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STAFF STUDY

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THE AVAILABILITY OF STATE-LEVEL HIGHWAY ACCIDENT EXPOSURE INFORMATION

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TABLE OF CONTENTS

1.0 INTRODUCTION AND SUMMARY OF FINDINGS

A variety of different types of information have been used to standardize or normalize descriptive statistics on highway accident occurrence for the purpose of making comparisons among data from divergent geographic locations, time periods and/or specific circumstances. This type of information is commonly referred to as highway accident exposure data.

The purpose of the investigation described in this report is to ascertain the availability and accuracy of highway accident exposure data at both the Federal and state levels. The ultimate aim is to develop a computer file of generally available and useful highway accident exposure data. The primary use of this data is to support the analytic and reporting capabilities of NHTSA's Traffic Safety Programs (TSP). Because many of TSP's activities deal with individual states, an important characteristic of the exposure data system is that information be available by state and, in addition, in as much temporal disaggregation as possible.

Among the uses of the automated exposure data file are the following: (1) generation of standard descriptive statistics, e.g., the number of accidents or deaths per vehicle mile travelled, per registered vehicle, per licensed driver or per unit population; (2) time series analysis of accident rates, possibly including the development of predictive models; and (3) generation of information characterizing the current state of accident experience in the U.S.

A listing of suggested data items developed jointly by NHTSA's National Center for Statistics and Analysis and the Transportation Safety Program are presented in Table 1.1.

The approach taken to investigate the availability of exposure information and build a data base capability included three elements:

1. Contacting Federal agencies to determine the availability of relevant data from Federal sources.

TABLE 1.1: DATA ELEMENTS

Item Name	Additional Requirements
VMT	Total
VMT	By type of road system
Speed Data	By type of road system
Compliance Data	By type of road system
Population	Total
Population	By age group
Licensed Drivers	Total
Licensed Drivers	By age group
Vehicle Registration	Total
Motorcycle Registration	Total
Moped Registration	Total
Road Miles	With speed limit of 55 MPH
Road Miles	With speed limit of 50 MPH or less
Weather Data	Temperature
Weather Data	Precipitation
Alcohol Consumption	Total

2. Conducting pilot studies in several states to determine what additional information may be available.

3. Collecting and integrating the available data into a computerized data base.

Details of the methodology employed and the results obtained from the study are discussed in subsequent sections.

The major conclusion of the study is that the development of an annual data base of state level highway accident exposure information derived from Federal sources has been demonstrated to be feasible. These data are sufficient to satisfy most of the general exposure data needs of TSP identified in Table 1.1, but they are not adequate to meet the specific requirements for monthly availability of all types of data, road specific speed information, and moped registration data. Unfortunately, this missing information cannot be compiled by collecting data directly from the states. However, some types of highway accident exposure data, e.g., odometer readings and multivariate volume counts (see findings 4 and 5 below), are potentially available from the states.

Other important findings include the following:

1. With few exceptions, highway exposure data are not available more frequently than at annual intervals. This is true at both the state and Federal levels.

2. Most state generated highway exposure information is currently being reported to the Federal Government. The vehicle miles travelled information generated by the states is not modified in FHWA reports.

3. The annual highway accident exposure data available from Federal sources are presented in Table 1.2. They have been compiled to produce a prototype highway accident exposure data base for 1980.

TABLE 1.2 SUMMARY OF FEDERAL DATA SOURCES AND AVAILABILITY

Data Item	Source	Update Frequency
VMT	Highway Statistics	annual
	FHWA internal report	monthly
	TIUS	every 5 years
	NPTS	every 5 years
Speed Data	HPMS	annual
Compliance Data	FHWA internal report	quarterly
Population	Census/Highway Statistics	annual
Licensed Drivers	Highway Statistics	annual
Vehicle Registratiton	Highway Statistics	annual
Motorcycle Registration	Highway Statistics	annual
Moped Registration	not available	---
Weather Data	NOAA	monthly
Alcohol Consumption	NIAAA	annual
Road Miles	HPMS	annual

4. New volume counting equipment, which is being implemented by some states, possesses the capability of producing detailed, multivariate VMT estimates by road type, time period, speed range and vehicle type. However, the states are not now planning to take advantage of these new capabilities to collect these data.

5. Some types of highway accident exposure information, which are not available at the Federal level, including odometer readings and highway speed limit data are compiled by some states. However, these data are not computerized and, therefore, use of this information for safety analysis would require considerable expense.

