ANALYSIS OF THE NATIONAL CRASH SEVERITY STUDY DATA

Report Number UM-HSRI-78-63

by

James O'Day
Phyllis Gimotty
Richard Kaplan
Lily Huang
Bruce Bertram
Kenneth Campbell

Highway Safety Research Institute
The University of Michigan
Ann Arbor, Michigan 48109

December 20, 1978

Prepared under Contract DOT-HS-8-01944

National Highway Traffic Safety Administration
Department of Transportation
Washington, D. C. 20590

Interim Report

42024

Technical Report Documentation Page

1. Report No. UM-HSRI-78-63	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Analysis of the National Crash Severity Study Data		5. Report Date December 1978 6. Performing Organization Code
7. Author(s) J. O'Day, P. Gimotty, R. Kaplan, L. Huang, B. Bertram, K. Campbell		8. Performing Organization Report No.
9. Performing Organization Name and Address University of Michigan Highway Safety Research Institute Ann Arbor, Michigan 48109		10. Work Unit No. 11. Contract or Grant No. DOT-HS-8-01944
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration Department of Transportation Washington, D.C. 20590		13. Type of Report and Period Covered Interim Report June 1978 - Dec. 1978 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

This is an interim report on a program of analysis of the data from the NHTSA-sponsored National Crash Severity Study. The design of the study has been reviewed and commented on. The state of the data at about the midpoint of the field investigation has been reviewed, and the effects of non-reporting examined.

Preliminary studies with the data include development of general models to estimate crash severity, tabulation of injury and body contact statistics, and some presentation of distribution of crash severity using the Delta V parameter.

A sample "Factbook" has been included in this report, suggesting methods of presentation for crash, vehicle, and occupant statistics.

17. Key Words Accident, Analysis, Sampling, Crash Severity, Injury Severity	18. Distribution Statement Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
----	--------	208	

This page reserved for metric chart

42024

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

SECTION I

INTRODUCTION

This section of the report will outline the general scope and objectives of the study, provide a brief summary of the work to date, and describe the report organization.

A. General Scope and Objectives

This document is an interim report on a project concerned with the analysis of data emanating from the NHTSA-sponsored National Crash Severity Study (NCSS). The NCSS program was initiated by NHTSA in pilot form in late 1976, and beginning in January of 1977 data were collected in relatively final form. Seven teams of accident investigators operating in eight defined regions of the United States have investigated a sample of crashes occurring since that time. The resulting data have been codified, built into working digital files, and the present report is concerned with the early analyses of data collected during the first fifteen months of the study. This report concentrates primarily on task 2 of the items tabulated in the next paragraph. In addition, initial plans for the fact book, including sample tables, are presented.

The NCSS analysis study is divided into nine tasks as follows:

1. Literature review
2. Initial statistical analyses
3. Clinical analysis
4. Design of statistical models
5. Programming of statistical models
6. Revised statistical analyses
7. Development of a Crash Phase fact book
8. Development of inputs to accident analysis models.
9. Review accident analysis models.

The NCSS program was expected to produce, over a period of twenty-seven months, data on approximately 25,000 vehicle occupants. The present data (after fifteen months of investigation) contains 13,525 case vehicle occupants. The specific objectives of task 2 of this study have been to develop logical groupings of the injury and crash severity data, to consider initial models to predict injuries as a function of crash parameters, and to prepare for the model development work of task

6. With regard to task 7, the early objective has been to produce sample tables for a factbook and to develop presentation methods for such tables.

B. Summary

The first step in this analysis study has been to take a hard look at the data, to try to understand its strengths and weaknesses, and in general to prepare for the model-building tasks to follow. At the same time it has been possible to use the existing data for preliminary model development and analysis. With an aim toward eventual reconstruction of national estimates from these data, the sampling design has been reviewed, and the demographic characteristics of the regions sampled have been studied.

The NCSS program is a vital step toward the eventual generation of national estimates for accident statistics. This report concerns the first efforts toward the methodology for translating field data into useful inferences. A major problem is to find the level of detail upon which models can be built which will permit the most powerful inference. Of particular importance is the intersection of injury and crash severity data. Much of this report addresses this relationship. Preliminary findings are presented mainly in Section IV of this report, supplemented by numerous tables and graphs in the prototype Factbook of Section V.

While the NCSS design precludes the type of inference possible from a true probability sample, the site representativeness will permit such inference with respect to each site. Further, since the sites were deliberately chosen to provide a good range on the urban/rural characteristics, the ability to observe stability across this dimension has the potential, for the first time, to provide needed support for this kind of modeling activity.

The most recent NCSS data set, which became available at about the end of November, 1978, has some apparent deficiencies in quality and completeness. The intersection of the most detailed injury information (assigned Occupant Injury Classification codes) and the most detailed crash severity information (Delta V as computed from the CRASH algorithm) is less than 40% complete, so that injury-crash severity relationships for 60% of the occupants cannot be addressed at this level of detail. The present data are also undergoing modification to correct for some inadvertent coding changes which occurred early in the program, and to add more detail to the injury information than was originally provided in computerized form. These deficiencies in turn influence the modeling program with regard to substantive output, but the present data certainly permit model development.

C. Report Organization

Section II of this report addresses the general sampling and statistical characteristics of the NCSS program and the demographic characteristics of the regions surveyed.

Section III presents a description of the NCSS data collection process (as it affects the computerized data). Included in this section is a description of the current analysis files.

Section IV contains a discussion of the extent and import of missing data, and refers to an appendix containing univariate distributions of important variables. Also in Section IV are the results of early analysis and modeling efforts. Section V presents the fact book tables in sample form.

While data have been collected in the NCSS program on both the towed passenger cars and on the other kinds of vehicles involved in accidents with towed passenger cars, the passenger cars alone were the units of most interest. These towed passenger cars are usually referred to as case vehicles, and it is for these that the most complete and detailed injury and crash damage information is available. Generally in this report analyses will be restricted to case vehicles and to case vehicle occupants, and in most tables, figures, etc. this restriction may be assumed.

The present data set contains all but about 8% of the cases investigated over the period January 1, 1977 through March 31, 1978. Note that this is a 15-month period, and that it contains two winters but only one summer. Some of the discussions in the following sections are limited to only one year of data so as to avoid any seasonal bias. Also, a few analyses were completed using an earlier version of the data which contained about 10% fewer cases than the present one; where these have not been updated the use of the earlier data has been noted.

Most analyses presented in this interim report will not attempt any correction for the effects of missing data. While one of the purposes of this study program is to search for methods of accounting for missing data effects, this will not be done until the next phase.

Appended to this report is a codebook showing the one-way distributions of most variables for NCSS Crashes, Case Vehicles, and Case Vehicle Occupants. Also appended is a copy of the field forms used during most of the project, and a variable by variable discussion of the data keyed both to the field forms and the univariate codebook. While the form of the data may change in the near future (by the addition of some new information, and by correction of some of the old), potential users may find these appendices useful in understanding the data.

A review of the crash/injury literature was conducted under Task 1 of this contract, and will be published as a separate document. The clinical analysis work (task 3) has begun, and is currently addressing the subjects of side impact, knee injuries, and anterior neck injuries. This will also be reported separately.

SECTION II

SAMPLING AND STATISTICAL CONSIDERATIONS

The National Crash Severity Study provides an initial preview of statistical analyses of injury severity, some of which may be more fully implemented with the data collected in the National Accident Sampling System. Eventually NASS will take over where NCSS has started, benefiting from what has been learned in NCSS. The purpose of this section is to review the plan of the NCSS program and to evaluate the implications of this plan on the feasibility of solving various problems which now face NCSS and will eventually face NASS.

There are two major tasks which need to be carefully examined and an assessment made as to whether they can be accomplished at present. One task involves the production of a FACTBOOK, which is to contain only national estimates of totals, ratios, and distributions. The other involves the development of predictive models for injury severity as a function of crash severity. In the following the prerequisites for these tasks will be briefly discussed and the extent to which NCSS meets these needs will be considered.

A. Estimation

In order to obtain a national estimate, the plan by which the sample was selected should be nationally representative. That is, every element in the population has some specified chance of being included in the sample. This is what is technically referred to as a sample design. The sample design can be very simple, (e.g., every element in the population has the same chance of being in the sample), or very complicated, (e.g., a complex multi-stage sample), but still with every element having a known probability of being in the sample.

The estimation procedure involves choosing a "good" estimator. One accepted statistical definition of good is to require the estimator to be such that on the average (i.e. considering all possible samples of the population of elements) it is expected that it will equal the population parameter of interest. This property makes the estimator unbiased for the population parameter which can be any total, ratio, or distribution under consideration.

The quality of the estimation procedure can be evaluated by the error associated with the estimator. An estimator can be chosen so that it has the smallest possible variance within a given specified set of estimators. The choice is equivalent to choosing the estimator which gives the most precise estimate.

All estimates are just approximations to the true state of affairs. They can be biased, i.e. be an over- or underrepresentation, because of missing data but also simply by the choice of the estimator; that is the method by which the data is combined to yield the estimate. Various estimators have different variances and it is optimal to choose an estimator such that the variance is minimized. It is crucial not only to look at the estimate but also the variance of the estimate. From the variance an upper and lower bound for the estimate (called a "confidence interval") may be computed which defines the precision of the estimate.

Once the sample design is developed, the estimation procedure is specified. This defines how the sample elements will be weighted to yield an estimate of the population total (or ratio or distribution) of interest. The estimate is unbiased for a population total or distribution (or in the case of a ratio estimate is approximately unbiased for the population ratio). If a sample is selected by a specified design it is also then possible to calculate the variance of the estimate. Sampling theory has evaluated the statistical properties of these estimates and provides guidance as to which estimation procedures are best when a proper sample design is specified.

The NCSS plan is not nationally representative. All areas which did not have accident investigation teams nearby had <u>no</u> possibility of being included in the sample areas; therefore those accidents could not have been in the sample. Since there was no nationally representative plan there is no <u>objective</u> way of producing a national estimate.

Yet NCSS does have, within each site, a plan which is <u>site</u> representative. The sampling design is explicitly stated. An accident is in the population of police-reported accidents under consideration if there is at least one occupied towed vehicle and the occupant who had the most extensive treatment (no injury or transport to medical facility, transported and stayed overnight at treatment facility, or fatal) was in one of the towed vehicles. The population of accidents is then stratified according to the level of treatment and each stratum is sampled randomly (or for some teams days are sampled and all applicable accidents for those days are investigated). Here every accident has a chance of being sampled.

The site sample design allows the estimation of the number of accidents, the number of towed vehicles and the number of people involved in the towed vehicles as well as many other totals, ratios, and distributions for each site. The estimates combine the data obtained from the sample and the sample design. The sample design implies the weights and how the weights should be combined with the data. Estimated standard errors can also be obtained which provide the potential users of these estimates some measure of how reliable the estimates may be. Estimates for the number of accidents, the number of towed vehicles, and the number of occupants in the towed vehicles with their standard errors for each site are presented in Tables 1 to 3.[1] These estimates are for the year January 1, 1977 to December 31, 1977. There is currently five percent of the accidents missing from the one-year data set.

The question of producing an estimate for a national total, ratio, or distribution without a sampling design is indeed a complex problem. The complexity arises because of the virtually unlimited number of possibilities with which to generate numbers hopefully reflecting the national experience and the lack of a statistical means of assessing which number is actually the number which does best at describing the true state of the nation.

Given the above considerations it does not seem advisable to publish estimates, to be called national estimates, which cannot be supported by an objective theoretical argument which states that on the average the estimates produced will represent the national total, ratio,

---

[1]The estimators for the total and the variance of the total for the four teams presented in Tables 1-3 are based on a stratified cluster design. HSRI, SWRI, and DySci used a different sampling plan and estimates of the variance of the total are not yet available.

Table 1

Estimates of the Number of Accidents Involving Towed Vehicles
(NCSS Cases for Calendar Year 1977)

Site	Estimate	Standard Error
Calspan . . .	3738	284
HSRI	2436	
U of Indiana	2705	143
U of Miami .	2705	237
U of Kentucky	4093	138
SwRI	6418	
Los Angeles .	2340	

Table 2

Estimates of the Number of Towed Vehicles
(NCSS Cases for Calendar Year 1977)

Site	Estimate	Standard Error
Calspan . . .	4569	342
HSRI	3053	
U of Indiana	3354	163
U of Miami .	3214	292
U of Kentucky	5192	166
SwRI	7924	
Los Angeles .	2934	

or distribution of interest and which cannot be evaluated because no measure of variability is available for that estimate. The best that the NCSS design can justify are estimates which reflect what is going on within each site chosen to participate in the study. In our future model building effort subjective pseudo-national estimates will be explored and evaluated for their suitability in describing the national experience.

Table 3

(Estimates of the Number of Occupants in Towed Vehicles
NCSS Cases for Calendar Year 1977)

Site	Estimate	Standard Error
Calspan . . .	7294	342
HSRI	4721	
U of Indiana	5228	304
U of Miami .	5368	433
U of Kentucky	7989	333
SwRI	12767	
Los Angles .	4418	

B. Modeling

The second objective of NCSS is to investigate possible models which relate injury severity to crash severity and to evaluate how well such models describe the data collected in the NCSS project. Models need to be developed to describe general injury mechanisms which are applicable over many crash configurations and these models need to be assessed for the amount of information they contain. An example of a general model could be the probability of injury at each specific Delta V observed. This is a model which describes the functional relationship of the likelihood of injury conditional on the value of Delta V for the population of concern. Specific injuries and specific crash configurations are also of interest. Models, built upon subsets of occupants who share the same injury type and/or were involved in similar crash configurations, need to be investigated and assessed for quality and compared with the information obtained in the laboratory situation.

In the development of general models it is necessary to obtain data which reflect the spectrum of accident experience of areas throughout the country. A model is general only if it is applicable and predicts well for a wide range of areas with different environments.

The NCSS database provides a unique opportunity to develop general models and to evaluate the "generality" of these models by investigating the adequacy of these models within each site. Sites were chosen to reflect some diversity in both urbanization and region of the country. Since crash severity was thought to be negatively correlated with population density, the sites will provide diversity on which to test a general model. Table 4 indicates which sites represent different levels of urbanization and different regions of the country.

Tables 5 through 12 display a number of demographic characteristics of the accident investigation regions, and suggest that there are many differences between the sampled areas and the United States as a whole. Of note, perhaps, is the high Spanish population (because Miami and Los Angeles are the two urban centers), and the relatively high population densities.

Table 4

Distribution of Sites by Region and Degree of Urbanization

Area	North East	North Central	South	West
Central Cities *			Miami	Dyn. Sci.
Suburbs ** . . .	Calspan			
Other SMSA's ***			SwRI: (Urban)	
Non SMSA's or Small SMSA's****		HSRI Indiana	Kentucky SwRI: (Rural)	

*Central cities of Standard Metropolitan Statistical Areas (SMSA'S) containing more than 1,000,000 persons

**Suburbs of SMSA's with more than 1,000,000 persons

***SMSA'S with more than 250,000 people but less than 1,000,000 persons

****SMSA'S with fewer than 250,000 people

Site to site variation will become increasingly important in the model building effort to predict injury severity. There is very little census information that is directly applicable to evaluating sites in terms of their accident populations. Measures like traffic density, number of registered vehicles, or drivers or miles of interstate highway are not readily available for all of the NCSS areas. The task is confounded by the fact that characteristics of the people who live in the area of investigation may not represent the characteristics of the people who have accidents in that area. Thus the fact that sites exhibit similarities based on the characteristics of their residents may not imply that the sites do indeed have similar accident populations.

Table 5

Site Characteristics - Demographic
Based on 1970 U. S. Population

Team	Land Area (Sq. Miles)	Population Density per sq.mi.	Death Rate per 1000
Calspan . .	1016.7	640.0	7.4
HSRI	1464.0	215.65	6.8
U of Indiana	7165.0	69.77	10.2
U Miami . .	34.3	9769.0	13.9
SWRI	13263	79.83	8.1
Dyn Sci L.A. County	19.5	40300.70*	9.3
U.S.		57.46	9.5

*Based on 1977 population of the three police districts covered by Dynamic Sciences, Inc.

The study of specific occupant injuries and the relationship of severity to the crash conditions and occupant kinematics requires a

Table 6

Site Characteristics - Urbanicity
Based on 1970 U.S. Population

Team	Percent Farm Pop.	Percent Urban pop.	Percent Rural Pop.
Calspan . . .	1.0	79.0	19.8
HSRI	5.1	68.5	26.5
U of Indiana	10.5	39.8	49.6
U Miami . . .	0	100.0	0
U of Kentucky	8.6	73.8	17.6
SWRI	2.8	85.7	11.4
Dyn Sci L.A. County .	0	100.0*	0
U.S.	4.1	73.5	22.4

* For the three police districts covered by the investigative team, and not for the entire county.

workable number of injuries for each condition that is of interest. Ideally when designing a sample for developing models of phenomena at this level it would be best to design it to obtain enough of each level of crash severity and each occupant characteristic of interest and to insure that there is a range of injury severity within each category. Cost considerations and administrative problems involved with such a design would show that this is probably not a feasible undertaking.

As a compromise the NCSS design sampled accidents within each site and the relative sample size of each occupant treatment category was controlled. In the current sample more severe injuries are oversampled and accidents where there was just minor injury to the occupants were undersampled. In the NCSS database there is a census of all accidents which involved a fatality in a towed vehicle. The sampling of

Table 7

Site Characteristics - Population
Profile Based on 1970 U.S. Population

Team	Percent Female Population	Percent Negro Population	Percent Spanish Population	Percent White Population
Calspan . . .	51.1	0.7	0.29	98.8
HSRI	50.7	5.9	1.85	93.3
U of Indiana	51.1	0.5	0.17	98.99
U of Miami .	53.3	22.8	45.3	76.7
U of Kentucky	51.6	10.5	0.28	85.5
SWRI	50.8	6.2	42.8	93.1
Dyn Sci* L.A. County .	24.3	16.6	41.1	31.2
U.S.	51.3	11.0	4.6	87.6

* All four percentages based on 1977 population of the three police districts covered by Dynamic Sciences, Inc.

treatment categories within each accident is an attempt to eliminate any bias which might be built into the data collection procedure for accidents.

In the collection of data for 1977, the NCSS data processors are coding only the three most severe injuries that the occupant received and the associated points of contact. This does bias the NCSS database toward the more severe injuries sustained within an individual and does reduce the information available about minor injuries sustained by occupants who have had major injuries. When studying a particular type of injury there is valuable information in knowing which occupants received minor injuries to be able to compare them with the occupants who received the more severe injuries.

Table 8

Site Characteristics - Age
Distribution Based on 1970 U.S. Population

Team	Percent of Population Less than 5 yrs.	Percent of Population Over 16 yrs.	Percent of Population Over 65 yrs.
Calspan . . .	8.5	63.2	7.8
HSRI	8.6	68.1	6.7
U of Indiana	8.4	66.0	10.6
U Miami . . .	6.3	74.6	14.5
U of Kentucky	8.4	67.8	8.7
SWRI	9.1	62.7	8.7
Dyn Sci L.A. County .	8.2	68.3	9.5
U.S.	8.4	65.6	9.9

The success of studying specific situations and related injuries will depend upon the availability of enough data so that injuries may be subjectively grouped into "similar" injury types. Ideally injuries within a type should be the same injury and there may be enough data, in the current NCSS database, to form such groups. But most injury types will be a composite of different injuries and as the number of kinds of injuries becomes large within the group the variability within the group may be too large to do any specific modeling.

This discussion has attempted to assess how the design of NCSS will affect the subsequent analysis, the estimation and model building activities. The design is just the first stage in the creation of a database and there are still problems with data collection and consistency of coding which contribute to the success of any analysis of this database. Problems in these areas will be addressed in other

Table 9

Site Characteristics - Labor Force

Team	Based on 1970 Civilian Labor Force		Based on 1970 Labor Force
	Percent Females in Labor Force	Percent of Labor Force Unemployed	Percent White Collar Workers
Calspan . . .	35.0	3.8	64.2
HSRI	41.5	5.1	55.6
U of Indiana	36.2	4.6	38.7
U Miami . . .	46.1	4.3	40.9
U of Kentucky	40.0	3.3	49.1
SWRI	38.7	4.0	49.8
Dyn Sci L.A. County .	39.4	6.4	55.8
U.S.	38.1	4.4	48.3

sections of this report. While NCSS cannot justify objective national estimates, it does have great potential for building interesting and informative models of crash severity. The site estimates will provide information about site differences which may prove eminently valuable to the national planner.

Table 10

Site Characteristics - Related to Driving Behavior

Team	Based on 1970 U.S. Households		Based on 1970 Employed Civilian Labor Force	
	Percent of Households with More than one Auto	Percent of Low Income Households	Percent using Public Transp. to Work	% of People working outside Residence County
Calspan	92.1	4.1	4.8	5.6
HSRI . .	91.4	5.6	2.3	13.0
U of Ind	86.1	10.0	0.8	20.4
U Miami	71.5	16.4	17.1	2.3
U of Ken	84.0	12.6	3.5	13.7
SWRI . .	85.6	17.2	4.8	6.8
Dyn Sci L.A. Cnt	83.4	8.7	6.7	2.5
U.S. . .	82.5	10.7	8.9	17.8

Table 11

Site Characteristics - Auto and Auto Service Sales

Team	Based on Total 1970 Retail Sales		Based on Total 1970 Receipts
	Percent of Sales from Auto Dealers	Percent of Sales from Gas and Service Stations	Percent of Receipts from Auto Repair Service
Calspan . . .	18.7	7.1	10.4
HSRI	19.8	7.3	9.1
U of Indiana	19.2	7.8	3.5
U Miami . . .	17.6	4.8	10.1
U of Kentucky	18.3	8.9	10.6
SWRI	20.7	8.7	11.1
Dyn Sci L.A. County .	17.8	7.0	9.1
U.S.	17.9	7.9	11.6

Table 12

Site Characteristics - Highway Expenditures

Team	Percentage of Local Government Finance Direct General Expenditures Spent on Highways
Calspan . . .	7.8
HSRI	8.4
U of Indiana	11.2
U Miami . . .	5.4
U of Kentucky	3.4
SWRI	6.2
Dyn Sci L.A. County .	7.0
U.S.	7.6

SECTION III

NCSS DATA COLLECTION AND AUTOMATION

The NCSS field accident investigation program was initiated in the fall of 1976, and involved many changes from previous accident investigation acitvities. New geographical areas were sampled (i.e., counties in which there had been no such investigation going on); new investigators were trained to permit expansion of the number of cases; new data and new data forms were needed; and, in order to produce consistency, all teams were trained and monitored by a central agency. Such changes had to be made quickly in order to begin field operations.

There have been a number of adjustments in the details of data taking which have resulted from observation of the data and subsequent feedback or retraining of the field personnel. The data for the first fifteen months of the program is now largely automated and free of logical errors. But some of the early field program changes have affected individual data elements.

In this section the history of changes in the data collection procedures as they affect the quality of data are discussed. Following that is a brief description of the filebuilding process carried out at HSRI, and the resulting analysis files.

A. History of Changes in the Data Acquisition

Over the early part of the NCSS data collection activity, most of the teams were learning to sample and report in a consistent fashion. In addition, a quality control contractor monitored the resulting data, and pointed out discrepancies which could be corrected.

The data collection actually began in August of 1976 (with practice cases), and in October for "real" data collection. The October and November cases have been held (i.e., never computerized) are are considered to represent an additional two months of practice in data collection. Major changes were made in the forms and procedures as of January 1, 1977, and the present analytical files were built only from data acquired from that time on.

A printed coding manual, clarifying the procedures, was made available to the field teams in January of 1977 and has been revised twice since then. (A fourth coding manual, dated April 1, 1978, is considered to be a separate and new document rather than a revision of the original coding manuals). The first revision was dated April, 1977 and the second, September, 1977. Newer styles of field forms were made available in February of 1977 but were either not all sent out at once, not implemented at once, or both. The net effect is that a period of overlap exists between the introduction of the new forms. No cutoff date was established for the last use of the earlier field forms and most teams simply exhausted their supply before starting to use the new versions. Each of these changes had some effect on the data, and the purpose of this section is to state the likely effects so that persons analyzing data using the computer files will understand such problems.

During the summer of 1978 most of the early cases have been reviewed by an NHTSA contractor to remove known errors (i.e., to replace invalid and some missing values with valid ones), and to develop some additional variables not originally in the digital file. When this project comes to the final analysis phase many of the problems discussed here will hopefully have disappeared. Nevertheless, for understanding of the analyses presented in this interim report, this section is necessary.

The detailed discussion of changes is given on a variable by variable basis in Appendix A. A copy of the field forms used for most of the first fifteen months is included as Appendix B, and a set of univariate distributions for crashes, case vehicle, and case vehicle occupants (using variable numbers currently assigned in the HSRI files) is included as Appendix C. The history provides the cross references between the field forms and the computer files.

B. Data Automation and Filebuilding

Field data for the NCSS program is initially recorded on paper forms by members of the individual teams, then keypunched and forwarded to CALSPAN Corporation for further processing. At CALSPAN each case has been carefully edited to insure consistency and completeness, and a digital file of all cases to date is periodically furnished to NHTSA. NHTSA then constructs a master occupant-level file--i.e., a complete set of accident, vehicle, and occupant data for each occupant reported on--and uses this file to build working files in both the TPL[2] and the SPSS[3] formats. As a result of the various processing steps a number of summary variables are derived and available on the TPL and SPSS versions of the file. The form of the file we have used as an input is the modification of the master file used to build the SPSS versions at NHTSA.

Periodically we have acquired a tape copy of this SPSS-input file, and then have constructed several analysis versions of the data at HSRI. The principal analyses files are built into the OSIRIS[4] form, and placed in the HSRI ADAAS[5] control system. This allows individual analysts easy access to the files for. There are several format modifications necessary in converting the data to OSIRIS, the most notable being that OSIRIS generally uses numeric codes, and does not recognize blanks or special characters. The NHTSA file uses blanks to indicate data which is missing now but expected to be provided later, and asterisks to indicate data elements which are inapplicable (such as the make and model of the second vehicle in a single vehicle crash). In

---

[2] TPL=Table Producing Language, a Bureau of Labor Statistics packaged program.

[3] SPSS=Statistical Package for the Social Sciences, a statistical analysis package supported by SPSS, Incorporated.

[4] OSIRIS=Organized Set of Integrated Routines for Investigations in Statistics, developed and supported by the University of Michigan's Institute for Social Research.

[5] ADAAS=Automated Data Access and Analysis System, an executive system developed and supported by HSRI for interactive processing of highway safety related data.

the processing, these characters (blanks and asterisks) are assigned numeric values and the OSIRIS version of the file then contains the same information.

Four versions of the OSIRIS analysis files are maintained, one containing a record for each crash, the second a record for each vehicle in each crash, the third a record for each occupant, and the fourth a record for each recorded injury or OIC.

The most complete file (the injury file) may be used for analyzing crash, vehicle, or occupant factors by restricting the analysis to a subset (e.g., taking only those cases for the first injury to each occupant makes an occupant file), but the several files are provided as a matter of convenience and economy.

The files available for analysis at the time of this report include 6216 crashes (about 8% short of the total cases collected from January 1977 through March 1978), 8057 case vehicles (passenger cars), 13,525 occupants, and 25,512 injuries (including one "injury" record for each uninjured person). The injury count is an incomplete estimate since no more than three injuries are recorded for each occupant.[6]

While the OSIRIS package serves well for general display of the data (in the form of two-way or n-way tables, or for computation of mean values) and for some statistical procedures, it has been more convenient to construct an alternative file using the MIDAS[7] package. Particularly for regression analyses, and for computations involving several variables at a time, this has been useful.

---

[6] By comparison the mean number of recorded injuries (or OIC's) in the older MDAI files is approximately 4.5 per injured person, with a maximum of 48 separate injuries for a severe fatality with a complete autopsy.

[7] MIDAS=Michigan Interactive Data Analysis System, supported by the University of Michigan Statistical Laboratory.

SECTION IV

INITIAL STATISTICAL ANALYSES

This section describes the initial analytic work that has been done. The early work focused on an examination of missing data rates and production of some descriptive statistics. Selected portions of this work are presented in Part A of this chapter. Beyond this, some preliminary modeling work has been carried out. This is presented in Part B.

A. Missing Data Discussion and Descriptive Statistics

In order to begin the model building activities, one must thoroughly understand the dataset. Of foremost interest is the missing data rate for the analysis variables. This topic and its implications are discussed in the first portion of this section. The remainder of this section presents selected tabulations describing the relationship between AIS level and specific injury types in section IV-A-2, and the relationship of body region and contact point in section IV-A-3. These descriptive statistics provide guidance in the formulation of models for evaluation.

1. Missing Data Frequencies and Discussion

In any survey, data which is expected to be acquired may be unavailable. In the NCSS program there are a number of reasons why certain data elements may not be obtained--inability to see medical reports, unavailability of a vehicle for damage measurements, or refusals of persons to be interviewed or to respond to particular questions. The values for data elements which are not acquired are usually combined under the heading of "missing data".

