//========================================
Function sigma(x,i)
//========================================
Local total :=0
Local j

For j:=1 to len(x[1])
        total +=x[i,j]
Next

Return total

//========================================
Function msigma(x,i,j)
//========================================
Local total :=0,a

For a:=1 to len(x[i])
        total +=x[i,a] * x[j,a]
Next

Return total

//========================================
Function mYsigma(x,y,i)
//========================================
Local total :=0,a

For a:=1 to len(x[i])
```

```
          total += x[i,a] * y[a]
Next

Return total


//=========================================
Function Matrix(x,y)
//=========================================

Local temp :={}
Local fini :=.F.,Found1:=.F.
Local r,rw,ii,i,j
Local multi :=0
Local total,leng


leng :=len(x)
asize(temp,leng+1)

For i:=1 to leng+1
          temp[i] :=0
Next

j:=1

For i:=1 to len(x[1])

          if x[i,j] != i

                    If ! found1
                              multi :=1/x[i,j]
                              Smultiple(x,y,i,multi)
                    Endif

          Endif


          For R:=1 to len(x)

                    If R !=i
                              multi :=If(x[R,i] <0 , x[i,j] * -x[R,j], -x[i,j] * x[R,j])
                              multiple(x,y,i,multi,temp)
                              AddR(x,y,R,temp)
                    Endif
```

```
        Next

        j +=1

Next


return Nil

//=======================================
Function change(x,y,r1,r2)
//=======================================
Local temp:={} ,i


For i:=1to len(x[1])
        temp[i] :=x[r1,i]
Next

temp[len(x[1])+1]:=y[r1]

For i:=1 to len(x[1])
        x[r1,i] :=x[r2,i]
Next

y[r1] :=y[r2]

For i:=1 to len(x[1])
        x[r2,i] :=temp[i]
Next

y[r2] :=temp[len(x[1])+1]

return nil

//======================================
Function Multiple(x,y,r,multi,temp)
//======================================

Local i

For i:=1 to len(x[1])
        temp[i] :=x[R,i] * multi
Next

temp[len(x[1])+1]:=y[R] * multi
```

```
Return temp


//=====================================
Function Smultiple(x,y,r,multi)
//=====================================

Local i,leng
leng :=len(x[1])

For i:=1 to leng

        x[r,i] :=x[r,i] * multi
Next

y[r] :=y[r] * multi

return nil


//=====================================
Function AddR(x,y,r,temp)
//=====================================

Local i

For i:=1 to len(x[1])
        x[r,i] :=x[r,i] +temp[i]
Next

y[r] :=y[r] +temp[len(x[1])+1]

Return Nil

//=====================================
Function Checkpm(Pam)
//=====================================

Local returnval :=.t.

If VAL(Pam) <0  .and. VAL(pam) >5
        returnval :=.f.
Endif

return returnval
```

```
//=========================================
Function Checkpmy(Pam)
//=========================================

Local returnval :=.t.

If VAL(Pam) <0 .and. VAL(pam) >5
        returnval := .f.
Endif

Return returnval

//=========================================
Function changepm(pam)
//=========================================

Local retary :={}
Local dat,i,zero:=0

If valtype(pam) ="A"

        For i:=1 to len(pam)

                If pam[i] =0
                        zero +=1
                Else
                   dat :=pam[i]

                        Do case

                                case dat =1
                                        Aadd(retary,2)
                                case dat =2
                                        aadd(retary,8)
                                case dat =3
                                        aadd(retary,10)
                                case dat =4
                                        aadd(retary,11)
                                case dat =5
                                        aadd(retary,5)
                        Endcase

                Endif


        Next
```

```
       Asize(pam,0)

       For i:=1 to len(retary)
              Aadd(pam,retary[i])
       Next

Endif

If Valtype(pam) ="N"

       Do case

                     case pam =1
                            pam :=2
                     case pam =2
                            pam :=8
                     case pam =3
                            pam :=10
                     case pam =4
                            pam :=11
                     case pam =5
                            pam :=5
       Endcase

Endif

Return pam


//========================================
Function Length(aa)
//========================================

Local zero :=0

For i:=1 to len(aa)

       If aa[i] =0
              zero + =1
       Endif

Next

Return zero
```