2.0 AVAILABILITY OF STATE EXPOSURE DATA FROM FEDERAL SOURCES

The purpose of this section is to examine the availability and utility of various measures of accident exposure. The key data elements which are desirable for inclusion in a data base of state exposure information are identified in Table 1.1. The general requirements are that the data elements be available by state, by month. The needed data elements, such as total VMT by autos, are aggregate in nature, but the collection period is disaggregated, i.e. by month. Table 2.1 contains a summary of data available from Federal sources. The remainder of this section will focus on a critical description of the available data.

VMT

Annual estimates of VMT by highway functional class (see Table 2.2) are available and published in the FHWA Highway Statistics report. The annual estimates are derived from estimates of VMT provided by the states. Monthly vehicle counts are also available from FHWA. The reported road types for the counts are: rural, urban, and total. (Much of the other exposure related data available from FHWA, which will be presented later in this section, is reported for the full range of highway functional classes, rather than just these three categories.) FHWA's process of developing monthly counts makes use of automatic counters in 35 states and infers VMT for the other states based on reported traffic in neighboring jurisdictions. The monthly VMT estimates are made by adjusting the annual VMT estimate by the percentage change in traffic count from the same month in prior years. While monthly traffic counts are available six weeks after the month in question, annual VMT estimates are published in Highway Statistics, ten months after the end of the year in question (The 1981 Highway Statistics is scheduled to be published in October, 1982). The VMT estimates available from FHWA are thus likely to be quite old. Personnel contacted at both FHWA and NHTSA cautioned against use of FHWA generated monthly VMT estimates and instead preferred to utilize only the direction and percent change in traffic counts.

TABLE 2.1 **FEDERAL DATA SOURCES**

Data Item	Federal Source
VMT	FHWA Highway Statistics
	TIUS
	NPTS
Speed Data	HPMS
Compliance Data	FHWA + Highway Statistics
Population	Census + Highway Statistics
Licensed drivers	FHWA Highway Statistics
Vehicle Registration	FHWA Highway Statistics
Motorcycle Registration	FHWA Highway Statistics
Moped Registration	not available
Weather Data	NOAA
Alcohol consumption	NIAAA
Road Miles	HPMS

TABLE 2.2 HIGHWAY FUNCTIONAL CLASSES

Rural

Principal Arterial - Interstate

Principal Arterial - Other

Minor Arterial

Major Collector

Minor Collector

Local Roads

Urban

Principal Arterial - Interstate

Principal Arterial - Other Freeways and Expressways

Principal Arterial - Other

Minor Arterial

Collector

Local

VMT data are generally available from existing data sources. One source, the Truck Inventory and Use Survey (TIUS), is conducted every five years as part of the Census of Transportation. The TIUS is based on a probability sample of private and commercial trucks registered in each State. Since the sample was constructed and data collected in this way, comparison of data elements by state is possible. Using the 1977 TIUS, VMT can be obtained by truck category, body type and/or weight category.

Auto VMT is available from the 1977 National Personal Transportation Survey (NPTS). However, unlike the TIUS, the NPTS sample was not constructed to develop state totals. The NPTS was designed to collect information on all trips taken during a designated 24 hour period and some additional detail on trips of 75 miles or more during the preceding 14 day period. While the purpose of the NPTS was to address the full range of travel in the U.S., it does not disaggregate travel on a state basis. Consequently, state comparisons as needed for the data base cannot be derived from the NPTS data.

SPEED DATA

In the FHWA terminology, compliance data generally refers to compliance with the 55 mph speed limit. There does not appear to be any specific effort directed at measuring compliance with all posted speed limits, only the 55 mph speed limit. The percent of vehicles exceeding 55 mph on facilities posted at 55 mph speed limit is estimated quarterly by the FHWA. As part of this effort, total mileage by state subject to the 55 mph speed limit and numbers of speeding citations are tabulated and available. Since total mileage is also available by state, the difference between the two sets will be mileage by state at speed limits less than 55 mph. Statewide compliance totals are published quarterly and annually by FHWA for the following measures: average speed, 85th percentile, and percent exceeding 55, 60, 65 mph. Radar equipment used in earlier years to collect speed data has largely been replaced by automatic equipment such as speed sensitive loops in the road to measure vehicle operating speeds. Inductive loops embedded in the pavement are typically calibrated to measure speed in 5 mph increments. However, some states refine the calibration in the vicinity of 55 mph to be in 2 mph increments in the speed range of 50-60 mph. Certain states even have 1 mph

counts. The states report annual totals to FHWA. However, the annual speed totals are merely the simple average of the four quarterly counts. Such annual totals will mask out any seasonal variation in volume. The result might well be called average speed per day but not average speed per vehicle. Compliance information has only been collected in recent years.