The error in the estimate of a proportion from a survey may be expressed as in the following equation, the first term of which represents the random error, and the second term the bias error:

$$\epsilon = \sqrt{\underbrace{\frac{pq}{N}\left(\text{deff}\right)\left(1-f\right)}_{\text{Random Term}} + \underbrace{\omega^2 \Delta p^2}_{\text{Bias Term}}}$$

where ϵ = the "one-sigma" error
p = the proportion observed in the valid data
$q = 1 - p$
N = the number of observations (cases)
deff = the design effect (for cluster samples) (a number usually greater than 1)
$1 - f$ = the finite population correction
ω = the proportion of missing data
Δp = the difference in the value of p in the valid and in the missing data

Clearly the best way to avoid a large bias term in this equation is to make ω very small--i.e., to have little or no missing data. In surveys in which the missing data represent on the order of ten percent of the cases, authors often argue that the effect of the missing information may be neglected, and present the statistics for the obtained data as representative of the whole population.

Table 13 indicates the one-sigma error computed from equation (1) under three conditions--(1) no bias, (2) a small bias (in this case 10% missing data and a $\Delta p = .05$), and (3) a larger bias (40% missing data with a $\Delta p = 0.1$). The bias term dominates in the latter case, and even if the N were infinite the error would be substantial. We must find a way to live with the missing data rates which exist in the present data, but the above illustration indicates that when the proportion of missing data approaches 50% there must be a good deal of effort to know the value of Δp or to insure that it is small.

In the present data, use of restraint systems by case vehicle occupants is of the order of 10%--this would be the observed value of "p" in the equation above. A recent survey reported by NHTSA estimated that about 14.5% of passenger car occupants wear belts. There are several possible explanations for the difference in these two numbers: people who have accidents may wear belts less often than people who don't; the measure of restraint usage in the two studies may be different, (e.g., NCSS investigators may have required absolute proof of usage before entering a positive response, while the survey observers may have entered a positive response when they were unsure); or the proportion of belt-wearers in the missing data group for NCSS may be substantially different from that of the observed group. If we assume that the belt-wearing percentage is 14.5% in the NCSS population, then the percentage of people wearing seat belts in the missing data group must be on the order of 25%.

Table 13

Error in an Estimate for
Several Values of the Bias Term*

Factor	No Bias	Small Bias	Large bias
Number of cases	1000	1000	1000
Difference in value of "p" in valid and missing data	0	.05	.10
Proportion of Missing Data	0	.1	.4
One-sigma error	1.4%	1.5%	4.5%

* This table assumes that p is about 0.3, DEFF = 1, and f=0.

There are several approaches to accounting for missing data, none of which are completely satisfactory. The first has been noted above--in effect to assume that the value of Δp is small or that the value of ω is small (or both) and to neglect the effect. In this case inferences are drawn from the valid data alone, and error statistics are estimated as if the bias term were zero.

A second approach involves getting some independent measure of the missing data cases which will permit an estimate of the magnitude of Δp.[8] This could be done by resampling the missing data cases for the missing data elements, and making an estimate of the value of Δp. Or it could be done by using some surrogate variable which is known to be

[8] This discussion presumes that there are no missing cases. This effect will be discussed later.

correlated with the variable of interest, perhaps showing that the surrogate variable is distributed in the missing data as it is in the valid data, and thus permitting the inference that the bias term is negligeable. (If the surrogate variable is not distributed in the same manner it may be possible to say something about how much error may be involved by neglecting the missing data).

A variant of this method would be to develop a surrogate variable by modeling. In section IV-B-1 a model is presented to compute a surrogate value for Delta V using information which is more frequently available than that required for the CRASH program. With respect to the injury data, the NHTSA staff has created a new variable (NEWOAIS) which assigns each person's maximum injury to a value of 2 or less vs. 3 or more. Enough information is available for a much larger proportion of occupants (than those for which the full AIS is available), and the effective proportion of missing data is reduced at the expense of a reduced level of detail.

Thirdly it may be possible to find a subset of the cases which is of interest and for which little data are missing. Then the bias term for the subset will be small, and inferences may be drawn to that subset rather than to the entire population. In the NCSS data, for example, if injury data on drivers is available 95% of the time, for for other occupants only 70% of the time, one might restrict inferences about certain injury phenomena only to drivers.

Since the primary purpose of the NCSS program has been to determine interrelationships between crash and injury parameters, the data on injury severity, type, location, and on crash severity are most important. Crash severity data may be viewed relative to the total number of case vehicles sampled, and injury severity relative to the total number of case vehicle occupants.

As of this writing the number of vehicles for which investigations have been completed (in the first 15 months of field data collection) is approximately 8640 of which 8057 (about 92%) have been computerized and are available for analysis. There is potentially a larger set of vehicles which qualified for sampling but were not known to the field investigators.[9] With the method of selection used in NCSS there is really no way of determining this number, and we will neglect it.

The 8% of the actually sampled cases still missing from the data set are expected to ultimately appear, and they will not be treated further here. It seems likely, however, that they will exhibit biases with respect to both injury and crash severity relative to the presently available data, simply because there is usually something different about cases which are delayed.

Of the 8057 case vehicles in the computer file the principal severity parameter (Delta V as obtained by the damage only method) is available for 4634 (58%). But the value of Delta V derives from application of the CRASH program, and this algorithm is not applicable to certain crash configurations. Thus a more useful measure of missing data rate may be the percentage of cases which could have had Delta V computed. Table 14 shows the relation between these factors. If the cases in which not enough information was available to tell whether Delta V should have been computed are all considered to be non-computable, then the percentage of cases with a valid Delta V (of those possible) is 68.7%.

A rough check on the representativeness of the cases for which Delta V is known may be made by cross-tabulating Delta V (known vs. unknown) and the primary CDC extent for each vehicle. This is is shown in table 15, and it can be observed that the missing Delta V cases are relatively more frequent at the more severe CDC levels.

The cumulative distribution function (with speed) for all crashes[10] is little affected by the kind of variation is missing data for Delta V. But the curve representing fatalities would be more sensitive to such missing data. If there are more missing fatalities at the higher Delta V levels (as implied by those missing at the higher values of CDC extent), the true cumulative distribution function would lie to the

---

[9] This might include towaway crashes for which no police reports were prepared, or those for which the police reports were never made available to the NCSS investigators.

[10] See the plots in Section IV-B-4 of this report.

Table 14

Computed and Not Computed Delta V's
NCSS Case Vehicles (Row % Shown)

Condition	Value for Delta V Computed	Value for Delta V Not Computed	Total
Crash type permits Delta V Computation	4599(68.7%)	2091(31.3%)	6690
Crash type does not permit Delta V computation	22(2.5%)	841(97.5%)	863
Not enough information to tell whether Delta V should be computed	13(2.6%)	491(97.4%)	504
Total	4634(57.5%)	3423(42.5%)	8057

right of that shown. A possible method of estimating this effect would be to use a surrogate value of Delta V, such as that developed in section IV-B-1 of this report. But this is likely to be an inadequate substitute for more complete data at the outset.

Injury data are reported by designating specific Occupant Injury Classification (OIC) codes for each injury sustained by an occupant. In creating computer files only the first three (generally the three most severe) injuries have been coded. These then become three separate variables associated with each occupant, and the most severe injury is taken to create a fourth injury variable designated the Overall Abbreviated Injury Scale (OAIS). Since the OAIS depends upon the OIC codes, any data coded as missing for an OIC translates to a missing data code for OAIS.

Since the development of an OIC required fairly detailed information from a qualified (medical) source, many injuries had to be coded into one of two "missing data" classes--either "injured but

Table 15

Primary CDC Extent vs.
Delta V known or unknown
(Case Vehicles Only)

CDC Extent	Value for Delta V Computed	Value for Delta V Not Computed	Total
(1) . .	934(65.1%)	501	1435
(2) . .	1642(72.9%)	609	2251
(3) . .	1234(68.3%)	573	1807
(4) . .	376(64.9%)	203	579
(5) . .	182(65.2%)	97	279
(6) . .	90(56.6%)	69	159
(7) . .	32(47.1%)	36	68
(8) . .	26(57.8%)	19	45
(9) . .	60(51.7%)	56	116
Blank or Missing	58(4.4%)	1260	1318
Total .	4634(57.5%)	3423(42.5%)	8057

severity unknown" or "not known whether injured or not". Sometimes one or more of an occupant's three assigned OIC's would have known severity values (1 through 6) and another might be assigned the "severity level unknown" code. In this case the overall AIS would also be assigned the severity unknown code, since it was not known that the unknown OIC was not the worst injury.

One of the effects of this coding convention is that a number of persons who died in the NCSS crashes have been coded as injured/severity unknown, an appropriate assignment, since persons may die from injuries at various levels. However, there is often other detail available in the field reports which permits a more accurate assignment of OAIS in a dichotomous code such as "injured vs. not injured" or "AIS-2 or less vs. AIS-3 or more". A new variable was created by NHTSA for the latter, and appears as NEWOAIS in the data. This substantially reduces the number of cases for which injury data is missing, but at the expense of less detail. Information about the distribution of valid and missing data for the OAIS variable is presented in Table 16. The present variable for NEWOAIS is evidently not properly coded, and its distribution is not presented here. From earlier files it should have about 10% missing data.

Table 16

Valid and Missing Data
for Overall AIS

Injury Level	Number of Persons	Percent of Total
Not Injured . .	3596	30.0%
Minor(AIS1) . .	2512	20.9%
Moderate(AIS2) .	895	7.5%
Severe(AIS3) . .	554	4.6%
Serious(AIS4) .	167	1.4%
Critical(AIS5) .	140	1.2%
Maximum(AIS6) .	75	0.6%
Injured but Severity Unknown	2609	21.8%
Unknown if Injured	1449	12.1%
Total	11987	100.0%

Note: Data for this table was taken from an earlier file with fewer cases.

In many analyses it will be necessary to have both crash severity and injury data, and thus one should consider these two data elements relative to missing data. Table 17 presents the injury missing data restricted to those cases with valid Delta V values.

Table 17

Computed and Not Computed Delta V's
vs. Known and Unknown OAIS
NCSS Case Vehicle Occupants

Injury Status	Value for Delta V Computed	Value for Delta V Not Computed	Total
OAIS Known Value=0-6	4456*	3473	7929
. . . .	5072	3783	8855
OAIS Not Known . .	2283	1775	4058
. . . .	2649	2021	4670
Total . .	6739	5248	11987
. . . .	7721	5804	13525

* Note: The upper numbers are from the earlier (August) data; the lower numbers from the October file. The percentage of occupants in both files for whom both OAIS and Delta V are known is about 37% (e.g., 5072/13525).

2. Frequencies of Specific Injury Types

This section attempts to characterize the most frequent types of injuries found in the NCSS data for each level of the Abbreviated Injury Scale. By looking at the types of injuries coded at each AIS level, insight is gained about the dimensions represented by the AIS scale. For the model building activity, one needs intuition about the AIS scale, crash severity variables, and laboratory parameters, and how they relate to each other. Detailed models relate specific injury types to variables which have physical significance. These models would focus on specific collision types, injury types, and contact points; and they will seek to identify which variables influence the severity of the resulting injury. Ideally, the detailed models developed with the NCSS data should describe the same phenomena as models developed in the laboratory.

Following are six tables, one for each AIS severity level, of the top ten most frequently occurring specific injuries and their frequency in the NCSS data file. A specific injury is defined by these OIC variables: Body Region, Lesion and System/Organ. Body Region was recoded in the following manner (OIC codes in parenthesis):

1. Head/Face (H and F)
2. Neck (N)
3. Thorax (C)
4. Abdomen (M)
5. Vertebral (B)
6. Lower Extremities (P,Y,T,K,L and Q)
7. Upper Extremities (S,X,A,E,R, and M)

and System/Organ was reclassified into the following eight groups:

1. Skeletal (S,V and J)
2. Digestive (D and L)
3. Nervous System (N,B,C and E)
4. Cardiovascular (A,H and Q)
5. Respiratory (R and P)
6. Urogenital (G and K)
7. Muscles (M)
8. Integumentary (I)

Of a total of 876 possible specific injuries, only 143 were found in the current NCSS file. In particular, there were 87 specific injuries at AIS level 1 (Minor), 62 at level 2(Moderate), 42 at level 3 (severe), 29 at level 4 (serious), 24 at level 5 (critical), and 13 at level 6 (fatal).

There are two observations which can be made from the data in looking at each of the three dimensions--body region, type of lesion, and system or organ injured. Each AIS level seems to be predominately associated with a particular region, lesion, or system/organ. As AIS increases, the body region appears to start with injury to the head, then extremities, abdomen and thorax, and finally at the AIS 6 level returns to the head. Lacerations and contusions appear at AIS 1 level, then fractures, and finally lacerations again. The systems and organs involved start at low AIS levels with the skin, then the skeletal system, then cardiovascular and digestive systems, and the nervous system.

Secondly, at each AIS level it seems possible to characterize the specific injuries. At AIS level 1 it appears to be predominately skin wounds in the head area, AIS level 2 and 3 skeletal fractures to the extremities, AIS level 4 skeletal fractures to extremities and cardiovascular injuries, AIS level 5 lacerations of the abdomen and thoracic regions, and at AIS level 6 injury to the nervous system in the region of the head.

Other NHTSA contracts have attempted to develop models relating various laboratory test parameters to the AIS scale. Work in this area is complete for the head, and in progress for the thorax. The information available from these studies combined with a thorough understanding of the data in the NCSS file must guide the development of specific models using field accident data. The current information suggests that although the AIS scale may do a reasonable job of ranking the threat to life, focus on specific body regions will often place almost all of the injuries in one or two levels.

Table 18

Specific Injuries
Minor (AIS=1)

Body Region	Lesion	System/ Organ	Frequency
Head/Face	Laceration	Integumentary	1184
Head/Face	Contusion	Integumentary	780
U. Ext .	Contusion	Integumentary	492
L. Ext .	Contusion	Integumentary	486
Neck . .	Pain	Muscle	434
L. Ext .	Abrasion	Integumentary	415
Head/Face	Concussion	Nervous System	386
Head/Face	Abrasion	Integumentary	372
Thorax .	Contusion	Integumentary	365
L. Ext .	Contusion	Skeletal	330

Table 19

Specific Injuries
Moderate (AIS=2)

Body Region	Lesion	System/ Organ	Frequency
L. Ext .	Fracture	Skeletal	287
Head/Face	Concussion	Nervous System	273
U. Ext .	Fracture	Skeletal	250
Head/Face	Laceration	Integumentary	185
Head/Face	Fracture	Skeletal	154
Thorax .	Fracture	Skeletal	120
Vertebral	Fracture	Skeletal	78
Head/Face	Laceration	Digestive	58
L. Ext. .	Sprain	Skeletal	53
Head/Face	Fracture	Respiratory	51

Table 20

Specific Injuries
Severe (AIS=3)

Body Region	Lesion	System/ Organ	Frequency
Thorax .	Fracture	Skeletal	255
L. Ext .	Fracture	Skeletal	206
U. Ext .	Fracture	Skeletal	95
Head/Face	Fracture	Skeletal	70
Thorax .	Contusion	Respiratory	58
L. Ext .	Dislocation	Skeletal	55
Abdomen .	Contusion	Urogenital	55
Neck . .	Fracture	Skeletal	37
Head/Face	Concussion	Nervous System	37
U. Ext .	Dislocation	Skeletal	28

Table 21

Specific Injuries
Serious (AIS=4)

Body Region	Lesion	System/ Organ	Frequency
Head/Face	Fracture	Skeletal	53
Abdomen .	Rupture	Cardiovascular	49
L. Ext .	Fracture	Skeletal	44
Abdomen .	Laceration	Digestive	43
Thorax .	Fracture	Skeletal	28
Head/Face	Concussion	Nervous System	27
Head/Face	Contusion	Nervous System	21
U. Ext. .	Fracture	Skeletal	15
Abdomen .	Laceration	Cardiovascular	13
Thorax .	Contusion	Cardiovascular	12

Table 22

Specific Injuries
Critical (AIS=5)

Body Region	Lesion	System/ Organ	Frequency
Abdomen .	Laceration	Digestive	56
Head/Face	Contusion	Nervous system	43
Thorax .	Laceration	Cardiovascular	40
Head/Face	Concussion	Nervous System	38
Abdomen .	Rupture	Digestive	16
Thorax .	Laceration	Respiratory	15
Head/Face	Laceration	Nervous System	9
Neck . .	Fracture	Skeletal	7
Abdomen .	Laceration	Urogenital	5
Abdomen .	Laceration	Cardiovascular	5

Table 23

Specific Injuries
Fatal (AIS=6)

Body Region	Lesion	System/ Organ	Frequency
Neck . .	Fracture	Skeletal	37
Thorax .	Crush	All Systems	24
Head/Face	Laceration	Nervous System	14
Head/Face	Crush	All Systems	11
Neck . .	Laceration	Nervous System	7
Neck . .	Dislocation	Skeletal	3
Head/Face	Avulsion	Nervous System	1
Thorax .	Rupture	Cardiovascular	1
Thorax .	Laceration	Cardiovascular	1
Head/Face	Hemorrhage	Nervous System	1

3. Body regions and contact points

Injury data in the NCSS computer file has been limited to a maximum of three injuries (OIC's) per occupant, and thus underestimates the total number of injuries and misestimates the distribution of severity. With the present data it seem inappropriate to make weighted runs with the injury data, but it will be useful to present some of the unweighted data, at least for those cases which are likely to have come into the sample with a weight of one. Restricting the presentation to injuries of level 3 or greater will essentially insure that the cases have come from the first stratum, sampled at the 100% level.

Identification of the objects contacted by various parts of the body is included as a variable associated with each OIC code. During the early part of the NCSS field data collection program a change was made in the code values for this variable, and the data for the first six months (January 1977 through June 1977) contain some code values from both schemes. While this discrepancy is currently in the process of correction, the present computerized file has not been repaired, and the information presented in this section comes only from the period after June of 1977.

While the OIC provides quite detailed identification of body region and aspect (e.g., the right side of the face), and the "objects contacted" codes provide a comparable degree of resolution (mirror, coat hooks, air conditioner, parking brake, etc.), the possible intersection of these two variables boggles the mind--nearly 8000 possible combinations. One may indeed search the computerized files to identify individual cases in which a right knee impacted an air conditioner duct, etc., but for general presentation both the body regions and the contact codes have been recoded into convenient and hopefully useful groups. Body regions are arranged in seven major groups--head/face, neck, upper extremities (including the shoulder), chest, abdomen, back/spine, and lower extremities (including the pelvis). Objects contacted have been grouped into the steering assembly, the instrument panel, the windshield, other front (including such things as heater and air conditioning hardware, parking brakes, glove compartments, mirrors), pillars (A, B, C, D) and glass and frames, other side interior (the side interior surfaces, armrests, door handles), the roof (other than the headers), the floor, all exterior objects (own hood, other vehicles, poles), and a group of non-contact or "whiplash" injuries. In addition, there are a moderate number of injuries at the various AIS levels with unknown contacts--something like 20% of the level 3 and above injuries being in this category.

Body region vs. contact data are presented for three injury levels--AIS-2, AIS-3, and AIS-4,5,6, and are shown both in tabular form (in tables 24 through 26) and in graphic form (in figures 1 through 3). The pictorial form highlights some of the differences in the region-injury pattern with AIS level. AIS-2 injuries are dominated by the head-windshield combination, and by the head striking almost everything. Secondary peaks exist for for arms and legs. The AIS-3 pattern is dominated by thoracic injuries resulting from steering column and side interior contacts, and secondarily by the intersection of legs and the instrument panel. Finally, at level AIS-4,5,6 the abdomen and chest contacts with the steering column dominate, although serious head injuries are the most frequent overall.

Table 24

Level 2 Injuries among NCSS Case Vehicle Occupants
by body region and contact point (Unweighted data)

Body Region	Steering Assembly	Side Interior	Hood, Other Exterior	Instrument Panel	Other Front	Pillars Glass, etc.	Roof	Non-contact Injuries	Belts, Seats, Other interior	Windshield	Total
Head/Neck	84	42	12	42	70	30	13	0	19	150	462
Abdomen .	2	0	0	0	0	0	0	0	0	0	2
Chest . .	37	10	0	9	4	0	0	0	3	1	64
Neck . .	2	0	0	2	0	0	0	2	1	1	8
Lower Extremity	18	31	4	55	26	0	0	4	6	0	144
Upper Extremity	39	41	4	42	15	2	0	3	13	2	161
Back . .	1	1	1	0	1	0	0	39	2	1	46
Total . .	183	125	21	150	116	32	13	48	44	155	887

FIG. I. INJURIES VS. CONTACT POINTS, AIS-2

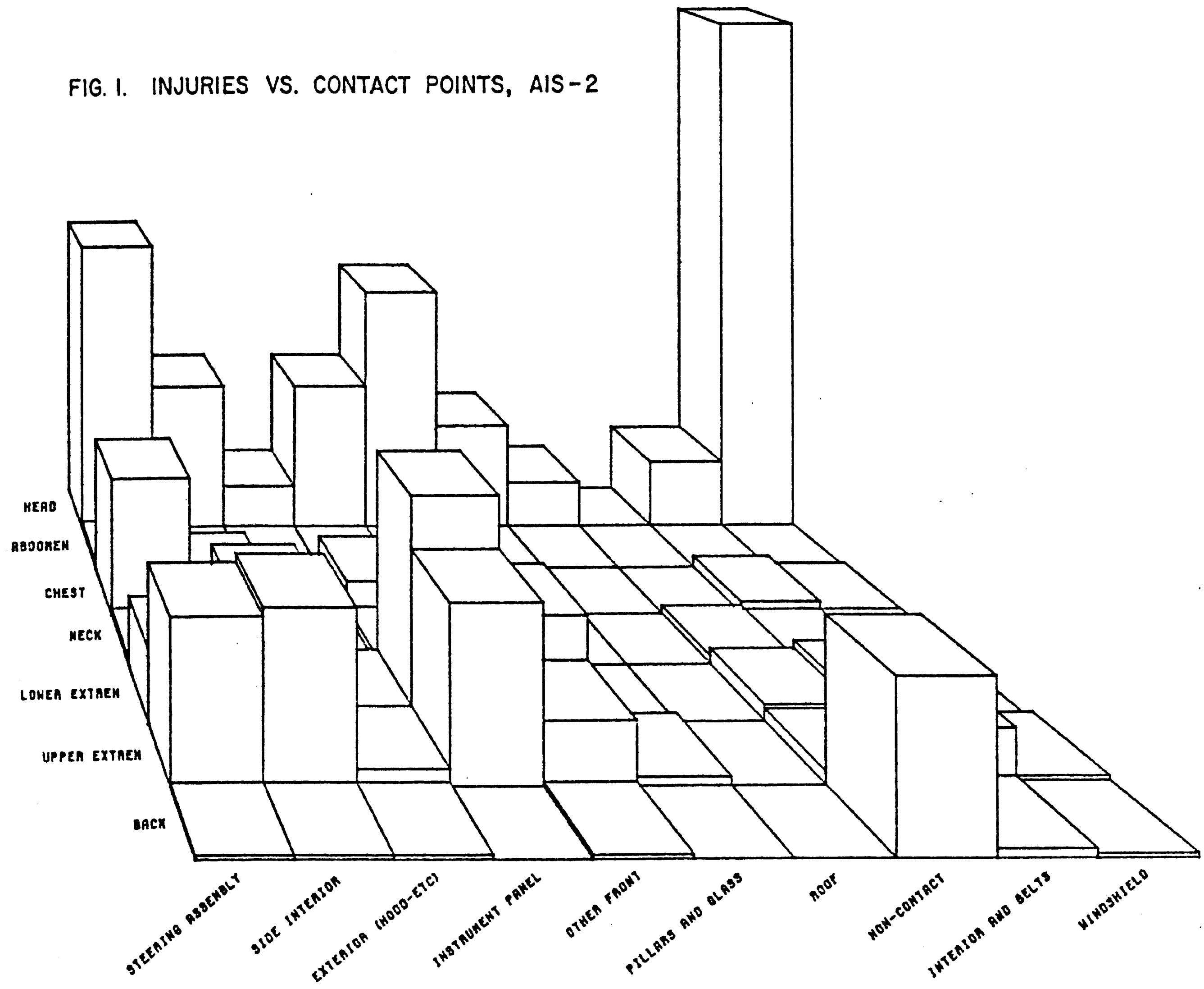


Table 25

Level 3 Injuries among NCSS Case Vehicle Occupants by body region and contact point (Unweighted data)

Body Region	Steering Assembly	Side Interior	Hood, Other Exterior	Instrument Panel	Other Front	Pillars Glass,etc.	Roof	Non-contact Injuries	Belts, Seats, Other interior	Windshield	Total
Head/Neck	13	7	5	6	7	5	1	0	3	15	62
Abdomen .	15	16	0	5	0	0	1	0	1	0	38
Chest . .	106	64	0	23	14	0	0	0	6	1	214
Neck . .	4	0	1	0	0	0	2	13	0	3	23
Lower Extremity	16	19	7	55	28	1	0	0	7	0	133
Upper Extremity	18	13	2	15	4	2	0	0	2	0	56
Back . .	0	1	0	0	0	0	0	7	0	0	8
Total . .	172	120	15	104	53	8	4	20	19	19	534