Operating speed profile data are highly desirable exposure measures. The Highway Performance Monitoring System (HPMS) contains some limited data on vehicle speeds. HPMS includes information on travel by highway functional class distributed by operating speed range for peak hour urban freeway and expressway travel only. Speed distribution information for other time periods or highway types are not available. The operating speed data which is included in the HPMS system is distributed into six mph categories: less than 35, 35-39, 40-44, 45-49, 50-54 and greater than 54. Also, peak hour VMT is reported in HPMS. Unfortunately, such data are not informative except for peak hour travel on urban expressways and freeways.

The purpose of the HPMS is to build a comprehensive information system that will avoid the necessity of performing a separate national study each time Congress includes in legislation study requirements concerning existing, new, or proposed programs as well as providing up to date information for day to day planning activities. The HPMS provides continuing monitoring of a data base for the collection of rural, small urban area, and individual urbanized area data for each of the 50 States, the District of Columbia, and Puerto Rico. Three general categories of data are included in the system. First, detailed data for a sample of highway sections in each state. A highway section may vary from one tenth of a mile up to one mile in length. Most states report data on several hundred sampled sections, though some states have many more. Section attributes include: county code, functional system, ADT and surface type. The second type of HPMS data is "typical" values from case studies. Some potential case studies to be conducted in representative states of various regions include: travel times, vehicle classification, and vehicle occupancy. The third type of HPMS data is areawide information for general and control total purposes. Some of the representative areawide data are: mileage, VMT, land use, population and bus usage.

REGISTRATION

Another desired element of the data base, vehicle registrations, is published annually in Highway Statistics. Information is provided on the statewide annual count of autos, motorcycles and trucks. An additional source of vehicle registration data for passenger cars, light trucks, and heavy duty trucks is the R. L. Polk data base. There are important differences between the vehicle population counts of FHWA and Polk that deserve consideration before inclusion in any analytic application. Polk utilizes a statistical sample of vehicle registration records selected from state registration records as of July 1 of each year. Vehicles which appear twice in the sample are screened out. An example is the case of a vehicle which is sold out of state during the year. On July 1, it would show up as a registered vehicle in each state. The Polk process compares VIN fields on each record and eliminates the double counting. The FHWA approach, however, includes all vehicles registered as of December 31. As a result, the incidence of vehicles registered more than once coupled with the natural growth in vehicle registrations between July 1 and December 31, results in numbers of registrations reported in the FHWA publications which differ from the Polk totals, often by several percent. No moped registration data have been uncovered; this may be due to the fact that in most states mopeds do not need to be registered as do cars and motorcycles. All of the vehicle registration data available at the Federal level are reported annually. It is questionable whether monthly tabulations, if they could be obtained, would be of great value because registration data would not be expected to show significant variation on a monthly basis.

WEATHER

The requirement for monthly temperature and precipitation information to obtain weather profiles would appear to generate information of limited usefulness. The weather information collected by the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA) is, by its nature, specific to each separate weather station. Many years of historical data exist, including monthly distributions of normal daily maximum and minimum temperatures and average precipitation for each site. The data are based on 30 year averages obtained at the

NOAA weather stations located in several locations in each state. The largest city was chosen as the point location for the weather data to be included in the data base since more exposure probably occurs there than at smaller population locations. Historical weather bureau information (e.g. average rainfall) without specificaiton of where it fell and at what time of day is not particularly useful. On the other hand, VMT generated under alternative weather conditions could be quite useful. These types of data are not available from existing Federal data sources and a special survey would probably be needed to obtain them.