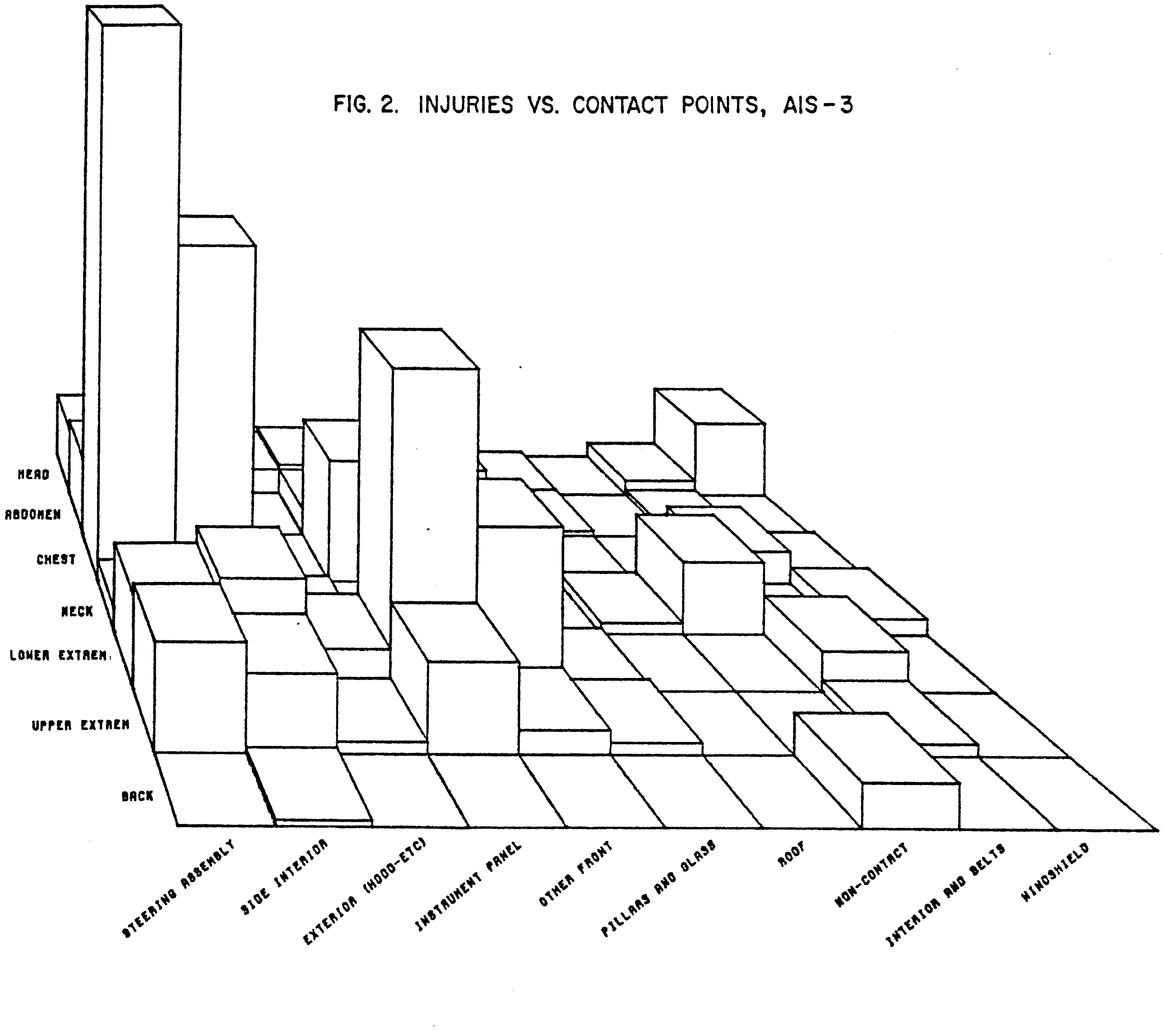


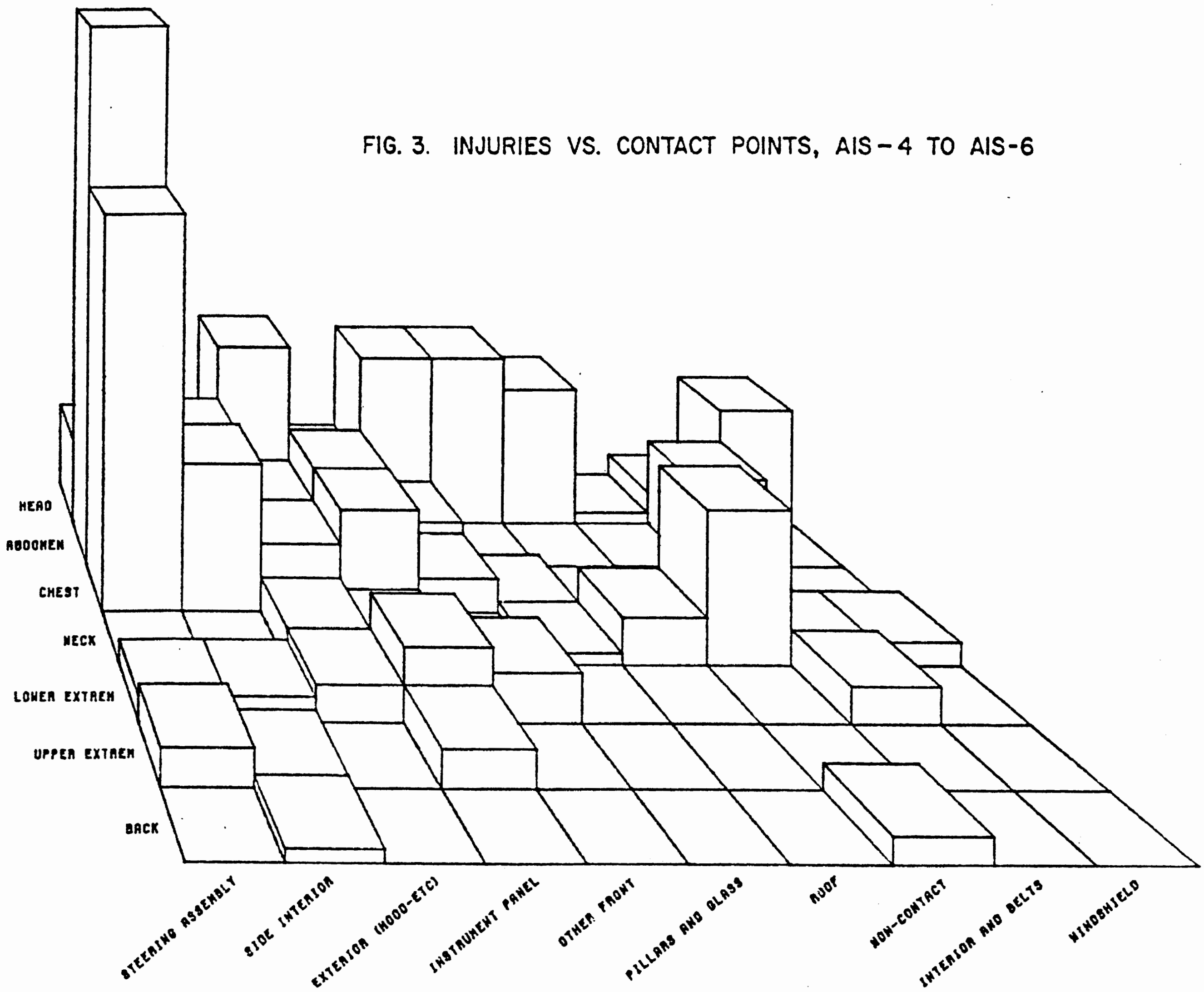
FIG. 2. INJURIES VS. CONTACT POINTS, AIS-3

Table 26

Level 4,5 and 6 Injuries among NCSS Case Vehicle Occupants by body region and contact point (Unweighted data)

Body :egion	Steering Assembly	Side Interior	Hood, Other Exterior	Instrument Panel	Other Front	Pillars Glass,etc.	Roof	Non-contact Injuries	Belts,Seats, Other interior	Windshield	Total
:ad/Neck	8	8	17	6	16	16	13	1	3	11	99
›domen .	50	12	6	9	4	0	0	0	8	0	89
ıest . .	35	13	6	9	3	1	0	0	0	0	67
:ck . .	0	0	3	2	0	1	4	13	2	2	27
›wer :tremity	2	2	3	6	4	0	0	0	3	0	20
›per :tremity	3	1	0	3	0	0	0	0	0	0	7
ıck . .	0	1	0	0	0	0	0	2	0	0	3
›tal . .	98	37	35	35	27	18	17	16	16	13	312

FIG. 3. INJURIES VS. CONTACT POINTS, AIS-4 TO AIS-6



B. Initial Analyses

Four separate types of modeling activities are described in this sub-section. The first deals with some preliminary models relating collision severity and injury severity for all collisions. Major independent variables are those describing the type of collision. Because of the large amount of missing data on Delta V, attention is then focussed on surrogate variables for collision severity which have lower missing data rates. For these models, a combination of variables including impact type and certain CDC components predicted injury as well as Delta V.

Section IV-B-2 develops a "severity index" for various sub-groups of drivers in the NCSS data set.

In IV-B-3 an example of a more detailed model is presented. Here the influence of occupant age and sex on the probability of thoracic injury is examined. The dependent variable is the probability that the injury was to the thorax, given that an AIS-3 or greater injury was sustained. This probability is found to increase strongly with age for both males and females.

Finally, in section IV-B-4 a very general model relating only the probability of fatality and Delta V is examined. This model is related to the cumulative distribution of Delta V for fatal occupants. The cumulative distribution is influenced by exposure (distribution of Delta V for all crashes) and may vary when comparing urban and rural sites. On the other hand, the probability of fatality as a function of Delta V may possibly describe a more stable physical phenomenon (overall crashworthiness), and, consequently, be more stable site to site.

1. Modeling Delta V

An analysis has been performed to determine the relationship between several crash variables and the percentage of drivers having injuries with a severity greater than AIS 2 (later AIS 1). Intrusion, ejection, and Delta V are found to be the most important variables in determining the severity of injury of the case vehicle drivers. However, the intrusion and ejection variables have only a few categories; thus they can not be effectively used to discriminate injury levels. Delta V on the other hand is a continuous variable,and therefore is a good candidate for discriminating between levels of severity.

Distinct from these directly measured crash variables, the Delta V is obtained from a crash reconstruction computer program and is not always available. However, Delta V, when it exists, is an excellent predictor of injury severity. When Delta V is 46 to 55 miles-per-hour, the probability of drivers having an injury with AIS 2 or more is increased to 87% from the 22.9% of average crash condition (64% increase). As indicated by the scatter plot (Figure 4) of Delta V against the percent of drivers having injuries with AIS 2 or more, Delta V is an excellent variable for estimating the probability of drivers sustaining an injury of OAIS 2 or more.

Several statistical models have been employed to determine the relationship between various combinations of vehicle crash variables and the Delta V values. Because of the nature of the vehicle crash variables, the Analysis of Variance (ANOVA) model is most appropriate for analyzing the Delta V using other vehicle crash variables as the independent variables. Type of impact, CDC location, and CDC extent are utilized[11] as the independent variables in the three way analysis of variance model. (This is essentially the same as one way ANOVA using all the combinations of impact type, CDC location, and CDC extent as the strata). The obtained ETA square[12] is 64.7%. For each vehicle, an estimated Delta V 1 is then obtained from the ANOVA model. Table 27 and Figure 5 show the relationship between Estimated Delta V 1 and the original Delta V. (R-square is the same as the ETA square).

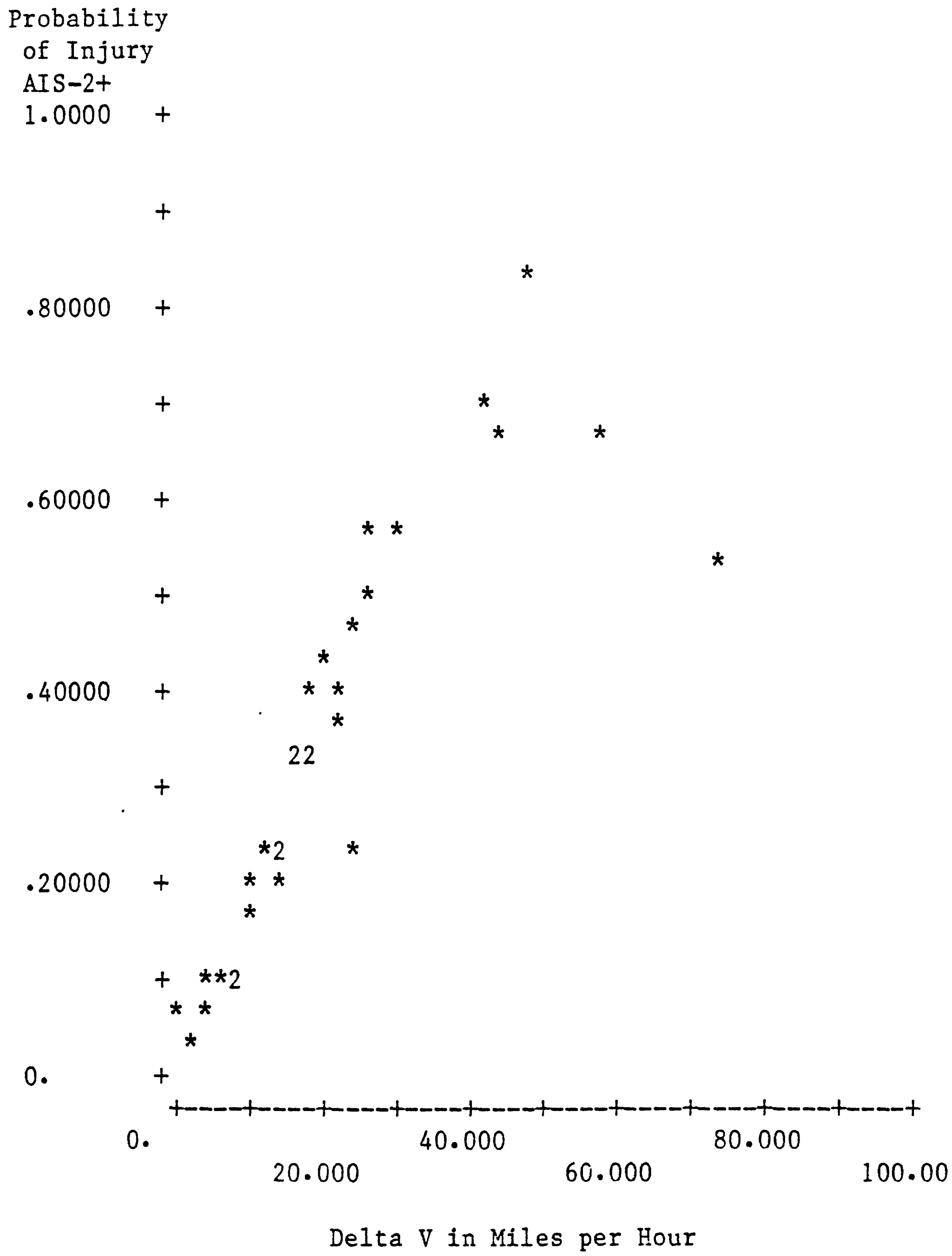
---

[11] These were chosen because they are available for most case vehicles, and because they have high corrrelation with injury severity.

[12] ETA-square is the percent of total sum of squares which can be explained by the between group difference. It is the ratio of sum of squares of between groups to the total sum of squares.

Figure 4

Delta V vs. % Drivers Injured
at AIS-2 or Greater



Note: In this graph the asterisk designates one entry at a point; numerals indicate more than one entry at a point.

Table 27

Linear Regression
Original Delta V
by Estimated Delta V

SOURCE	DF	SUM SQURS	MEAN SQ	F	SIGNIF
REGRESSION	1	296630	296630	7792.3	0.
ERROR . .	4239	161370	38.067		
TOTAL . .	4240	458000			
R-SQUARE=	.64767				
STANDARD ERROR= . .	6.1699				

The estimated Delta Vs are grouped into 37 levels in the following intervals: (1-3),4-34,(35-37),38,39,(40-42),43,44,(45-65), (66-90). For each of the 37 levels, the percentage of drivers sustaining injuries with AIS 3 or more is then calculated. The relationship between the estimated Delta V and the injury percentage is illustrated in the linear regression in Table 28. Using a regression model, the R-square is 86.5%

This estimated Delta V outperforms the original Delta V in its ability to predict the percent of injury. Even though the original Delta V also has R-square equal to 84.8% when the regression model is used.

A second predicted Delta V(Est Delta V 2) has also been calculated for each of the vehicles, using type of impact, latch/hinge damage, and intrusion as the three way factors in an ANOVA model.[13] These Delta Vs are also grouped into 37 levels. The R-squares of the predicted Delta V's with the percentage of drivers having injuries more severe than AIS

13 Again these variables were selected because they were generally available and because they correlated highly with injury.

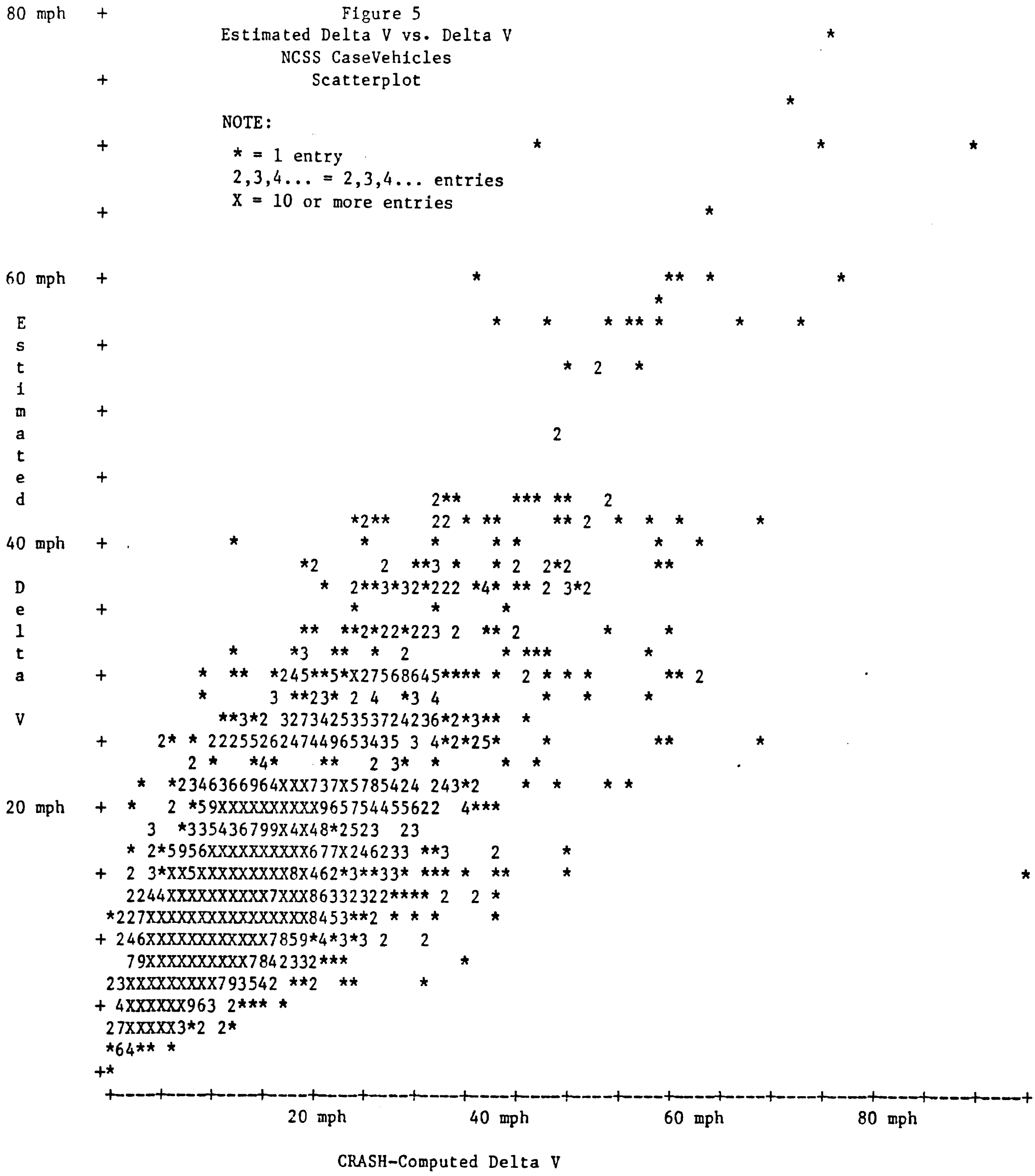


Figure 5
Estimated Delta V vs. Delta V
NCSS CaseVehicles
Scatterplot
NOTE:
* = 1 entry
2,3,4... = 2,3,4... entries
X = 10 or more entries
80 mph
60 mph
40 mph
20 mph
Estimated Delta V
20 mph
40 mph
60 mph
80 mph
CRASH-Computed Delta V

Table 28

Linear Regression
Percent of AIS > 2 by the Estimated Delta V 1

SOURCE	DF	SUM SQURS	MEAN SQ	F	SIGNIF
REGRESSION . .	1	.52566	.52566	231.25	.0000
ERROR	36	.081832	,0022731		
TOTAL	37	.60750			
R-SQUARE= . .	.86530				
STANDARD ERROR	.047677				

2 is 68%. Similar findings are obtained when the sample is restricted to the case vehicle only. These findings are summarized in Table 29.

Preliminary analyses indicated that when the percentage of drivers with injury severity greater than AIS 1 is the dependent variable, the first predicted Delta V (from the type of impact, CDC location and CDC extent) had about 90% accuracy in estimating the dependent variable. Further analysis will be performed to determine the relationship between the crash variables and the percentage of drivers (and passengers) sustaining injuries with AIS greater than 1.

Similar analyses will also be performed with injuries sustained in different body regions as the dependent variables. Bedrest days, other rest days, work days lost, and days in hospital may also be used as the dependent variables.

Table 29

Delta V, Estimated Delta V
and Percentage of AIS > 2

Variables	R-Square
Est. Delta V 1 and Delta V2 .	64.7%
Est. Delta V 2 and Delta V .	45.1%
Delta V and %AIS > 2 .	63.7%
Est Delta V 1 and %AIS > 2 .	86.5%
Est. Delta V 2 and %AIS > 2 .	68.0%

Table 30

Linear Regression
Percent of AIS > 2 Predicted by the Original Delta V

SOURCE	DF	SUM SQURS	MEAN SQ	F	SIGNIF
REGRESSION	1	.27307	.27307	61.620	.0000
ERROR . .	35	.15510	.0044316		
TOTAL . .	36	.42818			
R-SQUARE=	.63776				
STANDARD ERROR= . .	.066570				

Table 31

Linear Regression
Estimated Delta V 2 and the Original Delta V

SOURCE	DF	SUM SQURS	MEAN SQ	F	SIGNIF
REGRESSION	1	97905.	97905.	3446.7	0.
ERROR . .	4192	119080	28.406		
TOTAL . .	4193	216980			
R-SQUARE=	.45121				
STANDARD ERROR= . .	5.3297				

Table 32

Linear Regression
Percent of AIS > 2 by Estimated Delta V 2

SOURCE	DF	SUM SQURS	MEAN SQ	F	SIGNIF
REGRESSION	1	.22477	.22477	68.934	.0000
ERROR . .	32	.10434	.0032607		
TOTAL . .	33	.32911			
R-SQUARE=	.68296				
STANDARD ERROR= . .	.057102				

2. Severity Index

In the first part of the analysis, a relationship between several crash variables and the chances of a vehicle driver sustaining severe injuries (AIS 2 or more) were established. These relationships are then utilized to determine the severity of the crash conditions in producing the injuries. The severity of the crash conditions are defined to be the difference in the percentage of injuries between those drivers who encounter certain crash conditions and those drivers who encounter average crash conditions. For example, in roll-over accidents, 37.2% of the drivers sustain severe injuries (AIS 2 or more), but in all accidents with known roll-over information (non-missing data), only 19.7% of the drivers sustained injuries of AIS 2 or more. Therefore, the severity index of the roll-over condition is 17.5 % (37.2% - 19.7%). Table 33 lists the severity indexes of several important crash configurations.

Table 33

Severity Index for Several Crash Conditions

CRASH CONDITION	SEVERITY INDEX (STD. DEV.)
TRAPPED	68.5 (3.1)
STEER AND A-PILLAR INTRUS	62.8 (10)
PARTIAL EJECTION	53.2 (8.7)
CDC EXTENT - 7	48.7 (8.5)
COMPLETE EJECTION	47.4 (4.7
STEER COLUMN INTRUS	43.3 (5.1)
LF & RF HINGE-DAMAGE	41.8 (3.1)
LF &LR HINGE DAMAGE	36.9 (5.4)
OTHER COMBINAT INTRUS	36.8 (2.1)
CDC DAMAGE DIST- OVERHANG STRU	34.4 (11.9
OTHER COMBINAT HINGE-DAMAG	34.8 (5.1)
CDC EXTENT- 4	34.0 (2.7)
CDC EXTENT- 8	32.1 (10.9)
CDC VERT LOC - ALL	31.0 (3.5)
CDC EXTENT -5	29.3 (4.2)
CDC EXTENT- 6	28.6 (5.2)
A PILLAR INTRUSION	25.9 (6.1)
SIDE INTRUSION	23.6 (2.5)
LF HINGE DAMAGE	23.2 (2.3)
TRUCK INVOLV- 2	19.0 (3.6)
ROLLED OVER	17.5 (2.8)
CAR/OBJ FRONT IMPACT	16.1 (1.7)

HINGE DAMAGE - RF	15.8 (2.7)
ROOF INTRUSION	15.8 (3.5)
CDC EXTENT - 3	15.4 (1.5)
CAR/OBJ SIDE IMPACT	14.9 (3.3)
CDC SPECIAL VERT LOC -TOP	13.4 (3.9)
CDC HORIZ - SIDE REAR	12.6 (4.1)
CDC GEN AREA OF DAMAGE-TOP	11.9 (3.9)
PRIN ROLLOVER IMPACT	11.5 (3.3)
CAR/VEH HEAD ON IMPACT	11.8 (2.0)
CDC NARROW TYPE DAMAGE DIST	8.6 (2.8)
CDC HORIZ - SIDE CENTER	8.1 (4.2)
SIDE OVERRIDE INTRUSION	7.8 (4.1)
TRUCK INVOLV - 2	7.1 (2.3)
UNDERCARRIAGE IMPACT	5.2 (6.2)
CDC GENERAL AREA - L SIDE	5.7 (3.8)
CDC HORIZ LOC - SIDE OR END	5.1 (1.5)
CDC VERT LOC-BELT LINE & ABOVE	5.2 (7.0)
RF &LR HINGE DAMAGE	5.2 (5.9)
CDC HORIZ LOC - SIDE FRONT	4.6 (1.3)
CAR/VEH ANG FRT IMPACT	2.3 (4.8)
CDC TYPE DAMAGE - W	0.6 (0.8)
CDC VERTICAL UNDERCARRIAGE	0.5 (6.3)
CDC GENERAL AREA FRONT	0.4 (0.8)
CDC GENERAL AREA -UNDERCARRIAGE	.5 (6.3)
CDC HORIZ LOC-SIDE OR END Z	-0.6 (1.6)
REAR END INTRUSION	-1.8 (8.0)
LR HINGE DAMAGE	-1.6 (10.3)
CDC VERTI LOC - BELOW BELT LIN	-1.4 (0.7)
UNLISTED TYPE OF IMPACT	-2.8 (1.7)
CDC GENERAL AREA -RIGHT SIDE	-2.6 (1.7)
CDC HORIZ LOC - RIGHT	-4.3 (1.7)
CDC EXTENT - 2	-4.1 (1.0)
CAR/VEH SIDE IMPACT	-4.0 (0.9)
HINGE DAMAGE - SIDE	-5.8 (8.4)
CAR/VEH AN SIDE IMPACT	-9.1 (1.8)
CDC TYPE OF DAMAGE - CORNER	-10.2 (1.5)
CDC HORIZ LOC -LEFT	-10.5 (1.7)
CDC HORIZ LOC - DISTRIBUTED	-12.8 (1.5)
CAR/VEH REAR IMPACT	-13.5 (1.0)
CAR/OTHER OBJ	-13.0 (3.1)
SIDESWIPE IMPACT	-13.3 (3.2)
CDC HORIZ LOC -CENTER	-14.1 (3.1)
CDC TYPE OF DAMAGE -SIDESWIPE	-15.2 (2.9)
CDC EXTENT - 1	-15.9 (0.6)
CHAIN COLLISION IMPACT	-17.8 (1.4)
CDC GENERAL AREA- BACK	-17.6 (1.5)
CDC VERT LOC - MIDDLE	-18.2 (1.6)

The trapped condition introduced the greatest chance for the vehicle drivers to obtain an injury with severity greater than AIS 1. In this situation, 68.5% more of the drivers sustained injury with AIS 2 or more than in the average accident situation. Side intrusion and steering column and A pillar intrusion are the second most severe crash condition which create 62.8% more chance for the drivers to have injury with severity AIS 2 or more. Ejection is another important crash condition which induces about 50% greater chance for the driver to incur severe injuries (AIS 2 or more). Crash conditions which involve two or more hinge damages (e.g., LF & RF, LF & LR) also create a much higher chance for the drivers receiving severe injuries than the average crash condition (36 to 41% more). The least injury threatening crash conditions are the crashes from the rear and the chain collision impact. In these conditions the drivers have about 18% less chance of having severe injuries than in the average crash condition.

3. Age Dependent Injury Modeling

This analysis begins to look at possible models to predict the probability of injury to a specific body region conditional on injury at a specific AIS level. (Another possible choice could have been the probability of injury to a body region at a specific AIS level conditional on injury.) No attempt was made at this point to restrict the analysis to specific crash conditions or to include only occupants of towed vehicles. The proportions were calculated based on OIC codes and therefore only occupants with valid OIC codes are included in this analysis.

The analysis was done at the occupant level. The body region of the OIC code was recoded into the seven body regions (defined in the Section IV-A-2) and each region was examined separately. (The same occupant could have a level three injury in two body regions and for this report the occupant would be included as an injured occupant for both body regions). An occupant was included if there was at least one reported injury at AIS level greater than or equal to 3 (severe). Since there were possibly 3 injuries coded per person it was possible to have two injuries in the same body region. Here the highest AIS level of all injuries reported to that body region was used to represent the injury severity to that body region.

The independent variables of interest were sex and age. The only body region for which the probability of injury appeared related to age was the thoracic region. This trend looked to be the same for each sex.

The dependent variable is the proportion of occupants injured at AIS level >2 who received an injury to a specific body region at an AIS level >2. Previous work indicated that age was related to the likelihood of thoracic injury so, of the occupant variables, age and sex were the first independent variables examined.

For all body regions except the thoracic region, the proportion of occupants injured in that body region appeared to be independent of age for both sexes. But for the proportion that suffered injury to the thorax there appeared a striking positive relationship with age for both males and females and it appears quite similar for both groups.

Two sets of scatter plots are included. The first set (Figure 1 to Figure 3) are done by calculating the proportions at each age. The sample sizes, for Figure 3, of the occupants at each age rage from 1 to 41 with 59% of the 78 ages present having cell sizes <6. For the next set of scatter plots (Figure 4 to Figure 6) the proportions were calculated in age groups, each group representing 5 years. In Figure 6, with the exception of the first two groups and the last (sample sizes 5, 3, and 1 respectively) all of the other 16 groups have at least 10 occupants in each group.

Figure 6

Percent Thoracic Injuries vs. Age
Male Case Vehicle Occupants
Injured at AIS-3 or Above

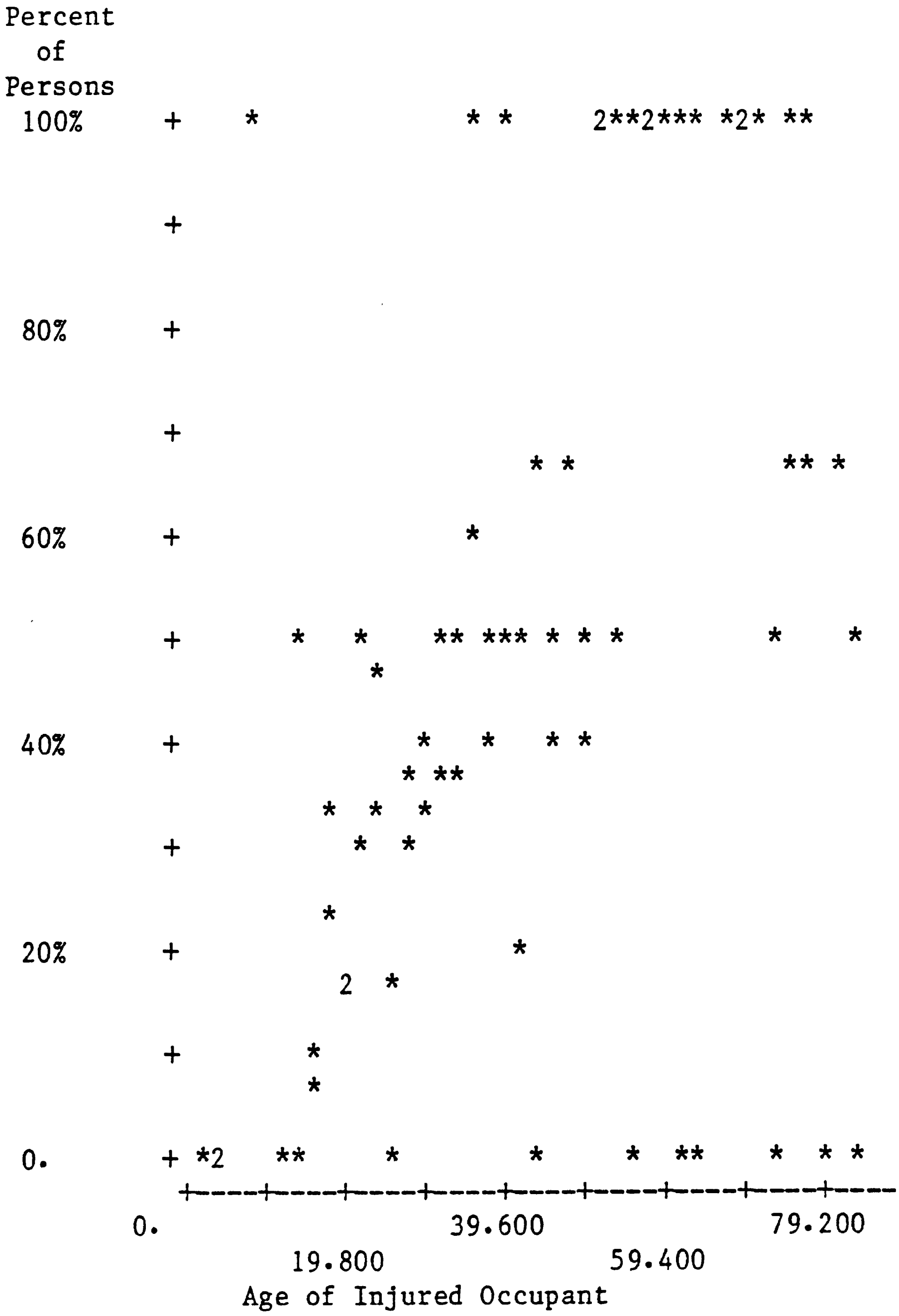


Figure 7

Percent Thoracic Injuries vs. Age
Female Case Vehicle Occupants
Injured at AIS-3 or Above

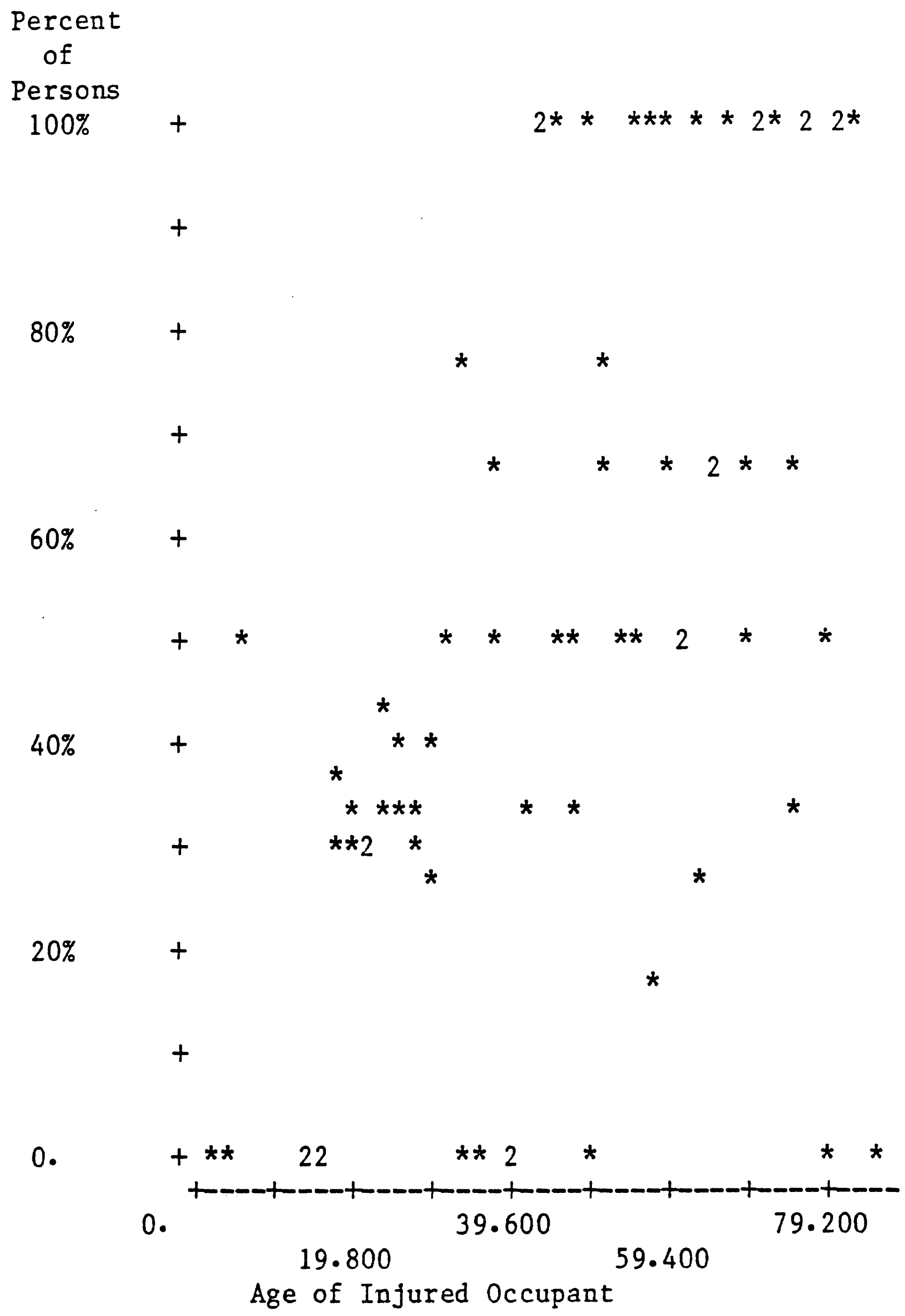


Figure 8

Percent Thoracic Injuries vs. Age
All Case Vehicle Occupants
Injured at AIS-3 or Above

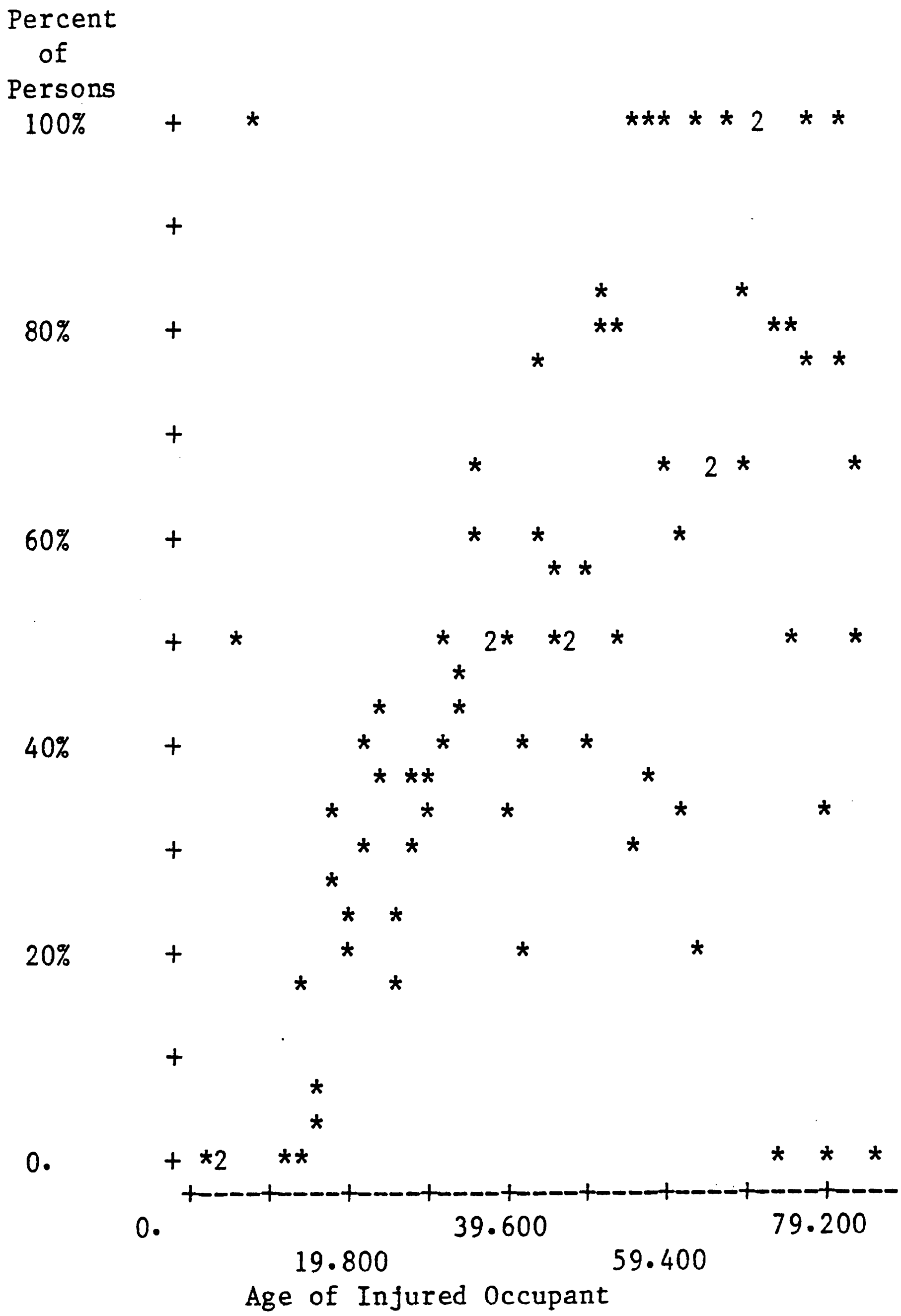


Figure 9

Percent Thoracic Injuries vs. Age Group
Male Case Vehicle Occupants
Injured at AIS-3 or Above

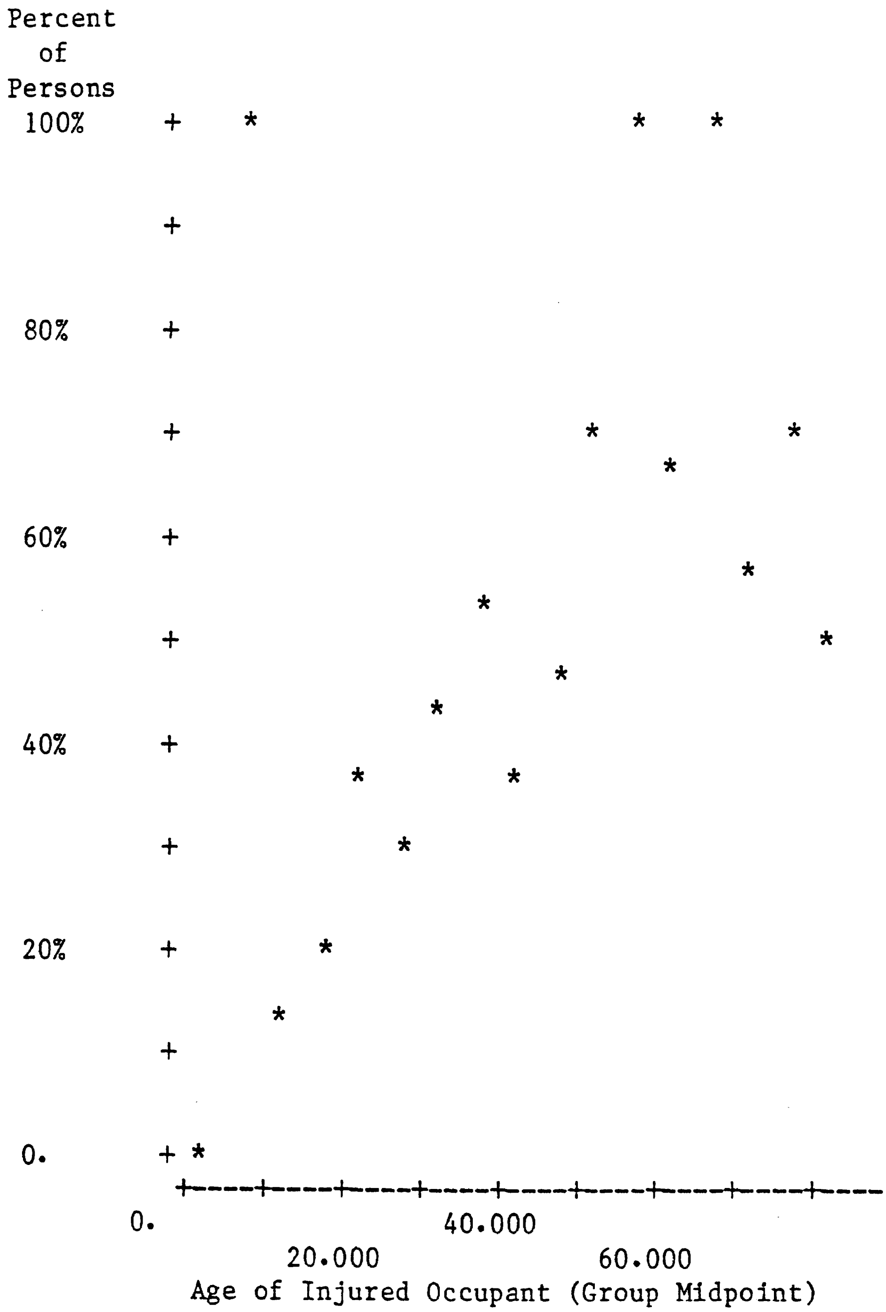


Figure 10

Percent Thoracic Injuries vs. Age Group
Female Case Vehicle Occupants
Injured at AIS-3 or Above

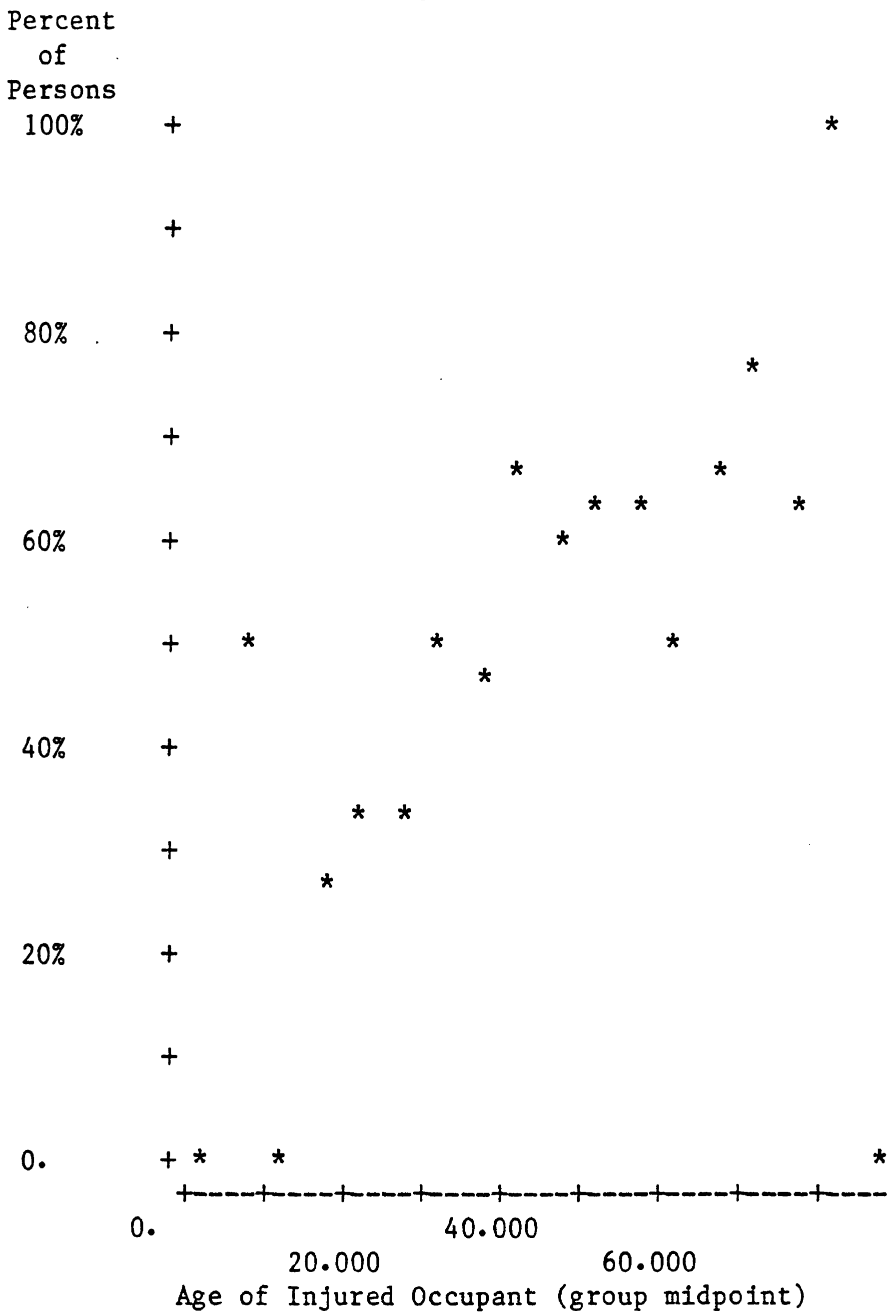
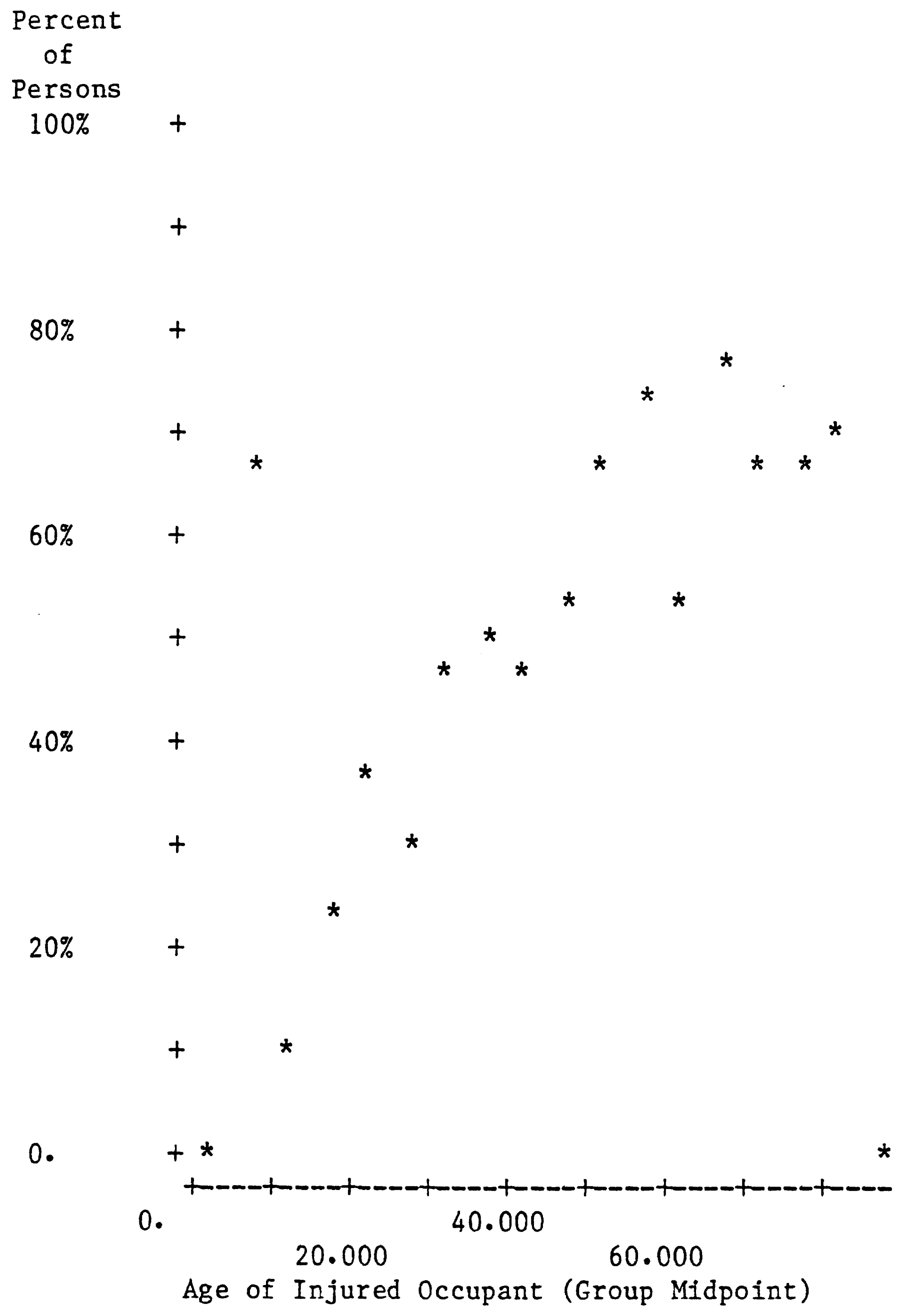


Figure 11

Percent Thoracic Injuries by Age Group
All Case Vehicle Occupants
Injured at AIS-3 or Above



4. Distributions of Collision Severity

Collision severity has been singled out as an important variable for study in the NCSS project. This emphasis is certainly appropriate. When taken in conjunction with collision type, these two variables provide the basic description of the collision environment current vehicle structures and restraint systems must contend with. This information is one of the inputs to the "accident analysis" models under consideration in Tasks 8 and 9 of this project. Described elsewhere in this section are various injury-severity prediction models in which collision type and severity are major independent variables. Historically cumulative distributions of collision severity for fatal accidents involving frontal damage have been cited by NHTSA[14] as supporting evidence for Occupant Protection Standards. Accordingly a discussion of the ability of the NCSS data to provide this information is in order.

Figure 12 shows the weighted probability density function of Delta V for all vehicle occupants and for fatal vehicle occupants. The corresponding cumulative distribution functions are shown in Figure 13. The first point to recognize is that when the cumulative distribution functions are viewed as a function of the injury level, this constitutes a "general model" as discussed in Section II-B. In this case we are viewing only two variables in a complex multivariate problem (vehicle crashworthiness). If the data used include all the combinations of the other variables (occupant age, restraint use, vehicle size, etc.) and their various levels in the same proportion as in the population of interest, then the distributions computed portray an accurate picture of one dimension of the current real-world experience. Two considerations are of interest in this case. The first is whether such a model is nationally representative (when computed using the NCSS data), and the second is the stability of the phenomenon modeled.

With regard to the first consideration, the model is nationally representative only to the degree that the data are. This follows from

---

[14] R.L. Carter, "Passive Protection at 50 miles per hour." DOT-HS-810-197,, NHTSA, June 1972.

the discussion in the preceding paragraph; because only two variables are in the model, the validity of the relationship exhibited is dependent on the influence of all the other variables (not in the model) being represented in the data set in their proper proportion. In the same way that statistically defensible national estimates of other parameters cannot be derived from the NCSS data, general models such as the relationship of collision severity and injury severity cannot be statistically defended as representative of the national experience.

A valuable feature of the NCSS plan is that the sampling design is such that the data are site representative. This aspect has positive implications for the second consideration, the stability of the phenomenon modeled. Here the questions is basically whether the "general" model is, in fact, general. Representative distributions can be computed for each site along with confidence intervals. Sites were chosen to reflect some diversity in both urbanization and region of the country. Since crash severity was thought to be negatively correlated with population density, site-to-site variations will provide important information on the stability of the models. This will be clarified in later paragraphs where the underlying relationship for these distributions is described more fully.

Beyond the sampling considerations, problems of bias must also be recognized. The major sources of bias which will be considered here are measurement and missing data. Possible bias arising from missing data on Delta V has already been discussed in Section III-A. (The higher CDC extent codes have higher missing data rates on Delta V). Possible measurement bias should be considered since the computations of Delta V is complex. In particular, the computations are carried out by the CRASH2 computer program. Any inadequacies in this algorithm are likely to produce systematic errors. In particular, the input parameters for the program defining the energy absorption characteristics of the vehicles are not well substantiated. Errors here would bias the results with respect to particular car sizes, and, therefore, are critical. In summary, the possibility of bias in the computed Delta V deserves serious consideration in a presentation of these distribution functions.

At this point, the relationship between collision severity, and injury severity as presented in these distributions will be discussed more fully. The following material is developed in a paper by Marsh, et al.[15] While the cumulative distribution of Delta V for fatal occupant describes an interesting aspect of current accidents, there is little information of use to either the vehicle designer or the rulemaker when the data is tabulated in this fashion. As pointed out by Marsh, et. al., the cumulative distribution presents the probability that the collision was at or below a particular level of collision severity, <u>given that a fatality occurred</u>, and not the probability of death as described in the paper by R.L. Carter referenced earlier. The probability of a fatality cannot be estimated by looking only at fatal accidents!

Marsh goes on to describe a formulation which does provide direct information on vehicle crashworthiness that is attributed to General Motors and other authors. Quoting from page 3,

> "The key here is to recognize that the probability of a fatality may be thought of as the product of two separate probabilities: the probability that the collision was within the given severity range, P(C); and the conditional probability that the injury was of level I, given a collision of severity C, P(I|C). This product must be summed over all C, as shown by the following equation for conditional probability:
>
> $$P(I) = \sum P(I,C) = \sum [P(I|C) \times P(C)]$$
>
> where: I = occurrence of an injury of level I
> C = occurrence of a crash of severity C
>
> The probability that the collision is of a particular severity, independent of the injury level [denoted by P(C)], may be thought of as a description of the collision exposure environment. Implicit in such a description is some definition of what constitutes an accident (e.g., a vehicle towed from the scene, or a fixed level of property damage), and a representative measure of

---

[15] Joseph C.Marsh IV, et. al., "An Assessment of the Relationship Between Frontal Impact Severity and Injury Level" SAE paper 770156, International Automotive Engineering Congress, Detroit, Michigan, February, 1977.

the cumulative frequency distribution of collision severity for all occupants in a given population.

The term of real interest, however, is the probability of a particular injury level, I, given a collision of severity C, denoted by P(I|C). This may be thought of as an overall measure of the injury potential of a collision that occurs with severity C. With other factors held constant, the higher the crash severity the higher the probability of injury. Furthermore, for a fixed set of accident factors and crash severity there is a set of probabilities associated with each level of injury (e.g., fatal, serious, minor, no-injury) whose sum is unity. By computing the probability of injury as a function of collision severity one can include the situation where some injuries at crash collision severity cannot be prevented."

Figure 14 shows the probability of fatality as a function of collision severity for all cases with Delta V computed in the aggregate NCSS file. (Delta V is missing on approximately half of the fatals). Note that even at the high levels of collision severity the probability is less than 50% in spite of the fact that these are nearly all unrestrained occupants.

In summary, extreme caution is in order when interpreting information on collision severity from the current NCSS data. When the number of cases available is sufficiently large it will be most interesting to compute this relationship separately for each site. Since the sites reflect some diversity of urbanization, one would expect the overall distribution of collision severity for all vehicles to vary from site-to-site. The cumulative distribution of collision severity for a specific injury level (like fatal) will also vary since the exposure is different. However, one would hope that the probability of injury given a particular level of collision severity reflects a more stable phenomenon. Such a finding would provide needed support for this type of approach.