POPULATION AND DRIVERS

Information on annual totals for population and licensed drivers as well as distributions by age group can be readily obtained from Federal sources. Annual population estimates contain population by state and age group and are produced by the Bureau of Census. The level of detail available from the Bureau of Census for the off-Census years, however, is significantly less than desired, but annual population estimates can be purchased from private sources or can be estimated by interpolation. The age group disaggregations used with the 1970 Census, however, are fairly coarse: 0-4,5-13,14-17,18-44,45-64 and over 64 years of age. Current plans at the Bureau of Census are for the post 1980 estimates to be disaggregated into 5 year age group intervals. The finer age group intervals should be a major aid to safety analysts when calculating and comparing the accident rates of drivers in their late teens and early and late twenties with the rest of the population. Many of the traditional Census products, such as the counts of population and housing, which contain information of potential interest such as income, educational level and detailed age distributions are only available for the decennial census year. Other Census products such as Dual Independent Map Encoding (DIME) files, which provide detailed geographic information for urban areas, are not particularly well suited for national highway safety analysis. Annual counts of licensed drivers by age, sex, and state appear in Highway Statistics. Monthly estimates of population and licensed drivers are not available from Federal sources, but these statistics are not likely to change significantly on a monthly basis.

ALCOHOL

Alcohol consumption rates for motor vehicle operators are desirable information, yet relevant data in this area are very difficult to obtain. Alcohol sales data, which are available annually from Department of Commerce or apparent consumption from the National Institute on Alcohol Abuse and Alcoholism (NIAAA), are not necessarily good substitutes for alcohol consumption because not all individuals who consume alcohol drive or ride in motor vehicles. However, time series statistics on total per capita apparent-consumption in gallons of ethanol for the period 1970-79 are considered of sufficient value to include in the data base since they do provide insight into variations in the extent and growth of alcohol consumption amongst the various States. The source of this information is the NIAAA publication, U.S. Alcohol Epidemiologic Data Reference Manual.

SUMMARY

Many of the exposure data elements of interest are already available in the Federal domain. The exceptions include the requirement for statewide weather data, moped registration and alcohol consumption by vehicle operators, which are not readily available. Information on alcohol sales and the average temperature and precipitation at the largest city in each state are included in the exposure data base.

As noted in Table 1.2, the general requirement for compilation of monthly exposure data cannot be satisfied from Federal sources. Additionally, for several exposure measures monthly updates would likely show very small changes in the general patterns. An alternative approach consistent with data availability involves the use of annual data with monthly or quarterly disaggregation, where appropriate. Since the Highway Statistics publication is an important source for much of the required exposure data, and since it provides a readily usable historical data summary, a practical program would involve an annual update to the highway accident exposure file scheduled to coincide with release of the Highway Statistics publication.

3.0 PILOT INVESTIGATION OF STATE EXPOSURE DATA

The pilot investigation of the availability of state generated exposure data was initiated in order to determine if gaps in the Federally available data could be filled with data obtained directly from the states. The pilot investigation consisted of interviews with representatives of three selected states in which questions were asked regarding the availability of data, collection, processing and storage methods and access to information generated at the state level. Table 3.1 summarizes the types of information solicited from each of the sampled states. It was expected that the information obtained from these interviews would provide a sufficient basis for making recommendations regarding the value of collecting exposure data directly from all 50 states.

The states selected to be contacted were Connecticut, North Carolina, Minnesota and California. California was subsequently dropped based on the results of the first three interviews. The states selected were chosen because they are geographically representative, they are large enough to have a diversity of urban and rural areas and they contain a good university or state highway planning department.

Interviews were conducted in June through August, 1982. All of the states were contacted via telephone and, in addition, field trips were made to Connecticut and North Carolina. Since highway exposure data of the various types are compiled in different departments within the state governments, several officials in each state were contacted. In addition, representatives of the University of North Carolina Highway Safety Research Center were also interviewed. Table 3.2 contains a list of the key people contacted in each state.

The next sections contain details of the information generated from the states. Table 3.3 summarizes this information.

TABLE 3.1

PILOT STUDY INFORMATION REQUIREMENTS

I. Types of Information Produced at the State or Local Level

- o Vehicle Miles Travelled
  - by road classification
  - by vehicle type
  - time of day/day of week
  - road counts (ADT)
- o Highway Inventory
  - mileage by classification
  - urban/rural, No. lanes, access
  - 55 mph. or lower speed limit
  - grade crossings/signals/bridges
- o Driver Registration
  - by age, sex
  - number of years driving
- o Vehicle Registration
  - type of vehicle/motorcycle/moped
  - model year
- o Compliance
  - % of vehicles above 55 mph.
  - average speed (speed distribution) by road type
  - citations

II. Data Collection Methods

- o Organizational responsibilities
- o Frequency of collection
- o Coverage (100% or sample)
- o Equipment/procedures used

III. Data Processing and Storage

- o Form: automated/manual
- o File format
- o Updating frequency
- o Amount/type of editing
- o Are data sent to the Federal Government?

IV. NHTSA Access to Information

- o Approval requirements
- o Form/frequency of transfer
- o Cost

TABLE 3.2

SUMMARY OF KEY STATE CONTACTS

State	Official	Position
Connecticut	Paul Silversmith	Highway Engineering
	Steve Dodge	Motor Vehicle Department
	Vin Bonaiuto	Traffic
	Norm Wheeler	Compliance
North Carolina	Paul Atkins	Traffic Engineering
	Gonzolie Rivers	Motor Vehicle Department
	Bob Cambell	University of NC
	Don Reinfort	University of NC
Minnesota	Don Kieffer	DOT/Planning
	Warren Gerber	Traffic
	Jim Johnson	Transportation Information System
	Dave Miller	Compliance
	Cathy Swanson	Public Safety/Registration
	John Schaeffer	Seat Belt Study

TABLE 3.3

AVAILABILITY OF HIGHWAY EXPOSURE DATA: SUMMARY OF STATE CONTACTS

ITEM	CONNECTICUT	NORTH CAROLINA	MINNESOTA
Traffic volume counts	Monthly-24 permanent stations, coverage counts on state and local roads every 2-4 years. Automated counters by Fall '82	Monthly-60 permanent stations, coverage counts on state and some local roads	Monthly-120 permanent stations, coverage counts by county every 6 years, special programs for trucks and metro areas, automated counters by Fall '83
Vehicle Classification	4 times peryear @ key locations off peak, weekdays	Throughout year @ permanent stations, all time periods covered	100 state highway locations/year, 24 hours covered
VMT by Road Type	Annual estimate using road counts	Annual estimate using gas sales & road counts	Annual estimate using road counts
Odometer Readings	@ vehicle registration, not computerized	@ annual inspection, not computerized	@ vehicle registration, not computerized
Highway Inventory	Annual update - road condition for state roads, computerized	Annual update - no curve/grade info., computerized	State highway info. updated when conditions change, local roads sampled data in information system.
Grade Crossings/ Bridges	Available/Computerized	Available/Computerized	Available in info. system
Speed Limit	Available on paper	On computer, but not well maintained	Only on trunk highways and interstates
Average Speed	Available for major roads, on paper	State Hwy. program discontinued, only available for 55 MPH roads	Only on 55 MPH roads

AVAILABILITY OF HIGHWAY EXPOSURE DATA: SUMMARY OF STATE CONTACTS

ITEM	CONNECTICUT	NORTH CAROLINA	MINNESOTA
Compliance w/55 MPH	Available Quarterly; speed distribution by 5 MPH intervals	Available quarterly, speed distribution by 5 MPH intervals	Available quarterly, speed distribution by 5 MPH intervals
Speeding Citations	Available monthly from State Police/Highway Patrol	Available monthly from State Police/Highway Patrol	Available monthly from State Police/ Highway Patrol
Registrations: Driver and Vehicle	Computerized but difficult to use	Computerized, UNC also has data and analysis system	Computerized, in process of integrating driver and vehicle registration and accident files
Moped	Not available	Not available	Available from 1978 (accidents also recorded)
Special Surveys	None currently	None currently	Seat belt/child restraint use @ 10 sites in 1981/82

VEHICLE MILES OF TRAVEL

The vehicle volume counting programs in the three states follow FHWA guidelines and are therefore very similar. There are two types of counts: permanent and coverage. Permanent counting stations generally employ buried detectors which operate 24 hours-a-day, 365 days-a-year. Coverage counts are taken on state and local roads on a rotating basis, usually for a 48-hour period in each location. The equipment used for both types of counts produces a summary of traffic volumes for each hour of operation. Differences between state programs arise from variation in the number of permanent counting stations and from the frequency with which road segments receive coverage counts (see Table 3.3). In general, all state maintained roads and metropolitan area roads receive coverage counts every couple of years, whereas local and less traveled roads are counted less frequently and/or only a sample of road segments are counted. Average daily traffic (ADT) on each road segment is calculated using factors derived from permanant counting station counts for day of week, month, and road type.

Two different methods are used in the three states to calculate estimates of statewide annual vehicle miles of travel. Connecticut and Minnesota calculate VMT directly from estimates of ADT by summing the product of annual traffic volume and distance for each road segment. For local roads where no road counts are available, traffic volume is assumed to take the average value for roads of that type. In North Carolina, information on gasoline sales and average auto miles per gallon are combined with trends in traffic counts to produce an estimate of VMT which is considered reasonable by state highway officials.