FIG. 12. PROBABILITY DISTRIBUTIONS OF OCCUPANTS BY DELTA V

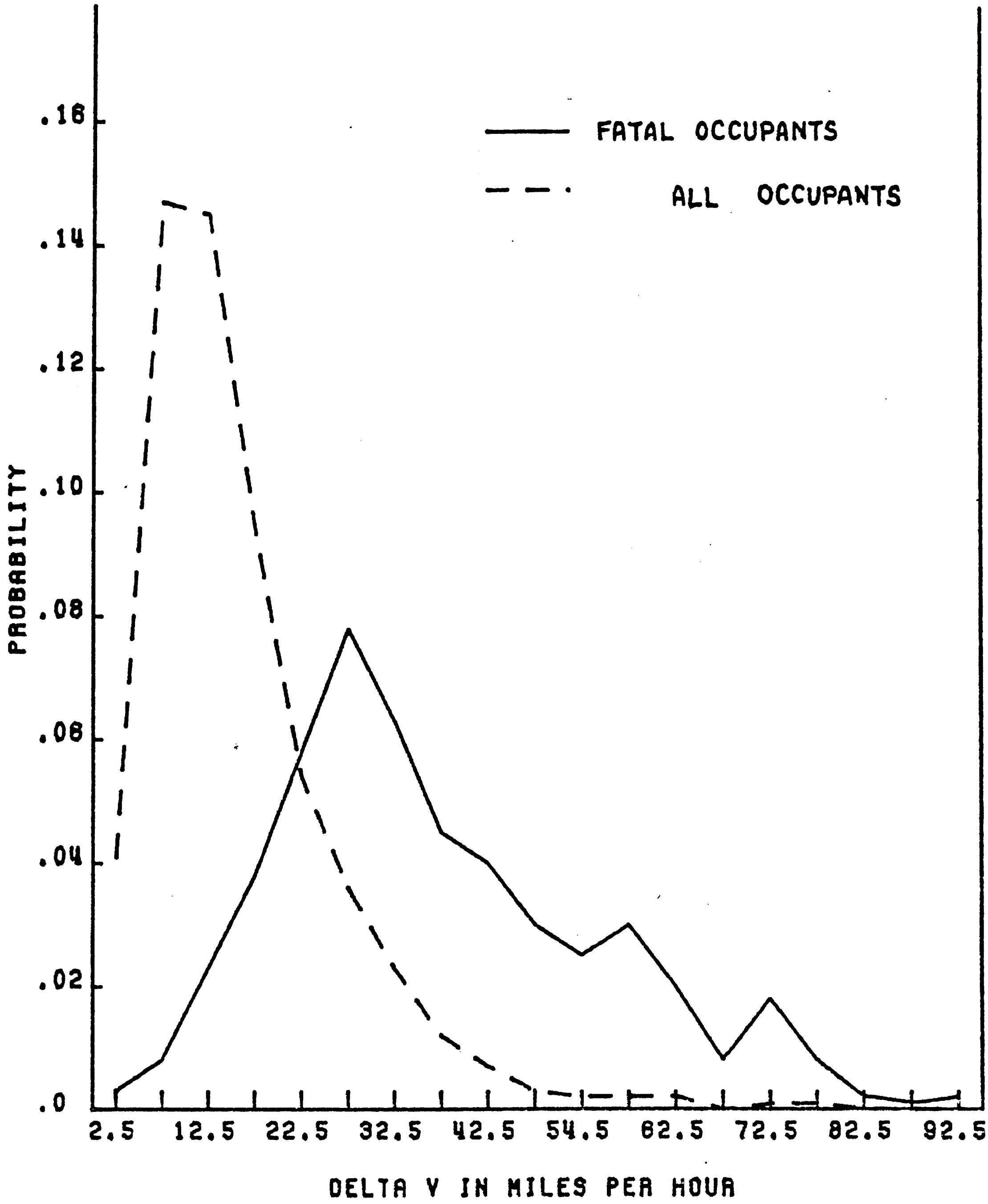


FIG. 13. CUMULATIVE PROBABILITY DISTRIBUTION, OCCUPANTS BY DELTA V

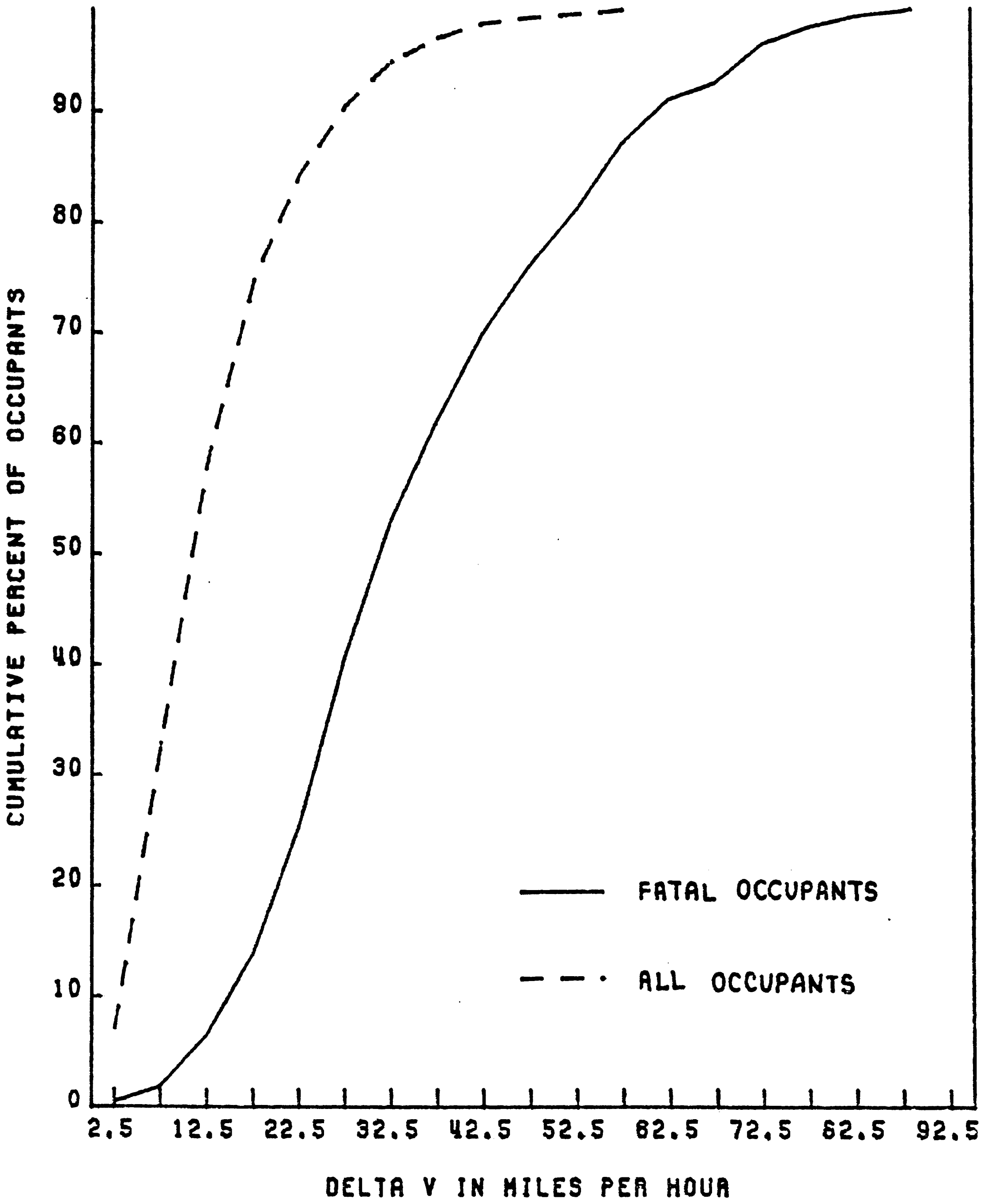
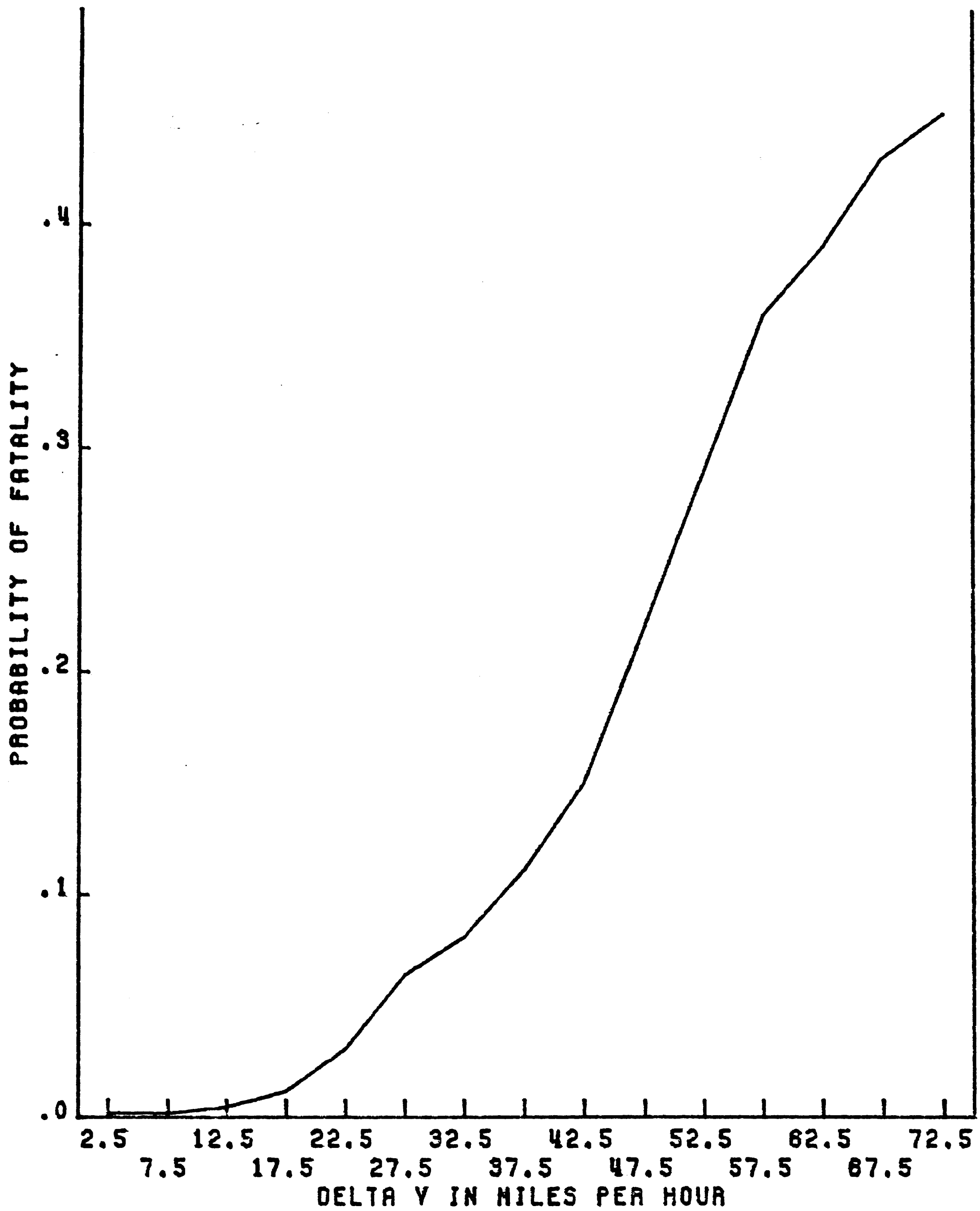


FIG. 14. PROBABILITY OF A FATALITY GIVEN A CRASH, BY DELTA V



V. THE FACTBOOK

A. Introduction

The Factbook, for purposes of this interim report, consists of sample tables and figures divided into three major categories pertaining to the areas of accidents, vehicles, and occupants. A fourth category concentrating on injuries is planned, but the current data file, containing substantially less than a census of the injury data, is not yet suitable for such presentation. The tables and graphic analyses presented here are meant to exemplify for discussion the form of a final Factbook covering the NCSS data.

In general each page of the Factbook depicts in both tabular and pictorial form some one aspect of the data. For the present version most of the tables will show each distribution for each of the seven investigative teams, as well as for the aggregate of the data from those teams. While it is desired eventually to produce national estimates from these data, and to present them in the Factbook, the quality and our understanding of the present data is inadequate to permit this. In addition to the incompleteness of the injury data, about 8% of the cases for the first 15 months of data collection are not yet in the computer file. The problems of missing data have been discussed in section III of this report, but our ability to correct or account for missing information is not adequate at this time to do more than to present the aggregate (and generally non-missing) data.

Aggregate tables, then, in the following pages, should be read with this caveat: Remember that for many variables--in particular those relating to crash severity and to injury--there are substantial proportions of missing data. If these data were present it is possible, and even likely, that the distributions presented would change substantially. One of the purposes of this study program is to make estimates of the uncertainty that arises from this source, but since all the cases are not yet available for analysis, we cannot complete and present that part of the analysis here. Following this introduction is an outline of tables suggested for a final Factbook, and then sample tables are given.

B. Index to the Factbook

Suggested table titles are shown in this section. The designation (F) indicates that a second table covering fatal cases (accidents, vehicles, or occupants as appropriate) will also be prepared. Only selected tables are actually included in this report.

INDEX

1. INTRODUCTION

2. ACCIDENTS
   2.1 Time
      Time of Day (F)
        -by No. of Vehicles/Accident
        -by No. of Occupants/Accident
      Day of Week (F)
        -by No. of Vehicles/Accident
        -by No. of Occupants/Accident
      Season of Year
   2.2 Accident Class
      Accident Configuration (F)
      Severity
        -Head-on
        -Side
        -Rear end
   2.3 Roadway/Environment
      Rural/Urban (F)
      Highway Type (F)
      Pavement Type
      Surface Condition (F)

3. VEHICLES
   3.1 Class
      Make/Model (F)
      Type (Pas. Car, Conv., St. Wag.) (F)
      No. of Occupants
      Weight (F)
      Age (F)
   3.2 Damage
      Location (F)
      Extent (CDC) (F)
      Object Hit (F)
   3.3 Impact Characteristics
      Velocity (delta V) (F)
      Principal Direction of Force (F)
      Worst Injury

4. OCCUPANTS
   4.1 General Characteristics
      Age (F)

Sex (F)
Height
Weight

4.2 <u>Special Characteristics</u>
Restraint Usage (F)
Ejection/Entrapment (F)
Seated Location (F)

4.3 <u>Injuries</u>
Severity (AIS or Degree)
- -by Age
- -by Vehicle Impact Location
- -by Seated Position
- -by Restraint Usage
- -by Ejection/Entrapment
- -by Delta V

Neck Injuries
Injury Severity Score

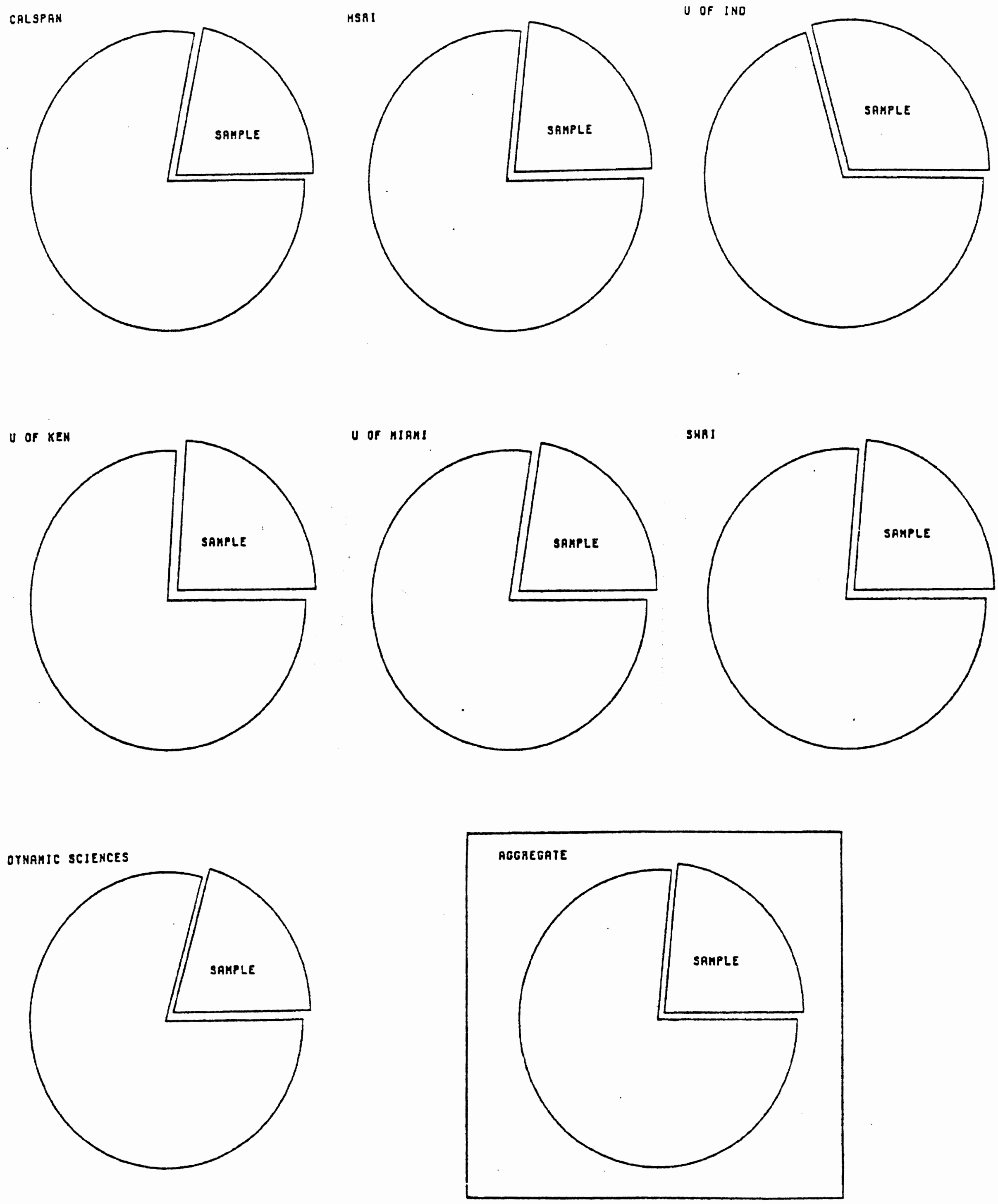
4.4 <u>Injury Consequences</u>
Hospitalization Time
Lost Work Time
No. of Outpatient Visits
Activity Restriction

Overview of NCSS Data
First Fifteen Months of Data Collection

Group	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
ACCIDENTS .								
Weighted .	3862	2582	2654	2764	4311	6374	2310	24857
Unweighted	899	614	860	710	1039	1583	511	6216
VEHICLES .								
Weighted .	5683	3601	3879	3938	6905	9403	3565	36974
Unweighted	1168	784	1059	884	1442	2044	676	8057
OCCUPANTS .								
Weighted .	9011	5435	5989	6608	10486	15150	5338	58017
Unweighted	1953	1252	1763	1575	2349	3542	1091	13525
Fatalities	47	50	92	43	15	130	19	396

The table above and the graphs on the next page present a description of the overall NCSS data set. The actual number of cases investigated is shown as the unweighted or sample figures, and the weighted numbers represent the reconstructed population for each data collection site.

SAMPLE AS A PROPORTION OF TOTAL POPULATION
OCCUPANTS OF CASE VEHICLES



The sample proportion is highest in the University of Indiana study area, as might be expected due to the higher average impact severity of rural accidents.

This page intentionally left blank.

2 ACCIDENTS

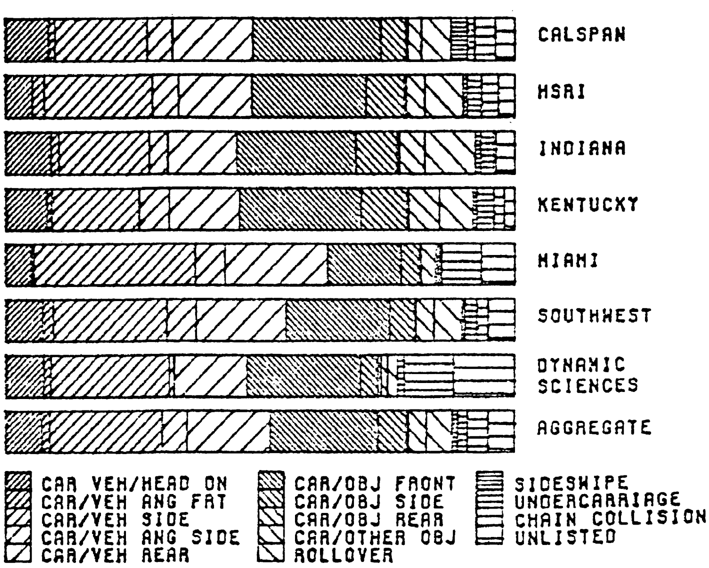
NCSS Crashes
by Type of Impact by Team
(Unweighted Data)

Type of Impact	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
CAR/VEH HEAD ON	80	42	93	62	50	127	31	485
CAR/VEH ANG FRT	10	11	7	4	5	27	6	70
CAR/VEH SIDE	152	105	118	86	289	285	96	1131
CAR/VEH ANG SIDE	37	25	21	32	45	64	4	228
CAR/VEH REAR	93	55	63	58	126	169	51	615
CAR/OBJ FRONT	172	142	194	177	147	310	101	1243
CAR/OBJ SIDE	51	42	63	62	26	80	19	343
CAR/OBJ REAR	2	2	2	3	1	4	2	16
CAR/OTHER OBJ	15	11	16	24	16	25	4	111
PRIN ROLLOVER	51	52	84	45	7	121	11	371
SIDESWIPE	16	2	4	2	3	5	0	32
UNDERCARRIAGE	7	14	17	13	1	26	4	82
CHAIN COLLISION	22	11	2	11	54	21	30	151
UNLISTED	32	22	31	24	69	68	53	299

NCSS Crashes
by Type of Impact by Team
(Weighted Data)

Type of Impact	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
CAR/VEH HEAD ON	320	135	237	221	218	454	166	1751
CAR/VEH ANG FRT	46	59	43	25	23	132	33	361
CAR/VEH SIDE	680	537	466	464	1354	1392	519	5412
CAR/VEH ANG SIDE	187	130	96	158	249	364	22	1206
CAR/VEH REAR	591	364	357	373	861	1105	318	3969
CAR/OBJ FRONT	946	568	617	645	618	1270	497	5161
CAR/OBJ SIDE	186	189	216	245	155	308	76	1375
CAR/OBJ REAR	14	11	11	6	10	10	14	76
CAR/OTHER OBJ	99	92	130	162	121	223	28	855
PRIN ROLLOVER	216	190	261	177	19	340	44	1247
SIDESWIPE	121	20	28	20	24	35	0	248
UNDERCARRIAGE	55	71	65	88	10	149	28	466
CHAIN COLLISION	151	83	14	56	330	138	216	988
UNLISTED	140	79	94	54	276	317	263	1223

COLLISION TYPE BY TEAM (WEIGHTED)

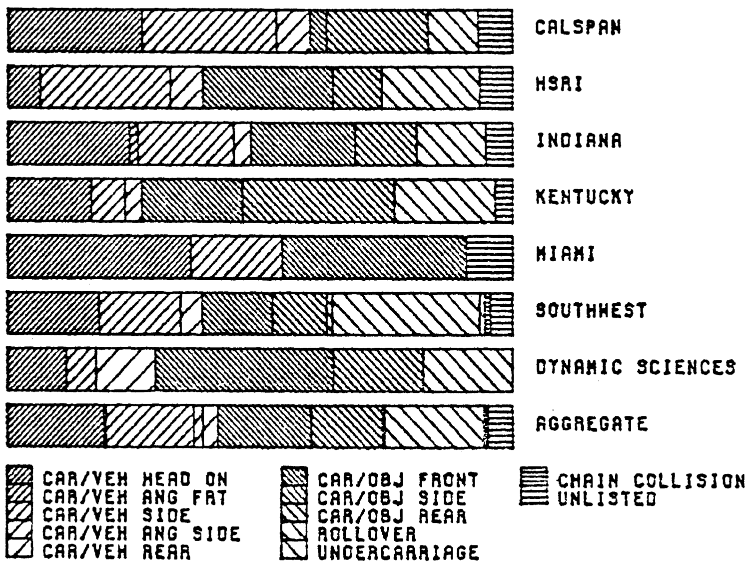


The most frequent type of collision, as indicated in the weighted data, is a two-vehicle, right-angle collision. The second-most frequent type involves a vehicle in a frontal collision with a fixed object.

NCSS <u>Fatal</u> Crashes
by Type of Impact by Team
(Weighted Data)

Type of Impact	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.*	Total
CAR/VEH HEAD ON	8	2	14	5	4	17	2	52
CAR/VEH ANG FRT	0	0	1	0	0	0	0	1
CAR/VEH SIDE	8	8	11	2	2	15	1	47
CAR/VEH ANG SIDE	2	2	0	1	0	0	0	5
CAR/VEH REAR	0	0	2	0	0	4	2	8
CAR/OBJ FRONT	1	8	12	6	4	13	6	50
CAR/OBJ SIDE	6	3	7	9	0	10	3	38
CAR/OBJ REAR	0	0	0	0	0	1	0	1
PRIN ROLLOVER	3	6	8	6	0	27	3	53
UNDERCARRIAGE	0	0	0	0	0	1	0	1
CHAIN COLLISION	0	0	0	0	0	1	0	1
UNLISTED	2	2	3	1	1	4	0	13

FATAL COLLISION TYPE BY TEAM (WEIGHTED)



The two impact types that contribute most to the number of fatal crashes are two-vehicle head-on collisions and rollovers. Because of the small numbers of fatal crashes in the NCSS data set, the bar graph shows large variations in the proportions of impact types among the seven data collection areas.

NCSS AGGREGATE/NOT NATIONAL ESTIMATES

All NCSS Crashes
by Day of Week by Team
(Unweighted Data)

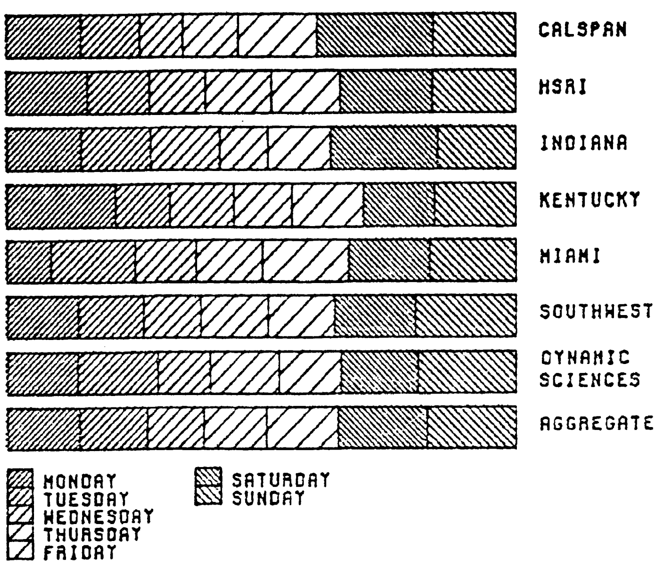
Day of Week	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
MONDAY	121	87	123	109	93	233	68	834
TUESDAY	78	64	79	72	123	158	68	642
WEDNESDAY	77	64	88	67	108	138	48	590
THURSDAY	86	62	71	71	115	155	53	613
FRIDAY	102	73	86	85	131	180	47	704
SATURDAY	145	98	140	93	134	221	61	892
SUNDAY	148	100	135	119	145	273	81	1001

All NCSS Crashes
by Day of Week by Team
(Weighted Data)

Day of Week	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
MONDAY	568	411	390	592	378	899	323	3561
TUESDAY	447	316	364	297	711	818	365	3318
WEDNESDAY	326	283	358	346	519	720	237	2789
THURSDAY	419	335	251	314	565	842	314	3040
FRIDAY	597	349	329	391	728	834	281	3509
SATURDAY	886	470	560	387	689	1016	352	4360
SUNDAY	619	418	402	437	721	1245	438	4280

NCSS AGGREGATE/NOT NATIONAL ESTIMATES

TOTAL ACCIDENTS BY TEAM BY DAY OF WEEK (WEIGHTED)



More accidents occur on Saturday than any other day with Sundays in second place. These two days account for 28 percent of the week and 35 percent of the accidents.

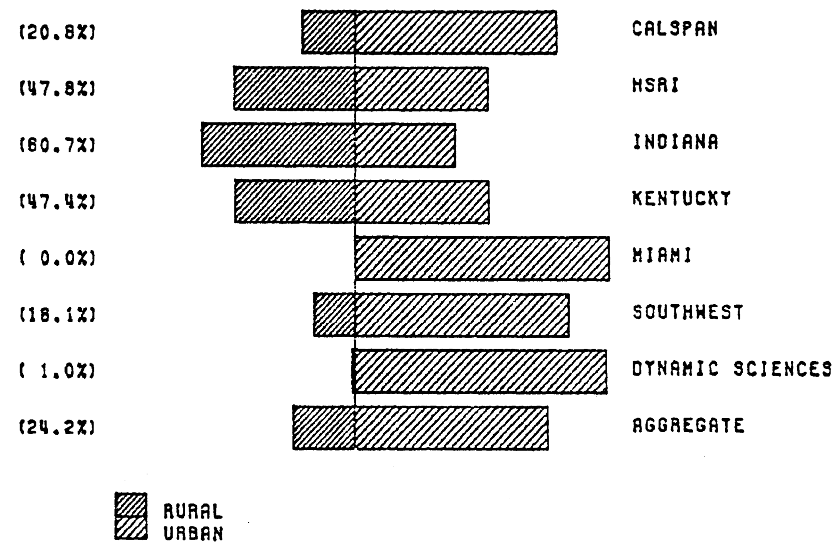
NCSS Crashes by Rural vs.Urban
(Unweighted Data)

Location	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
RURAL	194	306	495	320	0	333	3	1651
URBAN	563	242	227	296	848	1024	422	3622

NCSS Crashes
by Rural-Urban Designation by Team
(Weighted Data)

Designation	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
RURAL	803	1233	1611	1310	0	1026	24	6007
URBAN	3059	1349	1043	1454	4301	5347	2282	18835

RURAL VS. URBAN ACCIDENTS (WEIGHTED)



24 percent of the NCSS crashes occurred in areas classified as rural. A large variation among data collection sites is observed for this variable.

This page intentionally left blank

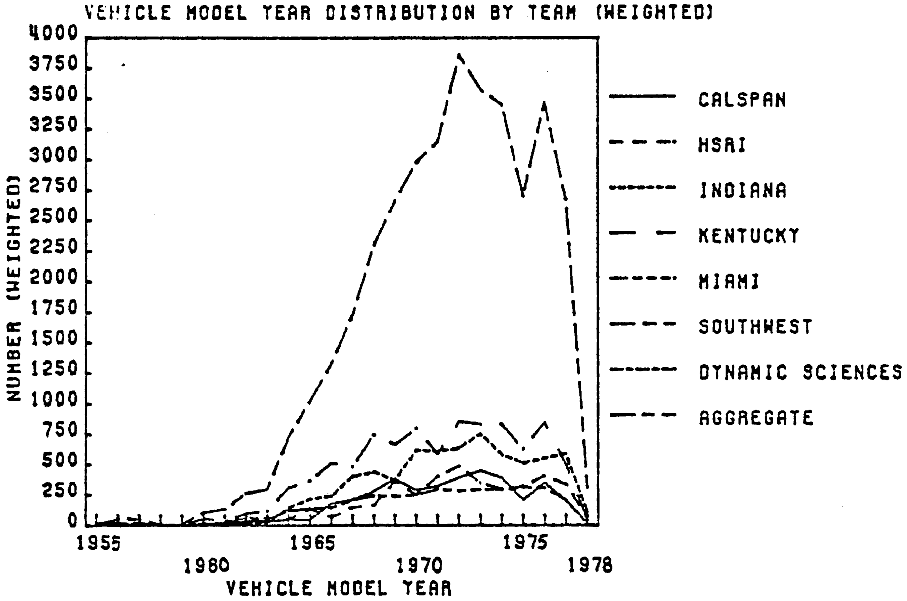
3 VEHICLES

NCSS Vehicles
Model Year by Team
(Weighted Data)

Model Year	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
(61)	4	0	16	28	19	35	36	138
(62)	5	4	39	29	23	103	65	268
(63)	21	6	35	37	27	122	54	302
(64)	20	25	48	55	148	312	122	730
(65)	84	38	46	133	218	368	140	1027
(66)	121	62	180	65	241	512	146	1327
(67)	150	128	211	149	403	483	209	1733
(68)	262	165	282	164	441	745	242	2301
(69)	468	181	379	360	370	667	238	2663
(70)	579	194	287	252	619	797	252	2980
(71)	593	331	324	402	611	591	297	3149
(72)	726	479	391	490	638	853	285	3862
(73)	544	349	450	348	756	831	297	3575
(74)	625	432	388	302	586	832	287	3452
(75)	367	352	205	320	513	629	314	2700
(76)	559	447	351	406	556	846	305	3470
(77)	493	356	199	334	591	497	202	2672
(78)	54	24	18	54	109	42	5	306

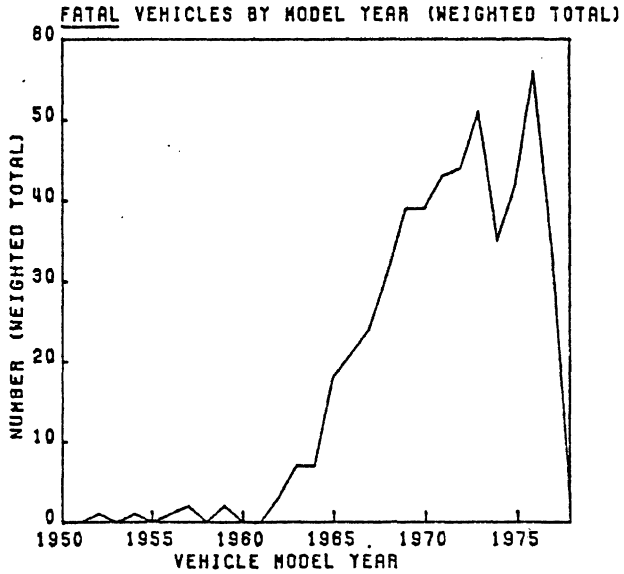
NCSS AGGREGATE/NOT NATIONAL ESTIMATES

VEHICLE MODEL YEAR DISTRIBUTION BY TEAM (WEIGHTED)



NCSS Fatal Vehicles
Model Year by Team
(Weighted Data)

Model Year	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
(62)	0	0	1	0	0	1	1	3
(63)	0	0	3	0	0	3	1	7
(64)	1	0	0	1	1	4	0	7
(65)	1	0	3	3	1	7	3	18
(66)	0	3	2	2	2	10	2	21
(67)	4	2	7	5	0	4	2	24
(68)	6	1	8	3	0	12	1	31
(69)	3	1	11	7	2	14	1	39
(70)	6	2	8	4	1	17	1	39
(71)	6	5	7	4	4	16	1	43
(72)	3	8	14	4	3	12	0	44
(73)	10	4	13	5	3	13	3	51
(74)	3	10	6	3	1	10	2	35
(75)	5	7	9	3	3	14	1	42
(76)	7	7	15	4	3	20	0	56
(77)	7	4	4	3	4	10	2	34
(78)	1	0	0	0	1	1	0	3



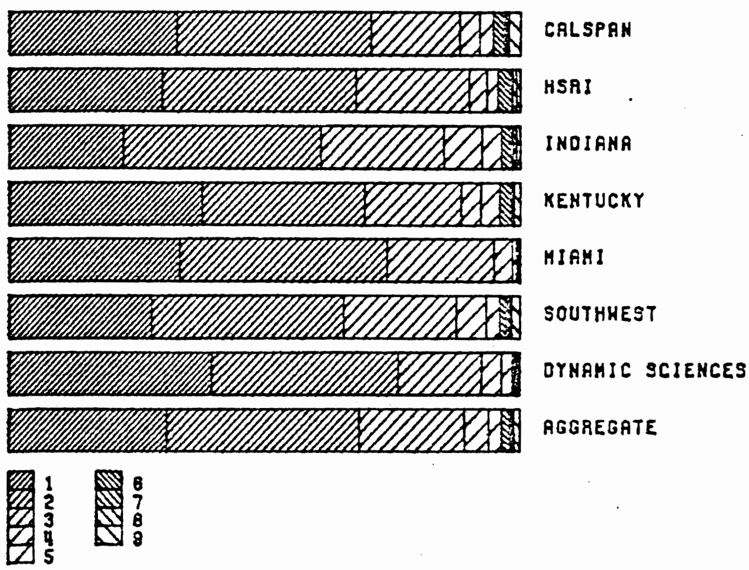
The graphs on these two pages reflect accident frequencies, not the accident rates per model year. Without adjusting for the numbers of various model year vehicles in use in each of the data collection areas, the rate of accidents per model year is unobtainable.

NCSS AGGREGATE/NOT NATIONAL ESTIMATES

NCSS Vehicles
by CDC Extent and by Team
(Weighted Data)

CDC Extent Code	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
(1)	1637	939	823	1192	1522	2266	841	9220
(2)	1902	1195	1425	1005	1849	3056	771	11203
(3)	871	696	885	597	950	1796	344	6139
(4)	192	108	273	121	163	469	81	1407
(5)	133	66	140	114	37	209	45	744
(6)	109	83	71	76	23	101	11	474
(7)	25	9	13	11	7	54	3	122
(8)	17	21	23	1	1	34	5	102
(9)	111	24	26	37	0	129	11	338

CDC EXTENT, ALL VEHICLES BY TEAM (WEIGHTED)

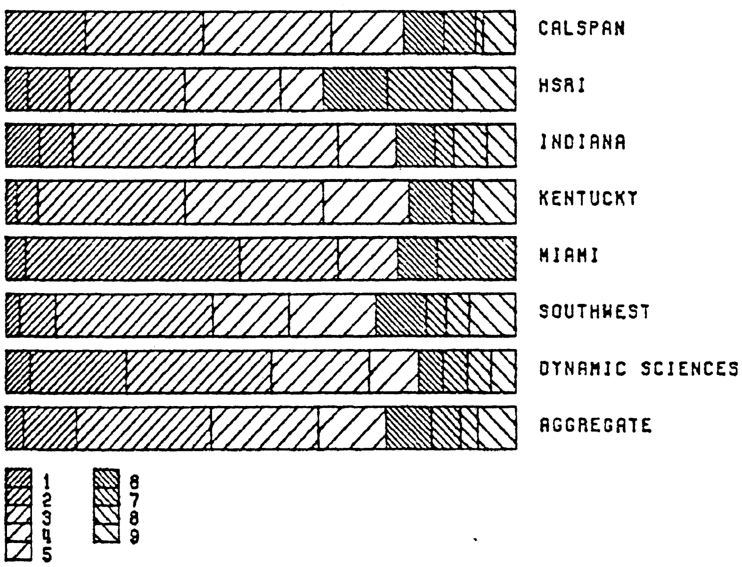


Vehicles with minor damage (CDC -1, -2, or -3) make up about 90 percent of the total weighted population of vehicles. The single-most frequent damage extent is CDC-2.

NCSS Fatal Vehicles
by CDC Extent and by Team
(Weighted Data)

CDC Extent Code	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
(1)	0	2	7	1	1	4	1	16
(2)	10	4	7	2	11	11	4	49
(3)	15	11	26	14	5	48	6	125
(4)	16	9	30	13	3	23	4	98
(5)	9	4	12	8	0	26	2	61
(6)	5	6	8	4	2	15	1	41
(7)	4	6	4	2	4	6	1	27
(8)	1	0	7	0	0	7	1	16
(9)	4	6	6	4	0	14	1	35

CDC EXTENT, FATAL VEHICLES BY TEAM (WEIGHTED)



NCSS AGGREGATE/NOT NATIONAL ESTIMATES

More than 60 percent of the vehicles in fatal accidents were damaged at CDC levels 3, 4, or 5.

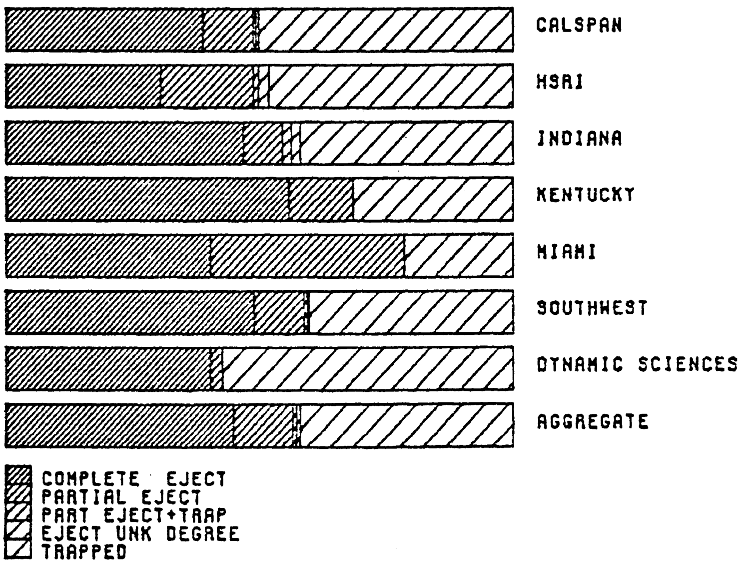
This page intentionally left blank

4 OCCUPANTS

NCSS Total Occupants
Ejection/Entrapment by Team
(Weighted Data)

Condition	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NONE	8812	5228	5747	6446	10401	14469	5276	56379
COMPLETE EJECT	70	30	80	75	17	140	17	429
PARTIAL EJECT	18	18	13	17	16	28	1	111
PART EJECT+TRAP	1	1	3	0	0	2	0	7
EJECT UNK DEG	1	2	3	0	0	1	0	7
TRAPPED	90	47	71	42	9	114	24	397
UNKNOWN	19	109	72	28	43	396	20	687

TRAPPED AND EJECTED OCCUPANTS BY TEAM (WEIGHTED)



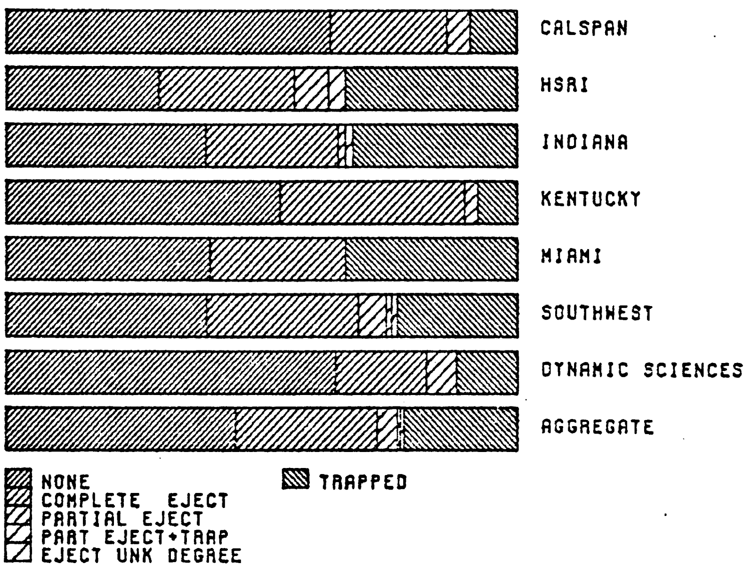
The graph shows the distribution of only the 2.8 percent for occupants in the weighted data who were in some way ejected or trapped.

NCSS AGGREGATE/NOT NATIONAL ESTIMATES

NCSS *Fatal* Occupants
Ejection/Entrapment by Team
(Weighted Data)

Condition	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NONE	28	9	27	21	6	37	11	139
COMPLETE EJECT	10	8	18	14	4	28	3	85
PARTIAL EJECT	2	2	1	1	0	5	1	12
PART EJECT+TRAP	0	1	0	0	0	1	0	2
EJECT UNK DEG	0	0	1	0	0	1	0	2
TRAPPED	4	10	22	3	5	22	2	68
UNKNOWN	3	19	22	4	0	35	2	85

TRAPPED AND EJECTED FATAL OCCUPANTS BY TEAM (WEIGHTED)



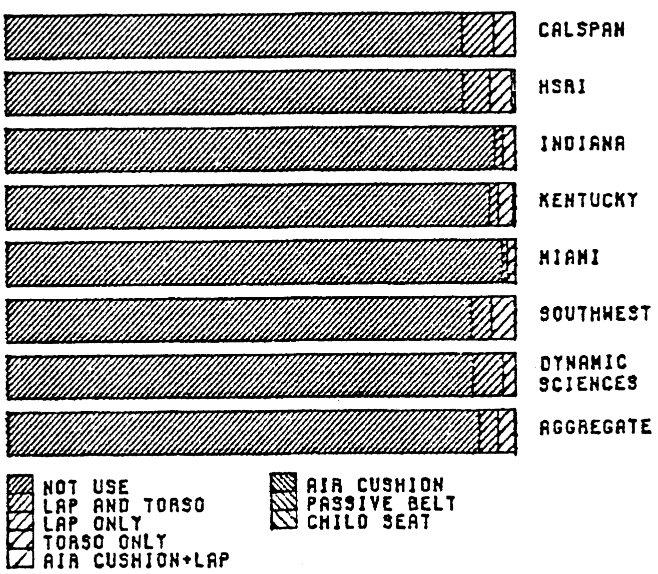
NCSS AGGREGATE/NOT NATIONAL ESTIMATES

Of all occupants killed, about 64 percent were in some way ejected or trapped.

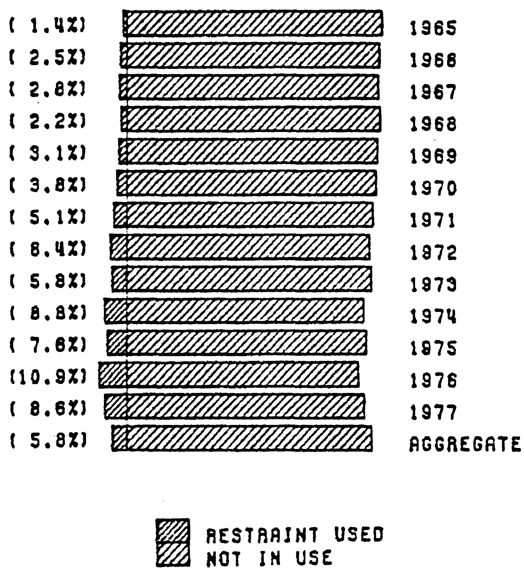
NCSS Occupants
Restraint Usage by Team
(Weighted Data)

Restraint	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NOT USE	8070	4887	5748	6267	10205	13841	4896	53914
LAP AND TORSO	566	295	96	119	112	608	321	2117
LAP ONLY	364	231	146	181	157	688	131	1898
TORSO ONLY	0	0	0	20	0	0	0	20
AIR CUSHION+LAP	0	0	0	0	10	0	0	10
AIR CUSHION	0	0	0	4	0	0	0	4
PASSIVE BELT	0	0	1	0	4	10	0	15
CHILD SEAT	12	39	2	18	0	20	0	91

RESTRAINT USAGE, ALL OCCUPANTS BY TEAM (WEIGHTED)



RESTRAINT USAGE BY ALL OCCUPANTS
1965-1977 (UNWEIGHTED)



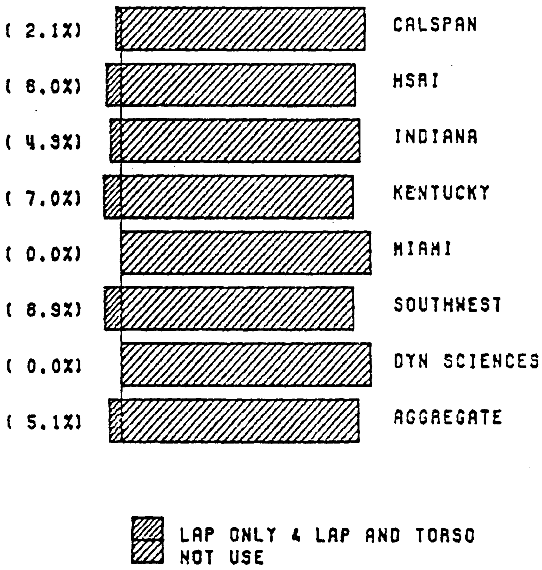
Of the total occupants in the weighted data, 7.2 percent were reported as using restraint systems, active or passive.

The graph at the lower right shows restraint usage by model year.

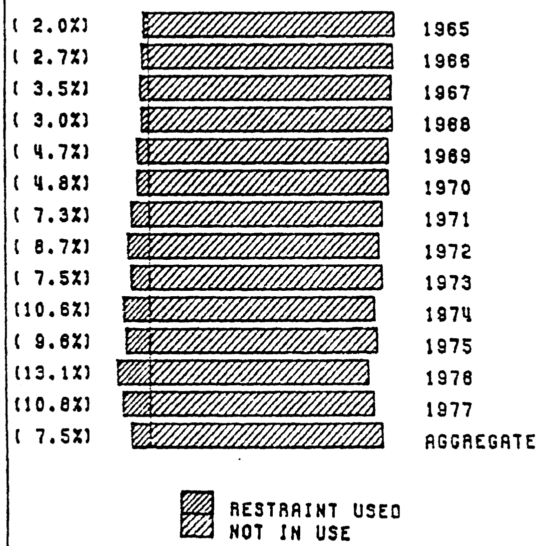
NCSS Fatal Occupants
Restraint Usage by Team
(Weighted Data)

Restraint	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NOT USE	46	47	88	40	15	121	19	376
LAP AND TORSO	0	1	2	2	0	4	0	9
LAP ONLY	1	2	2	1	0	5	0	11

RESTRAINT USAGE
FATAL OCCUPANTS BY TEAM
(WEIGHTED)



RESTRAINT USAGE BY DRIVERS
1965-1977 (UNWEIGHTED)



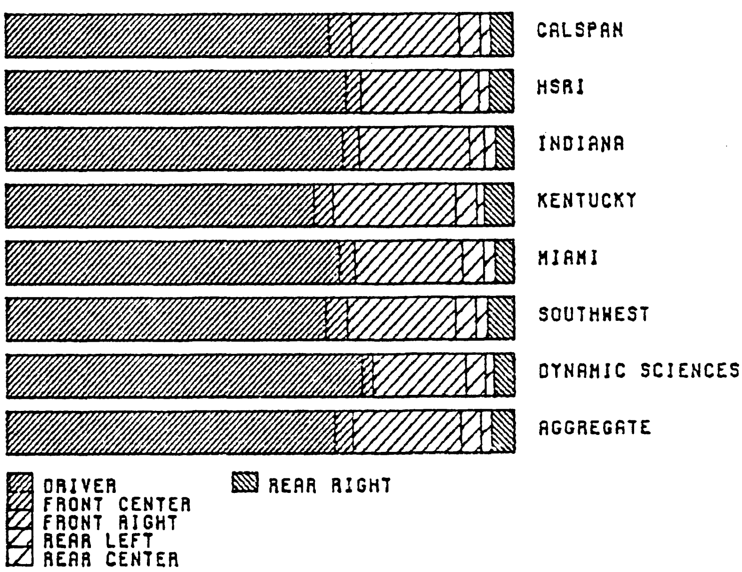
Of the total occupants killed in crashes, about 5 percent were reported as using restraint systems.

A comparison of the graphs presenting restraint use by model year shows that drivers have a consistantly higher rate of use than have all occupants.

NCSS Total Occupants
Seated Position by Team
(Weighted Data)

Seat Position	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
DRIVER . . .	5683	3589	3879	3952	6900	9413	3574	36990
FRONT CENTER	401	161	186	247	327	636	108	2066
FRONT RIGHT	1890	1040	1263	1565	2207	3169	925	12059
REAR LEFT .	367	193	169	270	437	587	191	2214
REAR CENTER	173	106	126	92	229	339	83	1148
REAR RIGHT .	385	247	199	365	376	759	201	2532

SEAT POSITION, ALL OCCUPANTS BY TEAM (WEIGHTED)



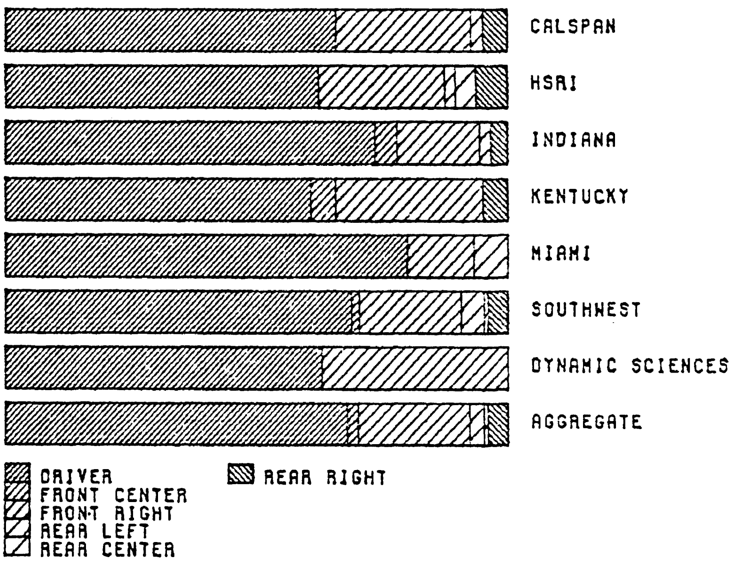
NCSS AGGREGATE/NOT NATIONAL ESTIMATES

Drivers account for about 65 percent of the occupants in the NCSS occupant population. Drivers combined with right front passengers make up 86 percent of the population.

NCSS Fatal Occupants
Seated Position by Team
(Weighted Data)

Seat Position	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
DRIVER . . .	27	30	67	25	12	89	12	262
FRONT CENTER	0	0	4	2	0	2	0	8
FRONT RIGHT	11	12	15	12	2	26	7	85
REAR LEFT .	1	1	2	0	1	6	0	11
REAR CENTER	0	2	0	0	0	1	0	3
REAR RIGHT .	2	3	3	2	0	5	0	15

SEAT POSITION, ALL FATAL OCCUPANTS BY TEAM (WEIGHTED)

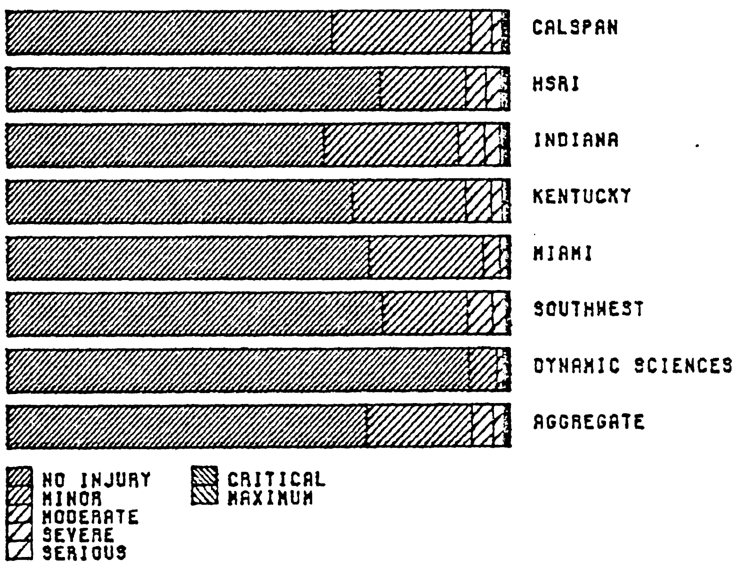


92.5 percent of all fatalities in the data set are incurred by drivers and front seat occupants. Center seat occupants, both front and rear account for less than 3 percent of the fatalities.

NCSS Total Occupants
by Injury Category(AIS) by Team
(Weighted Data)

Injury Category	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NO INJURY	4386	2469	2617	3556	5286	6876	2432	27622
MINOR	1853	565	1094	1149	1654	1536	148	7999
MODERATE	281	133	218	264	240	464	31	1631
SEVERE	136	99	125	113	98	238	14	823
SERIOUS	32	19	31	41	26	48	12	209
CRITICAL	44	26	28	26	20	16	8	168
MAXIMUM	20	11	19	9	4	20	5	88
INJURY SEV UNK	926	936	942	477	986	3137	1759	9163
UNK IF INJURED	1322	1155	790	876	2114	2822	877	9956

KNOWN INJURY DISTRIBUTION OF ALL OCCUPANTS (WEIGHTED)



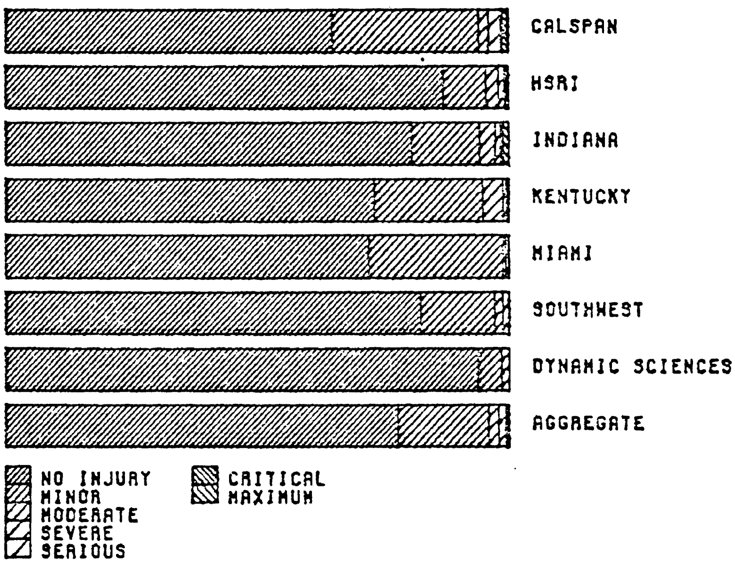
Of the total weighted occupants in the data file with known injury severity, 55% received no injuries, 33% of the occupants had injuries of unknown severity or were classified as unknown if injured.

NCSS AGGREGATE/NOT NATIONAL ESTIMATES

NCSS Restrained Occupants
by Injury Category(AIS) by Team
(Weighted Data)

Injury Category	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NO INJURY	430	314	154	186	119	689	185	2077
MINOR	193	31	26	55	44	123	9	481
MODERATE	13	9	6	10	1	13	3	55
SEVERE	16	4	2	2	1	10	0	35
SERIOUS	2	1	1	0	0	0	0	4
CRITICAL	7	1	0	1	0	0	0	9
MAXIMUM	1	1	2	0	0	1	0	5
INJURY SEV UNK	172	104	29	29	50	215	200	799
UNK IF INJURED	107	100	25	39	68	275	55	669

KNOWN INJURY DISTRIBUTION OF RESTRAINED OCC (WEIGHTED)



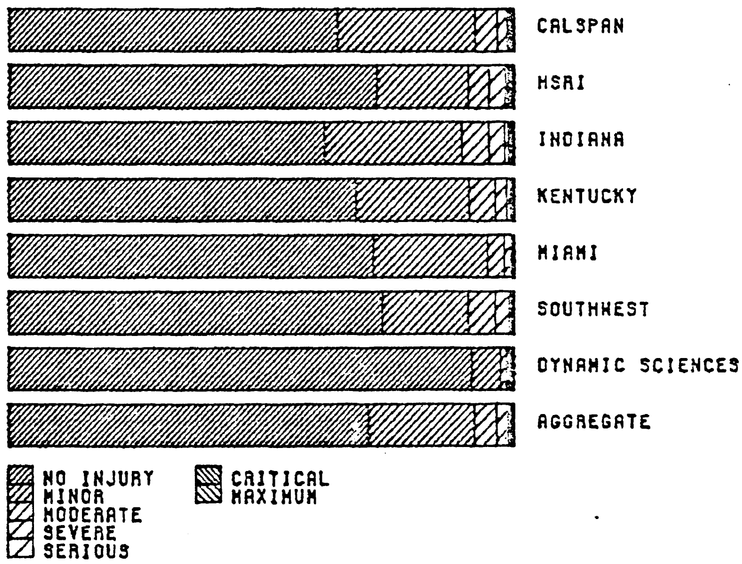
NCSS AGGREGATE/NOT NATIONAL ESTIMATES

Of the total occupants with known injuries who were restrained, between 1 and 2 percent received injuries at a level greater than AIS 2. Over 50 percent of the restrained occupants received no injuries.

NCSS Unrestrained Occupants
by Injury Category(AIS) by Team
(Weighted Data)

Injury Category	Calspan	HSRI	U of Ind	U of Ken	U Miami	SwRI	Dyn.Sci.	Total
NO INJURY	3956	2155	2463	3370	5167	6187	2247	25545
MINOR	1660	534	1068	1094	1610	1413	139	7518
MODERATE	268	124	212	254	239	451	28	1576
SEVERE	120	95	123	111	97	228	14	788
SERIOUS	30	18	30	41	26	48	12	205
CRITICAL	37	25	28	25	20	16	8	159
MAXIMUM	19	10	17	9	4	19	5	83
INJURY SEV UNK	754	832	913	448	936	2922	1559	8364
UNK IF INJURED	1215	1055	765	837	2046	2547	822	9287

KNOWN INJURY DISTRIBUTION OF UNRESTRAINED OCC (WEIGHTED)



Of the total occupants with known injuries who were unrestrained about 3½ percent received injuries at a level greater than AIS 2.

APPENDICES

This page intentionally left blank.

APPENDIX A

HISTORY OF CHANGES IN THE DATA COLLECTION

NCSS SUMMARY FORM AND CODING MANUAL CHANGES:

Summary Forms of September 1976, January 1977, February 1977, and May 1977. Coding Manuals of January 1977, April and September 1977.

INTRODUCTION

The following pages detail the changes made in the NCSS project summary forms and Coding Manuals used between December of 1976 and March of 1978. The first Summary Form, introduced in September of 1976, will often be referred to as the "early" or "old" form. The Summary Forms of January, February, and May of 1977 are lumped together because of their almost exact similarity. (Any differences will be noted.) The introduction dates of new Summary Forms do not necessarily coincide with the times these forms were first used. In most cases, a team would exhaust its supply of old forms before starting to use the newer version. For this reason, periods of overlap will exist in the use of different Summary Forms and different coded variables.

The changes documented are of three basic types; addition or deletion of data, differences in coding of the same data, and differences in interpretation of the same data. The various sections are arranged as follows; the page number of the summary form and a general description of that page, column number as it would appear on the summary form and title of the coded data, the variable number as used in the NCSS analysis data file, details of any changes made between the four summary form versions or two coding manuals, possible problems which might be encountered, and/or a brief description of the variable.

Pages 1-2: GENERAL ACCIDENT DESCRIPTION

Column 1: Update Number; (Not Computerized)...Update Number will most often be 0, indicating that this was the first submission of this case. If an update number is something other than a 0, it indicates either the case has been resubmitted in its entirety or additional information has been submitted such as an updated medical report.

Column 2: Team, Variable #2...One of seven NCSS teams. Coded as follows:

1 Calspan Corporation
2 Highway Safety Research Institute
3 Indiana University
4 University of Kentucky
5 University of Miami
6 Southwest Research Institute
7 Dynamic Science Inc.

Column 3: Year, Variable #3...Year the accident happened.

Columns 4-5: Month, Variable #4...Month the accident happened.

Columns 6-7: Day, Variable #5...Day the accident happened.

Columns 8-10: Sequence Number, Variable #6...An identification number used in conjunction with the team, year, and month as a case identification number. The usual identification is then in the form team-year-month-sequence...assuring a unique case number for each investigation.

Columns 11-13: General; (Not Computerized)...Columns 11-13 will all be coded 000.

Columns 14-16: County, Variable #8...The county where the accident took place. Codes come from the Worldwide Geographical Location Codes, November, 1976 edition.

Columns 17-20: Jurisdiction, Variable #9...The closest town or area to the accident site. Codes from the same source as variable 6. Some problems may exist in assignment of proper jurisdiction codes early in the program. At HSRI two examples were: Dixboro, a village within Washtenaw County, was not an allowable code for that county, while Brighton, not in Washtenaw County, was valid. Other teams had similar problems which have since been worked out, but may not have been corrected in early cases. Any problems should not have persisted past June of 1977.

Columns 21-22: Reported By, Variable #10...The police agency generating the accident report for a particular case. The codes have been supplied by Calspan Corporation in the various coding manuals.

Column 23: Accident Severity, Variable #11...A general description of the most severe injury sustained by an occupant of an applicable vehicle within the case, (usually the injury which qualifies the case). Codes used are 1-4 and are respectively: Fatal, Injury-Overnight Hospitalization, Injury-Transported to a medical facility, and No Transport to a medical facility.

Column 24: Sampling Fraction, Variable #12...The category to which the case has been assigned. Coded: 1- 100%, 2- 25%, and 3- 10%.

Columns 25-36: Reports Submitted, Variables #13-24...Cases prior to April of 1977, Vehicle (column 28, Variable 16), Interview, (column 34, Variable 22), and Medical, (column 34, Variable 23), were sometimes submitted with improper responses. Prior to April of 1977, these columns were to have been coded with the total number of forms of each type that were included in the case. After April of 1977, only those forms pertaining to "applicable" vehicles were to have been coded. (Other vehicle forms and interview forms were to have been included in the case but not counted as such in columns 25-36). It has always been the intent of the project that "Medical" applied only to reports of injuries obtained from a hospital, clinic, or physician. Prior to April of 1977 there were not specific instructions to this end, hence column 34 (Variable 23) being coded with a number greater than 0 may in fact mean that no real "Medical" report was obtained but rather injury descriptions were gotten from an occupant interview. The same situation will exist in a later section, Occupant Injuries, Overall AIS, in that before April of 1977 they to may have been based on interviews instead of a medical report. After April, 1977 these columns as well as column 35 (Variable 21) should be correct, and most if not all earlier cases have been corrected by editing.

Column 37: Number of Vehicles Involved, Variable #25...Total number of vehicles involved in accident exclusive of non-motor vehicles.

Column 38-43: Number of People Involved: Total, Injured, and Fatal, Variables #26-28...The total number of occupants involved in the accident (does not include pedestrians or witnesses) of that total, the number injured as reported by either the police report or occupant interviews, and of the total, the number killed. Fatalities are defined as those who die of injuries sustained in a vehicle accident up to and including 30 days after the accident.

Column 44: Number of Case Vehicles Involved, Variable #29...The total number of case (applicable) vehicles in the accident. An applicable vehicle is defined as a passenger car which was towed from the scene because of impact damage sustained in the accident and which was occupied at the time of the accident. Passenger car also includes station wagons. Pick-up trucks and vans were added as possible case vehicles (as long as they meet the towed for damage and occupied criteria, beginning on April 1, 1978). None of these cases (vans and pickup trucks) are in the data used for the present report.

Columns 45-50: Number of People Involved (Case Cars): Total, Injured, and Fatal, Variables #30-32...Prior to April, 1977 some trouble may be found in these variables. At that time it is possible the teams were coding these columns for occupants of "possible" applicable vehicles as well as actual case vehicles. That is, if a vehicle was a passenger car (even though it might not have been towed) because it was a vehicle that in different circumstances could have been a case vehicle it was coded as such. After April, 1977, this should not occur as it was more clearly defined in the coding manual that what was being sought was information only for occupants of actual applicable vehicles.

Columns 51-52: Time of Day, Variable #33...Prior to January, 1977, there was some confusion as to exactly what "Time of Day" meant. The summary form gave the instructions to put down the nearest hour while the coding manual said to use the hour as given on the police report even if that hour has 59 minutes with it. The latter method is now followed.

Column 53: Road Condition, Variable #34...No changes in coding between versions of summary form. At times, the road conditions given on the police report differ from those reported by occupants in an interview. In this case, the investigators' opinion would be coded. Many times the police report the road conditions as they are when the police arrive at the scene, which may be different from the conditions at the time of the accident.

Column 54: Intersection, Variable #35...Intersections apply only to roads or highways and do not include paths, private drives, driveways or parking lots.

Column 55: Rural-Urban, Variable #36...No clear cut definition exists in the NCSS project to precisely differentiate between an urban or a rural area. Generally an urban area is coded if the accident location is in or near a populated area, perhaps with buildings in sight. Rural would be coded for farm land, a lightly populated area outside city limits, or an area outside of city limits with no buildings or homes.

Columns 56-57: Type of Impact, Variable #37...Clear definitions for type of impact have existed since the beginning of the project and no changes have been made to these columns.

Columns 58-63: Vehicle Maneuver: Driver Controlled, Variables #38-40 ...Two problems exist in these columns. The first is the intent of the question as presented in the summary form and the second is the manner in which the possible choices are worded and assigned codes when going from the interview form to the summary form. The intent of the variables was evidently to have been to code drivers' attempted avoidance maneuvers. This interpretation was not put into writing until the coding manual revision of September 1977. Hence, many of the responses recorded in these columns prior to September, 1977, will probably reflect the vehicle position prior to the accident sequence rather than the drivers' avoidance maneuver. Secondly, and here the first problem is complicated further; the choices given for "vehicle maneuver" in the summary form are exact duplicates of what appears in the interview form as "vehicle activity prior to accident sequence", even though in the interview form a separate section with different codes and definitions is provided to describe attempted avoidance maneuvers. This section in the interview form is far more descriptive of what occurs in the field than those available codes in the summary form. The interview forms have had both sets of codes since February 1977. Some examples of the problems involved with these codes are as follows; a driver has braked and while braking turned toward the right would have to be coded as either "straight, sowing" or "right turn", a driver swerved to the left and then swerved to the right would have to be coded either "left turn", "right turn", "changing lanes", "passing", "sliding leading with right", "sliding leading with left", or "unknown". The choices in most cases do not properly express what in fact the avoidance maneuver was. Attempts to analyze this variable will probably be met with a certain amount of frustration.

Columns 64-66: Approach Description, Functional Classification of Roadway, Variables #41-43...The codes for these variables remain the same throughout the project though some problems might exist because of the vagueness and over-lapping of the roadway type definitions.

Columns 67-72: Roadway Alignment, Variables #44-46...Codes are the same for both summary form versions and should present no problems.

Columns 73-75: Surface Type, Variables #47-49...Coding the same, no problems.

Columns 76-78: Speed Limit, Variables #50-52...No changes, no problems.

Column 79: Crash Reconstruction, Variable #53...No changes or problems.

Pages 3-4: VEHICLE DESCRIPTION

Card #: 100, 200, 300, etc.

Columns 1-10: Accident Identification, Variables #61-65 (team #, year, month, day, sequence#)...Columns 1-10 are repeated from the first ten columns of the first page of the summary form. The vehicle number in the accident (columns 11-13) serves as the card number and as such identifies this card as separate from other cards.

Columns 11-13: Vehicle Number, Variable #66...See above. Vehicle number must be in the form of digit-zero-zero. Vehicle numbers are assigned by the investigating team in accordance with guidelines set out in the coding manual and do not always agree with the vehicle numbering system used on the police report. The general guideline is: vehicle one is the striking vehicle or in the case of a head-on collision, the vehicle on the wrong side of the road or at fault. Other vehicles are assigned numbers as they enter the accident sequence in regards to vehicle number one.

Columns 14-15: VIN, Number of Characters, Variable #67...Length in characters of the Vehicle Identification Number. Excludes the "script F" in Ford Motor Company VINs. In most cases Ford Motor Company vehicles will have 11 VIN characters, General Motors vehicles 13, and Chrysler Corporation vehicles 13.

Columns 16-22: VIN; (Not Computerized)...The first seven numbers of the VIN. Limited to seven so as to not specifically identify an individual vehicle.

Columns 23-27: Make/Model Code, Variable #69...The Make/Model Code for the vehicle being described using the Make/Model Codes supplied in the Calspan coding manual.

Columns 28-32: Odometer, Variable #61...Odometer reading of vehicle unless investigator has reason to believe the vehicle has over 100,000 miles on it, in which case the code is 99,998. The code for unknown is 99,999.

Columns 33-34: Model Year, Variable #71...The year of the vehicle is actually the model year of vehicle; the year sold and the year produced may not be the same.

Columns 35-36: Body Style, Variable #63...No changes, no problems, though some of the choices listed under "Trucks" are a little vague and over lapping.

Column 37-39: Vehicle Weight, Variables #73-74...Weight is divided into two sections, vehicle weight and weight of occupants and cargo. Both are coded using three columns. Weights are to the nearest 100 pounds. Ex., 3860-039.

Column 43: Towing Another Vehicle, Variable #75...Does not apply to tractor/trailer rigs which are assumed not to be towing and are considered one vehicle.

Columns 44-45: Vehicle Damage, Variables #76, 77, 82 (Object contacted, CDC Direction, CDC Extent)...These columns are divided into three groupings; Object Contacted, CDC and Vehicle Impact by/Impact

Number. In this section two impacts can be described (though more than two impacts may have occurred, only the two most severe are coded in the summary). Columns 44 and 45 and 55 and 56 (Variable 76) describe what this vehicle hit. Columns 46-52 ad 57-63 are the Collision Deformation Classification, or CDC. The NCSS analysis data file makes use of two components of the CDC, force direction (Variable 77) and CDC extent (Variable 82). Columns 53 and 54 and 64 and 65 describe what vehicle was struck and what impact number in the whole sequence that strike was. Objects other than vehicles are coded as "vehicle" 0.

Column 66: Vehicle Towed from Scene, Variable #94...Coded from police report unless other information is available to the contrary.

Column 67: Source of Vehicle Data, Variable #95...Where was vehicle inspected? Or, was it inspected?

Column 68: Vehicle Inspection by Investigator, Variable #96...Number of visits needed to find and inspect vehicle. 8= 8 or more visits, 0= not inspected.

Column 69: On early cases=Seat Type, on later cases=Applicable or non-applicable Vehicle. (Early cases are pre-April 1977). Variable #97 on later cases and #98 on earlier cases (if those early cases have not been corrected). In the earlier version of the summary form, column 69 is used to code seat type while in the later version the column denotes applicable or non-applicable vehicle. In the newer summary, column 70 denotes seat type. The remaining variables on either form (though not in the same order because of the insertion of 69 as applicable or non-applicable vehicle in the January, 1977 form) are the same. In the older form there are 77 columns per applicable vehicle card while in the newer form there are 78. In the analysis file Variable #97 is the Case Vehicle Indicator, and Variable #98 is the Seat Type. Both of these are quite consistent in the analysis file.

The summary form that was made available in January of 1977 was not immediately put into use by the NCSS teams, consequently, there will be a period of overlap in the use of the older and the newer versions of the summary. The older form should have disappeared from use about April of 1977.

Column 70: Old form: Head Restraint Type, New form: Front Seat Type, Variable #99 (Old Form), #98 (New Form)

Columns 71-72: Old form: Measurement, Top of Seat Cushion to Top of Head Restraint, Left Front, Variable #100 (Old Form)

Column 71: New form: Head Restraint Type, Variable #99 (New Form)

Columns 73-74: Old form: Measurement, Top of Seat Cushion to Top of Head Restraint, RF, Variable #101 (Old Form)

Columns 72-73: New form: Measurement, Top of Seat Cushion to Top of Head Restraint, LF, Variable #100 (New Form)

Column 75: Old form: Side Structure Performance, Door Opening, Variable #102 (Old Form)

Columns 74-75: New form: Measurement, Top of Seat Cushion to Top of Head Restraint, RF, Variable #101 (New Form)

Column 76: Old form: Latch or Hinge Damage, Variable #103

Column 76: New form: Side Structure Performance, Door Opening, Variable #102

Column 77: Old form: Intrusion, Variable #104

Column 77: New form: Latch or Hinge Damage, Variable #103

Column 78: New form: Intrusion, Variable #104

Page 5: OCCUPANT DESCRIPTION

Card #: 101, 102, 201, etc. (digit-zero-digit). Columns 1-10: Accident Identification, same as General and Vehicle pages. Variables #187-191 (team #, year, month, day, sequence #).

Columns 11-13: Occupant Number, Variable #193...The occupant number is a three digit code where the first digit indicates the vehicle number, which is consistent with the vehicle numbering in the rest of the case. The second number is always zero. The third number does not indicate the actual position in the vehicle of the occupant but rather the order in which that occupant is placed. An occupant whose number was 101 would most likely be a driver but could also be the first occupant listed on the police report in a vehicle with no driver. (This would be possible in the case of a parked car that was occupied with no one in the drivers' position.) The seating position of an occupant may be determined by columns 14 and 15, Variable #194.

Columns 14-15: Position in Vehicle, Variable #194...A two column code where the first column indicates which seat the occupant is in and the second column indicates the exact location, (i.e., left, center, right, or on the floor, left, center, right, entire). No changes have been made in these two columns or in the Occupant Number column though one problem might exist. Early in the project, probably before February of 1977, some teams may have thought the seating position question meant the position of the occupants after impact, hence some occupants, though normally seated before the accident, may be coded as being on the floor if that is where they were positioned after the vehicle came to rest. If an occupant is on the lap of another person, the lap seated occupant will have a different occupant number but should be coded as being the same seating position as the person on whom he or she is sitting. In the same manner two occupants sitting in the center area of a seat will have differing occupant numbers but again, will be coded as being in the same seat.

Columns 16-17: Age, Variable #195...Usually coded from the police report unless there is good reason to code otherwise.

Columns 18-19: Height, Variable #196...Usually coded from the interview form though may be from the medical report.

Columns 20-22: Weight, Variable #197...Coded in same way as Height.

Column 23: Sex, Variable #198...Code 4; Female, Unknown if Pregnant, will probably not appear as often as it should. With no interview or other occupant interview information, a female between the ages of 13 and 54 should be coded as Unknown if Pregnant.

Columns 24-26: Restraint Use, Variables #199-201 (Police, Interview and Investigator). On many of the cases, variable #199, Restraint Use, Police, will be coded Unknown. Not all of the police reports have provisions for reporting restraint use. In Michigan this was the case until January of 1978. The column for Restraint Use, Interview is to be coded with the information provided by the occupant even if that information is obviously incorrect, for example, if a driver says he was using lap and shoulder belts and the vehicle was not so equipped. The column for Restraint Use, Investigator is coded to the best of the investigators' knowledge on the basis of police report, interview, vehicle information and injury information.

Column 27: Injury Severity (Police Rating), Variable #202...The injury severity of an occupant as initially put down on the police report. May differ dramatically from actual injury report from either the occupant or the medical report.

Column 28: Ejection-Entrapment, Variable #203...Complete Ejection: Occupant's body is entirely outside car but may be in contact with car. Partial ejection: Part of occupant's body remains within the car. Partial ejection and trapped: As in previous definition, but part of body is trapped by car; ex. part of body outside car but collapse of structure pins occupant; occupant partially ejected but overturned car rests on part of body.

Columns 29-30: Ejection Area, Variable #204...No changes, self explanatory.

Column 31: NCSS Classification, Variable #205...Classification of occupant's degree of medical treatment. Should be self explanatory.

Column 32: Outpatient Visits, Variable #206...Number of outpatient visits by occupant not including initial visit to treatment facility.

Columns 33-34: Activity Restriction (Bed Rest), Variable #207...Bed Rest is the number of days the occupant was confined to bed or the number of days suggested by a medical person that he be confined to bed after either being released from the hospital or returning from a treatment facility. The codes for Bed Rest, as well as the rest of the activity restriction section, will be given as a table at the end of this section.

Columns 35-36: Other Restrictions, Variable #208...Period when use of cane, crutches, etc., was required. (From initiation to termination of use.)

Columns 37-38: Work Days Lost, Variable #209...Work Days Lost should apply only to full time college students or full time workers for cases on or after September of 1977. Prior to September we had no specific instructions for coding this variable thus many non full time college students and non full time workers were coded as having lost time at work.

Columns 39-40: Days in Hospital, Variable #210...The number of days an occupant has stayed in the hospital. Does not include those treated and released. Occupant must have stayed overnight or twenty-four hours. Parts of a day count as a whole day.

Columns 33-40: Activity Restriction Coding, Variables #207-210

Column 41: Neck Injury, Variable #211...Neck injuries are only coded if the vehicle in which the occupant or occupants were seated was struck from the rear. A rear end strike is defined as a clock direction in the CDC of 4 to 8. Thus an occupant may have an actual neck injury but it is not coded as such unless the direction of force is 4 to 8.

Column 42: Interview Completion, Variable #212...Self explanatory except code 7, Other, which most often is interview information obtained from a parent or adult concerning a child. If Interview Completion is coded YES, no connection should be made between the number of interviews completed and Variable #22, Interview Forms completed, as the latter is only counted for occupants of applicable vehicles. Though these two numbers may often be the same, there is no exact correlation between them.

Column 43-47: 1st OIC and AIS, Variable #217...No problems.

Columns 54-68: 2nd OIC and AIS, Variable #224...No problems.

Columns 65-75: 3rd OIC and AIS, Variable #231

Columns 48-49, 59-60, and 70-71: Injury Source, Variables #218, 225, and 232. Injury Source (Occupant Contact in earlier forms) codes changed in February of 1977. These changes appeared in the Vehicle Form of that date. As in some other cases, these forms did not immediately get superceded by their replacements, but continued in use until about

Time	Code	Actual Time in Days
Days .	00	None
. .	01	1 day
. .	02	2 days
. .	to	....
. .		....
. .		....
. .	20	20 days
Weeks	23	3 weeks
. .	24	4 weeks
. .	to	....
. .		....
. .		....
. .	40	20 weeks
Months	45	5 months
. .	46	6 months
. .	to	....
. .		....
. .		....
. .	80	40 months
Years	84	4 Years
. .	85	5 years
. .	to	....
. .		....
. .		....
. .	90	10 or more years
. .	96	Permanent
. .	97	Fatality
. .	98	Not Applicable
. .	99	Unknown

May or June of 1977. Thus there will be a period of overlap in the use of the two versions of Injury Source codes. The two sets of codes were basically the same in the selections given but dramatically different in the coding. A table showing the differences is included on a separate page.

Columns 50-53, 61-64, and 72-75: ICDA Rating, Variables #219, 226, and 233. The ICDA coding book is available in a number of editions. The NCSS teams prior to April of 1977 were not instructed as to which edition to use. Cases from January of 1977 through April of 1977 may have been coded using two differing versions of the ICDA. As of April of 1977, the Hospital Adaptation of the ICDA, 2nd edition, was supplied to the NCSS teams for the purpose of uniform injury coding. The differences in the ICDA coding prior to April 1977 are included on a separate list that follows. This list gives differences by code number and not injury description. Similarities or instances where there is no change in coding are also included. There are many codes used in the early ICDA manual that are not used at all in the later, hence identification should not be difficult. If need be, the ICDAs may be checked against the OICs for verification.

Column 76: Overall AIS, Variable #234...In most cases the same as the highest individual AIS, though it may be higher than any one AIS.

Columns 77-78: ISS, Variable #235...Sum of the squares of the highest AIS code in each of the three most severely injured body areas. (ISS body areas differ from AIS body areas.)

This ISS was not introduced until May of 1977. Cases before this date will not have an ISS unless supplied or calculated by Calspan or NHTSA. Cases after May of 1977 may not have an ISS due to the use of an earlier version of the summary form. Cases of May, June, and July 1977 may have "inflated" ISSs due to miscalculations based on improper calculation instructions.

Page 6: COLLISION SEVERITY

Card #: 010, 020, etc. (zero-digit-zero). Columns 1-10: Accident Identification, same as previous cards Variables #2-6.

Columns 11-13: Card Number; (Not Computerized)... In addition to identifying the keypunched car as that of the Collision Severity page, this card number is used to denote the order of severity of the individual crash runs within a case. A one in column 12 indicates that this crash run has the highest Delta V within the crash runs done, a two indicates the second highest Delta V, etc.

Column 14: Vehicle Number, Variable #118...The vehicle number within the case (and consistent with the numbering system used throughout the case) of the vehicle whose Delta Vs follow in columns 20-27, 29-36, and 17-18. In most cases, vehicle number one.

Column 15: Impact with Vehicle Number, Variable #119...The vehicle struck by or striking the vehicle in column 14, Variable #118.

Column 16: Impact Number, Variable #120...The impact number within the case that is being quantified by the Delta Vs that follow. Will be consistent with the impact numbering used in the rest of the case.

Columns 17-18: Impact Speed, Variable #121...The impact speed of the vehicle described in Variable #119. Will only appear if damage and trajectory run was made which may be ascertained by check for codes of 1 or 2 in columns 19 and 50 (Variables 122 and 140).

Column 19: Data Source, Variable #122...The type of damage and trajectory run, either with detailed damage or CDC only.

Columns 20-21: Delta V MPH, Total, Variable #123

Columns 22-24: Delta V MPH, Longitudinal, Variable #124. (NOTE: Codes are not usable in the ADAAS file at the present time.)

Columns 25-27: Delta V MPH, Lateral, Variable #126. (NOTE: Codes are not usable in the ADAAS file at the present time.)

Column 28: Data Source, Damage Only, Variable #128...Type of damage only run made. May be CDC only, Detailed Damage only, or insufficient data.

Columns 29-30: Delta V MPH, Total, Variable #129...Total Delta V MPH based on Damage portion of crash run rather than Damage and Trajectory as in variable 123, columns 20 and 21.

Columns 31-32: Delta V MPH, Longitudinal, Variable #130...Longitudinal Delta V MPH based on Damage portion of crash run rather than Damage and Trajectory as in variable 124, columns 22-24. First column (31) is positive or negative sign. (NOTE: Codes are not usable in the ADAAS file at the present time.)

Columns 34-36: Delta V MPH, Lateral, Variable #132...Lateral Delta V

MPH based on Damage portion of crash run rather than Damage and Trajectory as in variable 126, columns 25-27. Also includes positive or negative sign. (NOTE: Codes are not usable in the ADAAS file at the present time.)

Columns 37-41: Relative Velocity, Longitudinal and Lateral, Variables 134-135 to have been left blank as per instructions in the coding manual.

Columns 45-75: Same as Columns 14-44 but using the second vehicle in the impact as a focal point.

INJURY SOURCE/OCCUPANT CONTACT CODES

Codes as used 2/77 and later (up to the end of March, 1978)

EXTERIOR OBJECT INTRUSION	
None	0
Hood	1
Rail (guard or fence-rail)	2
Pole (telephone, sign)	3
Tree Limb	4
Other Vehicle	5
Other (specify ______)	8
Unknown	9

INTERIOR OBJECTS CONTACTED (Circle all items contacted)

FRONT PASSENGER COMPARTMENT	
None	00
Instrument Panel	01
Steering Assembly	02
Windshield	03
Glove Compartment Area	04
Hardware Items (ashtray, instruments, knobs, keys)	05
Heater or A/C Ducts	06
A/C or Ventilating Ducts	07
Mirrors	08
Parking Brake	09
Radio	10
Sunvisors, Fittings and/or Top Molding (header)	11
Transmission Selector Lever (column mounted)	12
Add-on equipment (CB, tape deck, air conditioner)	13
Parcel Tray	14

SIDES	
Side Interior Surface	15
Hardware	16
Armrests	17
A-Pillar	18
B-Pillar	19
C-Pillar	20
D-Pillar	21
Courtesy Lights	22
Window Glass	23
Window Frame	24
INTERIOR	
Front Seatback	25
Restraint System Hardware	26
Restraint System Webbing	27
Head Restraints	28
Air Cushion	29
Other Occupants	30
Interior Objects Loose (specify ______)	31
ROOF	
Roof Side Rails	32
Sunvisors, Fittings and/or Top Molding (header)	33
Roof or Convertible Top	34
Coat Hooks	35
FLOOR	
Transmission Selector Lever	36
Parking Brake Handle	37
Floor	38
Foot Controls	39
Console	40
REAR	
Backlight (rear window)	41
Backlight Header	42
EXTERIOR TO PASSENGER COMPARTMENT	
Hood	43
Objects Exterior to Car	44
Outside Surface of Car	45
Other (may indicate more than one item; specify ______)	46
Unknown Exterior Object	49
NON-CONTACT INJURY SOURCE (Impact Force)	90
UNKNOWN AREA OF CONTACT	99

Codes used prior to 2/77.

EXTERIOR OBJECT INTRUSION	
Hood	01
Pole (fence-top rail)	02
Pole (telephone, sign)	03
Tree Limb	04
Other	05
Unknown	99

INTERIOR OBJECTS CONTACTED (Circle all items contacted)

FRONT OF PASSENGER COMPARTMENT	
Instrument Panel	06
Steering Assembly	07
Windshield	08
Glove Compartment Area	09
Hardware Items (ashtray, instruments, knobs)	10
Heater or A/C Ducts	11
A/C or Ventilating Ducts	12
Mirrors	13
Parking Brake	14
Radio	15
Sunvisors, Fittings and/or Top Molding (header)	16
Transmission Selector Lever	17

SIDES	
Surface or Side Interiors	18
Hardware	19
Armrests	20
A-Pillar	21
B-Pillar	22
C-Pillar	23
D-Pillar	24
Courtesy Lights	25

<u>INTERIOR</u>	
Back of Seats	26
Restraint System Hardware	27
Restraint System Webbing	28
Head Restraints	29
Other Occupants	30
Interior Object Loose	31
<u>ROOF</u>	
Roof Side Rails	32
Sunvisors, Fittings and/or Top Molding (header)	33
Roof or Convertible Top	34
Coat Hooks	35
<u>FLOOR</u>	
Transmission Selector Lever	36
Floor	37
Foot Controls	38
Console	39
<u>REAR</u>	
Backlight (rear window)	40
Backlight Header	41
<u>EXTERIOR TO PASSENGER COMPARTMENT</u>	
Hood	42
Objects Exterior to Car	43
Objects Surface of Car	44
Other (may indicate more than one item)	45
Unknown	99

ICDA & H-ICDA: LISTING OF CODING DIFFERENCES

The following is a list of coding differences between the ICDA manual used by teams prior to April of 1977 and the H-ICDA manual use after April of 1977. The old codes appear in the left hand column and the newer codes appear in the right hand column. Where the same numeric codes are used (but with slightly or completely different meanings) both will be listed. If a numeric code is used in one version of the manual but not in the other the code will be given for the one used and "none" will be given in the other column. If the exact same definition appears in the manuals under two different numeric codes, the two equivalent codes will be given. If a code is used in one version and not in the other, and there is no equivalent meaning in the second, the second column will be left blank (or vice versa). If a code does not appear, there is no difference in old or new.

804.0	none
804.1	none

804.9		none	
805.2		805.2	
805.3		805.3	
805.4	(805.4 same as 805.6)	805.4	
805.5	(805.5 same as 805.7)	805.5	
805.6		805.6	
805.7		805.7	
none		805.8	
806.2		806.2	
806.3		806.3	
806.4	(806.4 same as 806.6)	806.4	
806.5	(806.5 same as 806.7)	806.5	
806.6		806.6	
806.7		806.7	
none		806.8	
808.0		808.0	
808.1		808.1	
none		808.2	
none		808.3	
none		808.4	
none		808.5	
none		808.6	
none		808.7	
809.0		none	
809.1		none	
809.9		none	
818.0		none	
818.1		none	
818.9		none	
819.0		none	
819.1		none	
819.9		none	
820.0	(very similar, different wording)	820.0	
820.1	(very similar, different wording)	820.1	
824.0		824.0	
824.1		824.1	
none		824.2	
none		824.3	
none		824.4	
none		824.5	
none		824.6	
none		824.7	
none		824.8	
827.0		none	
827.1		none	
827.9		none	
828.0		none	
828.1		none	
828.9		none	
830.0	(similar though not exactly same)	830.0	(Note the follow-
830.1	(" " " " ")	830.0	ing difference
830.9	(" " " " ")	830.9	in the 830 sec-
831.0	(" " " " ")	831.0	tion:
831.1	(" " " " ")	831.1	Dislocations...

831.9	(" " " " ")	831.9	the early manual
832.0	(" " " " ")	832.0	breaks them down
832.1	(" " " " ")	832.1	into simple and
832.9	(" " " " ")	832.9	compound,while
833.0	(" " " " ")	833.0	the later manual
833.1	(" " " " ")	833.1	calls them closed
833.9	(" " " " ")	833.9	or open. The
834.0	(" " " " ")	834.0	three digit
834.1	(" " " " ")	834.1	codes, 830, 831,
834.9	(" " " " ")	834.9	etc., are the
835.0	(" " " " ")	835.0	same in either.)
835.1	(" " " " ")	835.1	
835.9	(" " " " ")	835.9	
836.0	(" " " " ")	836.0	
836.1	(" " " " ")	836.1	
836.9	(" " " " ")	836.9	
837.0	(" " " " ")	837.0	
837.1	(" " " " ")	837.1	
837.9	(" " " " ")	837.9	
838.0	(" " " " ")	838.0	
838.1	(" " " " ")	838.1	
838.9	(" " " " ")	838.9	
839.0	(" " " " ")	839.0	
839.1	(" " " " ")	839.1	
none	(differences greater than above)	839.2	
none		839.3	
839.5		839.5	
839.6		839.6	
839.7		839.7	
839.8		none	
839.9		839.9	
840.0		840.0	
none		840.1	
none		840.2	
none		840.3	
none		840.4	
none		840.9	
841.0		841.0	
none		841.1	
none		841.2	
none		841.3	
none		841.4	
none		841.9	
842.0		842.0	
842.1		842.1	
none		842.2	
none		842.3	
none		842.4	
none		842.9	
843.0		843.0	
none		843.1	
none		843.2	
none		843.3	
none		843.4	

none	843.9
none	844.1
none	844.2
none	844.3
none	844.4
none	844.9
845.0	845.0
845.1	845.1
none	845.2
none	845.3
none	845.4
none	845.9
none	847.1
none	847.2
none	847.3
none	847.4
847.8	none
848.0	848.0
none	848.1
none	848.2
none	848.9
869.0 (similar)	869.0
869.1 (similar)	869.1
869.9 (similar)	869.9
900.0	900.0
900.1	900.1
900.2	900.2
none	900.3
900.9	900.9
901.0	901.0
901.1	901.1
901.2	901.2
none	901.3
none	901.4
none	901.5
none	901.6
901.9	901.9
902.0	902.0
902.1	902.1
902.2	902.2
none	902.3
none	902.4
none	902.5
none	902.6
none	902.7
902.9	902.9
903.0	903.0
903.1	903.1
903.2	903.2
none	903.3
none	903.4
none	903.5
none	903.6
none	903.7

903.9	903.9
904.0	904.0
904.1	904.1
904.2	904.2
none	904.3
none	904.4
none	904.5
none	904.6
none	904.7
none	904.8
904.9	904.9
905.0	none
905.1	none
905.2	none
905.9	none
906.0	none
906.1	none
906.2	none
906.9	none
907.0	none
907.1	none
907.9	none
923.0	923.0
923.9	923.9
924.0	924.0
924.9	924.9
925.0	925.0
925.9	925.9
926.0	926.0
926.9	926.9
927.0	927.0
927.9	927.9
928.0	928.0
928.9	928.9
929.0	929.0
929.9	929.9
929.9	929.9

APPENDIX B

The Field Data Forms

While there were several changes in detail of the field forms used during the first 15 months of the program, the data elements recorded and subsequently computerized remained relatively constant. This appendix provides a copy of the forms used during most of the period, and is divided into GENERAL ACCIDENT DATA (form pages 1 and 2), VEHICLE DATA (form pages 3 and 4), OCCUPANT DATA (page 5), and CRASH SEVERITY DATA (form pages 6 through 8).

Column numbers in these forms are those indicated in the variable-by-variable discussions of Appendix A.

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

CASE SUMMARY REPORT

NATIONAL CRASH SEVERITY STUDY: GENERAL ACCIDENT DATA

ACCIDENT IDENTIFICATION

1	_	UPDATE NUMBER
2	_	TEAM
3	_	YEAR
4-5	_ _	MONTH
6-7	_ _	DAY
8-10	_ _ _	SEQUENCE
11-13	0 0 0	GENERAL
14-16	_ _ _	COUNTY
17-20	_ _ _ _	JURISDICTION
21-22	_ _	REPORTED BY

NOTE: Where codes are listed, they may be circled or inserted on the lines provided throughout this form.

SAMPLE CONTROL

23 _ ACCIDENT SEVERITY

1 Fatal
2 Injury - Overnite Hosp.
3 Injury - Transported
4 No Transport

24 _ SAMPLING FRACTION

1 All Cases (100%)
2 One of Four (25%)
3 One of Ten (10%)

REPORTS SUBMITTED

25	_	Police
26	_	Environmental
27	_	Off-Road Object
28	_	Vehicle
29	_	Side Structure
30	_	Pass. Comp. Intrusion
31	_	Seat Performance
32	_	Fire
33	_	Rollover
34	_	Interview
35	_	Medical
36	_	Surgical Procedures

NUMBER OF VEHICLES INVOLVED

37 _ 1-7 = Total No. of Vehicles
8 = 8 or More
9 = Unknown

NUMBER OF PEOPLE INVOLVED

38-39	_ _	Total	Actual No. = 01-97
40-41	_ _	Injured	98 or More = 98 Unknown = 99
42-43	_ _	Fatal	

NUMBER OF CASE VEHS. INVOLVED

44 _ 1-7 = Actual No. of Case Vehs.
8 = 8 or More
9 = Unknown

NUMBER OF PEOPLE INVOLVED (CASE CARS)

45-46	_ _	Total	Actual No. = 01-97
47-48	_ _	Injured	98 or More = 98 Unknown = 99
49-50	_ _	Fatal	

GENERAL DATA

51-52 _ _ TIME OF DAY

53 _ ROAD CONDITION
1 Dry
2 Wet
3 Ice
4 Snow
5 Other Condition
9 Unknown

54 _ INTERSECTION
0 None
1 3 leg T
2 3 leg Y
3 4 leg cross
4 4 leg oblique
5 Multileg
9 Unknown

55 _ RURAL - URBAN
1 Rural
2 Urban
9 Unknown

ACCIDENT DESCRIPTION

56-57 _ _ TYPE OF IMPACT
00 No Impact
01 Car/Veh.: Head-On
02 Angle Frontal
03 Side
04 Angle Side
05 Rear
06 Car/Fixed Object: Front
07 Side
08 Rear
09 Car/Other Object
10 Principal Rollover
11 Sideswipe
12 Undercarriage
13 3 or More Vehicles - Chain
14 3 or More Vehicles - Other
99 Unknown

. DEPARTMENT OF
TRANSPORTATION
NATIONAL HIGHWAY
SAFETY ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: GENERAL ACCIDENT DATA (Page 2)

VEHICLE

#1	#2	#3	VEHICLE MANEUVER
63 ___	___	___	Driver Controlled
01	01	01	Going Straight
02	02	02	Right Turn
03	03	03	Left Turn
04	04	04	U-Turn
05	05	05	Changing Lanes
06	06	06	Passing
07	07	07	Straight, Slowing
08	08	08	Backing
09	09	09	Stopped in Traffic
10	10	10	None: Double Parked
11	11	11	None: Parked, Not in Traffic
12	12	12	Parking
13	13	13	Leaving Parked Position
14	14	14	Starting in Roadway
			Not Driver Controlled
21	21	21	Sliding, Leading with: Front
22	22	22	Right
23	23	23	Left
24	24	24	Rear
25	25	25	Rotating: Clockwise
26	26	26	Counterclockwise
97	97	97	Other
	98	98	Not Applicable
99	99	99	Unknown

APPROACH DESCRIPTION

#1	#2	#3	FUNCTIONAL CLASSIFICATION
66 ___	___	___	
0	0	0	Arterial Highway } Principal Arterials
1	1	1	Expressway } Principal Arterials
2	2	2	Freeway } Principal Arterials
3	3	3	Minor Arterials - Major Street/Highway
4	4	4	Collector - Through Street/ Highway
5	5	5	Local Street/Road
7	7	7	Other
8	8	8	Not Applicable
9	9	9	Unknown

VEHICLE

#1	#2	#3	ALIGNMENT	
67-72 ___	___	___		
01	01	01	Level	Straight
02	02	02	Uphill	Straight
03	03	03	Downhill	Straight
04	04	04	Crest of Hill	Straight
05	05	05	Bottom of Hill	Straight
06	06	06	Level	Curve Right
07	07	07	Uphill	Curve Right
08	08	08	Downhill	Curve Right
09	09	09	Crest of Hill	Curve Right
10	10	10	Bottom of Hill	Curve Right
11	11	11	Level	Curve Left
12	12	12	Uphill	Curve Left
13	13	13	Downhill	Curve Left
14	14	14	Crest of Hill	Curve Left
15	15	15	Bottom of Hill	Curve Left
98	98	98	Not Applicable	
99	99	99	Unknown	

#1	#2	#3	SURFACE TYPE
73-75 ___	___	___	
1	1	1	P.C. Concrete
2	2	2	Bituminous
3	3	3	Brick, block
4	4	4	Slag, stone, shell, gravel
5	5	5	Other
6	6	6	Dirt
8	8	8	Not Applicable
9	9	9	Unknown

#1	#2	#3	SPEED LIMIT
76-78 ___	___	___	
0	0	0	None (parking lot or other off-road)
1	1	1	20 MPH (or less)
2	2	2	25
3	3	3	30
4	4	4	35
5	5	5	40
6	6	6	45
7	7	7	50
8	8	8	55
9	9	9	Unknown or NA

79 ___ CRASH RECONSTRUCTION

1 Completed: Damage & Traj.
2 Damage Only
Unable to Complete:
3 Rollover
4 Vaulting
5 Other Non.-Horizontal Force
6 Insufficient Data
7 Skidding Sideways
8 Yielding Fixed Object
9 Other

Form 367A (Rev. 1/77)

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: VEHICLE DATA

(Complete this page for all vehicles in accident)

		ACC. IDENTIFICATION
1	_	UPDATE NUMBER
2	_	TEAM
3	_	YEAR
-5	_ _	MONTH
-7	_ _	DAY
-10	_ _ _	SEQUENCE
-13	_ _ _	VEHICLE NUMBER
-15	_ _	NO. OF VIN CHARAC.
-22	_ _ _ _ _ _ _	VIN
-27		MAKE/MODEL:
	_ _ _ _ _	Code
	______	Write In
-32	_ _ _ _ _	ODOMETER
-34	_ _	MODEL YEAR (last two digits)

-36 _ _ BODY STYLE:

AUTOMOBILES
01 Passenger Car
02 Stationwagon
03 Convertible
04 Car, Pickup Body

TRUCKS
05 Van - passenger
06 - cargo
07 Multipurpose
08 Pickup
09 Straight Truck
10 Tractor Trailer

OTHER
11 School Bus
12 Other Bus
13 Motorcycle
98 Other Body Style
99 Unknown

VEHICLE WEIGHT
(To nearest 100 lbs.)

-39 _ _ _ Vehicle Weight

-42 _ _ _ Occ. & Cargo Only

43 _ TOWING ANOTHER VEH.
1 Yes
2 No
9 Unknown

44-65 VEHICLE DAMAGE

	Object Contacted	CDC		Veh. #	Imp. #
(1)	44 45	46 47 | 48 49 50 51	52	53	54
(2)	55 56	57 58 | 59 60 61 62	63	64	65

(1)=Highest Severity (ΔV)

66 _ VEHICLE TOWED FROM SCENE
1 Yes
2 No
9 Unknown

67 _ SOURCE OF VEHICLE DATA
1 Inspection at repair or tow facility
2 Inspection at person's home
3 Inspection at scene
4 Not Inspected. (Photos or repair data)
5 Not Inspected. Reason: ____

9 Unknown

68 _ VEH. INSPECTION BY INVESTIGATO[R]
0 Not Inspected
1 Inspected on first visit
2-7 Actual number of locations visited (including follow-ups to same location)
8 8 or More
9 Unknown

69 _ APPLICABLE VEHICLE
1 Yes
2 No

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: VEHICLE DATA (Page 2)

(Complete this page only for applicable cars)

70 __ FRONT SEAT TYPE
1 Bench
2 Split-Bench
3 Bucket
8 Other
9 Unknown

71 __ HEAD RESTRAINTS
0 None
1 Integral
2 Adjustable: Left Side Only
3 Right Side Only
4 Both Sides
5 Add-On: Left Side Only
6 Right Side Only
7 Both Sides
8 Other
9 Unknown

MEASUREMENT, TOP OF SEAT CUSHION TO TOP OF HEAD RESTRAINT (INCHES)

:-73 __ __ LF
-75 __ __ RF

No Restraint = 00
Actual Measure = 01-97
Unknown = 99

SIDE STRUCTURE PERFORMANCE

76 __ DOOR OPENING
0 None
1 LF
2 RF
3 LR
4 RR
5 LF & RF
6 LF & LR
7 RF & RR
8 Other Combinations
9 Unknown

77 __ LATCH OR HINGE DAMAGE
0 None
1 LF
2 RF
3 LR
4 RR
5 LF & RF
6 LF & LR
7 RF & RR
8 Other Combinations
9 Unknown

78 __ INTRUSION
0 None
1 Steering Column
2 A-Pillar
3 Steering Column and A-Pillar
4 Side
5 Side, with sill override
6 Roof
7 Rear-end
8 Other Area Combinations
9 Unknown

COMMENTS (Describe latch damage and intrusion damage): ____________

____

____

____

____

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: OCCUPANT DATA

ACCIDENT IDENTIFICATION

Col.		
1	_	UPDATE NUMBER
2	_	TEAM
3	_	YEAR
4-5	_ _	MONTH
6-7	_ _	DAY
8-10	_ _ _	SEQUENCE
11-13	_ _ _	OCCUPANT NUMBER

POSITION IN VEHICLE

14 _
1 Seat Area: Front
2 Second
3 Third
4 Other
9 Unknown

15 _
1 Location - On Seat: Left
2 Center
3 Right
4 Entire
5 On Floor: Left
6 Center
7 Right
8 Entire
9 Unknown

OCCUPANT DESCRIPTORS

16-17 _ _ AGE: 00 - less than one year
01-97 - actual age
98 - 98 and older
99 - Unknown

18-19 _ _ HEIGHT (INCHES) to 98 - actual height
99 - Not Reported

20-22 _ _ _ WEIGHT (LBS.) to 998 - actual weight
999 - Not Reported

23 _ SEX:
1 Male
2 Female
3 Female, pregnant
4 Female, Unk. if pregnant
9 Unknown

RESTRAINT USE

24-26 _ _ _

POLICE	INTERVIEWER	INVESTIGATOR	
0	0	0	Not Used
1	1	1	Lap & Torso
2	2	2	Lap Only
3	3	3	Torso Only
4	4	4	Air Cushion & Lap
5	5	5	Air Cushion
6	6	6	Passive Belt
7	7	7	Child Seat
8	8	8	No Restraint
9	9	9	Unknown

INJURY SEVERITY (POLICE RATING)

27 _
1 K Killed
2 A Incapacitated
3 B Not Incapacitated
4 C Possible Injury
5 O Not Injured
9 Unknown

EJECTION - ENTRAPMENT

28 _
0 None
1 Complete Ejection
2 Partial Ejection
3 Partial Ejection & Trapped
4 Ejection, Unknown Degree
5 Trapped
6 Other
9 Unknown

EJECTION AREA

29-30 _ _

No Ejection 00

Window	LF	RF	LR	RR	REAR	UNK.
Open	01	02	03	04	05	09
Closed, dam.	11	12	13	14	15	19
Unk. if open	21	22	23	24	25	29
Door	31	32	33	34	35	39

Windshield:
Bond Sep. 40
Not Sep. 41
Roof (convrt. or sunroof) 50
Other 60
Unk. Ej. Site 98
Unk. if Ej. 99

NCSS CLASSIFICATION

31 _
1 Fatal - Autopsy Obtained
2 Fatal - Medical Diagnosis
3 Fatal - Not Documented
4 Non-Fatal - Overnight Hospitalization
5 Non-Fatal - Transported & Released
6 Other Treatment
7 Treatment Unknown - Not transported
8 No Treatment - Not Transported
9 Unknown

PATIENT HISTORY
OUTPATIENT VISITS

32 _
0 = None
1-6 = Actual Number
7 = 7 or More
8 = Not Injured
9 = Unknown

ACTIVITY RESTRICTION (DAYS)

33-34	_ _	Bed Rest
35-36	_ _	Other Restriction
37-38	_ _	Work Days Lost
39-40	_ _	Days in Hospital

SEE MANUAL FOR CODES USED IN COLUMNS 33-40

NECK INJURY (Rear & Rear Corner Impacts, 4-8 o'clock)

41 _
Whiplash Symptoms Appeared:
0 = Immediately
1-6 = Actual Days Later
7 = 7 or More
8 = Not Applicable
9 = Unknown

INTERVIEW COMPLETION

42 _
0 No Interview
1 First phone call
2 Subsequent phone call
3 First mailing
4 Subsequent mailing
5 First visit
6 Subsequent visit
7 Other ____________
____
9 Unknown

	Inj. No.	Body Region	Aspect	Lesion	System/ Organ	AIS Severity	Injury Source	ICDA Rating
43-53	1	_	_	_	_	_	_ _	_ _ _._
54-64	2	_	_	_	_	_	_ _	_ _ _._
65-75	3	_	_	_	_	_	_ _	_ _ _._

USE WITH AIS CODES:
8 = Inj. Sev. Unk.
9 = Unk. if Inj.

76 OVERALL AIS _

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: COLLISION SEVERITY

ACCIDENT IDENTIFICATION

1	___	UPDATE NUMBER
2	___	TEAM
3	___	YEAR
4-5	___ ___	MONTH
6-7	___ ___	DAY
8-10	___ ___ ___	SEQUENCE
11-13	___ ___ ___	CARD NUMBER

VEHICLE NUMBER ___ (14)

IMPACT WITH VEHICLE NO. ___ (15)

IMPACT NUMBER ___ (16)

IMPACT SPEED (MPH) ___ ___ (17 18)

DELTA "V" MPH

DATA SOURCE (INPUT)	Code		TOTAL	LONG.	LATERAL
Trajectory & Detailed Damge	1				
Trajectory & CDC Only	2	19	20 21	± 22 23 24	± 25 26 27
Detailed Damage Only	3				
CDC Only	4				
Insufficient Data	9	28	29 30	± 31 32 33	± 34 35 36

NOTE: Use Codes 1, 2 or 9 only in Column 19, and Codes 3, 4 or 9 only in Column 28.

RELATIVE VELOCITY: Longitudinal ± ___ ___ ___ MPH (37 38 39 40)

Lateral ± ___ ___ ___ MPH (41 42 43 44)

VEHICLE NUMBER ___ (45)

IMPACT WITH VEHICLE NO. ___ (46)

IMPACT NO. ___ (47)

IMPACT SPEED (MPH) ___ ___ (48 49)

DELTA "V" MPH

DATA SOURCE (INPUT)	Code		TOTAL	LONG.	LATERAL
Trajectory & Detailed Damage	1				
Trajectory & CDC Only	2	50	51 52	± 53 54 55	± 56 57 58
Detailed Damage Only	3				
CDC Only	4				
Insufficient Data	9	59	60 61	± 62 63 64	± 65 66 67

NOTE: Use Codes 1, 2 or 9 only in Column 50, and Codes 3, 4 or 9 only in Column 59.

RELATIVE VELOCITY: Longitudinal ± ___ ___ ___ MPH (68 69 70 71)

Lateral ± ___ ___ ___ MPH (72 73 74 75)

RTMENT OF TRANSPORTATION
IONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: CRASH PROGRAM SUMMARY

ACCIDENT IDENTIFICATION

1 UPDATE NUMBER ___

2 TEAM ___

3 YEAR ___

4-5 MONTH ___ ___

6-7 DAY ___ ___

8-10 SEQUENCE ___ ___ ___

11-13 CARD NUMBER ___ ___ ___

VEHICLE SIZE: #1___ #2___

CDC #1 ___ ___ ___ ___ ___ ___ ___

CDC #2 ___ ___ ___ ___ ___ ___ ___

WEIGHTS KNOWN
No - Go to 7
Yes - Wt. #1 ___ ___ ___ ___
- Wt. #2 ___ ___ ___ ___

REST AND IMPACT POSITIONS KNOWN
No - Go to 34
Yes - Veh. 1 X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___
Veh. 2 X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___

IMPACT POSITIONS Veh. 1 X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___
Veh. 2 X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___

DID VEH. 1 SLIDE SIDEWAYS
No - Go to 16
Yes - Did rotation cease prior to final rest?
No - Go to 16
Yes - Location X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___

WAS VEH. 1 PATH CURVED?
No - Go to 19
Yes - Point on Path X___ ___ ___.___
Y___ ___ ___.___

19 VEHICLE #1 ROTATED?
20 None - Go to 22
21 CW or CCW (circle one)
More than 360° Yes No (circle one)

22 DID VEH. #2 SLIDE SIDEWAYS?
23 No - Go to 25
Yes - Did rotation cease prior to final rest?
No - Go to 25
Yes - Location X___ ___ ___.___
Y___ ___ ___.___
ψ___ ___ ___ ___

25 WAS VEH. #2 PATH CURVED?
26 No - Go to 28
27 Yes - Point on Path X___ ___ ___.___
Y___ ___ ___.___

28 VEH. #2 ROTATED?
29 None - Go to 31
30 CW or CCW (circle one)
More than 360° Yes No (circle one)

31 COEFFICIENT OF FRICTION ___.___ ___

32 ROLLING RESISTANCE

33 1. Proportion Braking Each Wheel
Veh. 1 RF ___.___ ___
LF ___.___ ___
RR ___.___ ___
LR ___.___ ___
Veh. 2 RF ___.___ ___
LF ___.___ ___
RR ___.___ ___
LR ___.___ ___

OR

2. Longitudinal deceleration
Veh. 1 ___.___ ___
Veh. 2 ___.___ ___

TMENT OF TRANSPORTATION
NAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION

NATIONAL CRASH SEVERITY STUDY: CRASH PROGRAM SUMMARY

TRAJECTORY SIMULATION?
No - Go to 41
Yes - Steer Angles

Veh. 1 RF __ __
LF __ __
RR __ __
LR __ __

Veh. 2 RF __ __
LF __ __
RR __ __
LR __ __

TERRAIN BOUNDARY?
No - Go to 41
Yes - Boundary Points

XBP1 __ __ __.__
YBP1 __ __ __.__
XBP2 __ __ __.__
YBP2 __ __ __.__

SECONDARY FRICTION COEFFICIENT?

__.__ __

41 ARE DAMAGE DIMENSIONS KNOWN?
42 No - Go to 44
43 Yes - Dimensions in Inches

Veh. 1 L __ __ __.__
C_1 __ __.__
C_2 __ __.__
C_3 __ __.__
C_4 __ __.__
C_5 __ __.__
C_6 __ __.__
D ± __ __ __.__

Veh. 2 L __ __ __.__
C_1 __ __.__
C_2 __ __.__
C_3 __ __.__
C_4 __ __.__
C_5 __ __.__
C_6 __ __.__
D ± __ __ __.__

44 IMPROVED FORCE DIRECTIONS?
45 No - Program Completed
46 Yes - Angles from Straight

Veh. 1 ± __ __ __ __
Veh. 2 ± __ __ __ __

77

APPENDIX C

The Univariate Distributions for
NCSS Crashes
Case Vehicles
Case Vehicle Occupants

This codebook documents data sets for the first 15 months of the NCSS program. The format shown is that of the files used by HSRI, but this is essentially the same as that used for other versions of these data.

Shown here are the variable names and the code values for NCSS crashes (variables 1 through 60), NCSS Case Vehicles (variables 61 through 185), Case Vehicle Occupants (variables 186 through 240), and Injuries (repeating variables 213 to 219).

Generally frequency information has been shown for one and two-digit variables, and omitted for those variables with more than 100 levels. The variable numbers shown here are consistent with those in Appendix A, and the reader is referred to that appendix for further interpretation of the data elements.