Raw vehicle count information is communicated to the Federal Highway Administration on a monthly basis, while estimates of statewide VMT are transmitted to the FHWA once a year. State highway officials did not find any descrepancies between the VMT estimates given to FHWA and the ones published in Highway Statistics.

All three states conduct vehicle classification counting programs for the purpose of determining the relative percentage of autos and commercial vehicles travelling on the state highway system. In Connecticut, vehicles are classified into two categories of automobiles (small and large), buses and several types of trucks (by number of axles). Manual counts are conducted at 25 key locations throughout the state during the hours of 2-6 p.m., on weekdays. North Carolina also conducts mannual classification counts, at the permanent counting stations. Counts are carried out in every period of the day, for a one week period (not on consecutive days) over the year. Vehicles are broken down by five vehicle types, and by in-state and out-of-state vehicles. Minnesota conducts vehicle classification counts at about 100 locations on state highways and interstates. A 24-hour period is covered every other year. Vehicles are classified into automobiles, recreational vehicles and several types of commercial vehicles.

New volume counting equipment, which will have the capability of recording vehicle speed in 5 mph intervals and vehicle type (based on the number of and distance between axles) is being installed in Connecticut by the Fall of 1982, and in Minnesota by the Fall of 1983. The major advantage of this equipment from the states' points of view, is that it will reduce labor expenses by permitting the automatic communication of hourly volume counts via telephone lines. Although Connecticut plans to eliminate their classification counting program when the new equipment is in place, neither state is planning to make use of the new systems' vehicle speed recording capabilities.

A final state generated source of vehicle miles travelled information is odometer readings. All three states record odometer readings when vehicles are newly registered and when ownership is transferred. This information is recorded on the vehicle title, a copy of which is in the state motor vehicle's department files, but is not computerized. North Carolina also records odometer readings at the time of the annual safety inspection. In fact, for a period of several years, the current and previous odometer readings were recorded; but this practice has been recently terminated. Here again, the VMT information is not computerized, except for a small sample of records key punched by the University of North Carolina for purposes of a specific study.

VEHICLE AND DRIVER REGISTRATION

The three states each maintain separate computerized driver and vehicle registration files which are used primarily for operational (not analytical) purposes. The computer systems are designed to meet day-to-day requirements, e.g. processing of fees, collection of sales taxes, investigation of stolen autos and criminal complaints. Registration records are kept on all active drivers and vehicles, and are updated frequently (at least once a month) in all three states. Records are labelled inactive when reregistration materials are not returned or when cancellation notices are received. Since driver registrations are not reviewed every year (there is a four-year cycle in Connecticut), some records are likely to be mistakenly counted as active when, in actuality, the driver has died or moved out of state. This is less likely for vehicle registrations where there is an economic incentive to return plates to the registry, i.e. insurance refunds. Although procedures varied, drivers and vehicle registration records are manually purged from the files in each state after they have been inactive for a period of time (at least one year and up to five or more years for driver records containing information on DWI offenses). Although the driver registration files in each state include a history section which contains data on previous accident involvements and motor vehicle infractions, the confidentiality of this information is protected by state statute or regulation.

Even though standard summaries (such as the annual breakdown of drivers by age and sex, which is sent to the FHWA) are regularly produced, the systems cannot be conveniently manipulated to produce special studies as might be required for some highway exposure data analyses. A possible exception to this is the computerized information system which is currently being implemented in Minnesota. This system will integrate many aspects of the drivers and vehicle registration files and highway accident records. In order to enhance the systems usefulness, the needs of analytical users of the data are being considered in the system design.

Moped registration information is only available in Minnesota which has required the registration of this type of vehicle since 1978. Both Minnesota and North Carolina maintain moped accident data, whereas Connecticut does not record any information on mopeds.

VEHICLE SPEED INFORMATION

The major source of information on the speeds at which vehicles are traveling on state highways is the FHWA and NHTSA sponsored 55 mph Compliance Program. Under this program the states monitor speeds on roads with 55 mph speed limits in order to determine the percentage of vehicles exceeding the posted speed. The procedures used in each state are similar. Fifteen to twenty speed monitoring sessions are conducted each quarter; each lasting over a twenty-four hour period. Approximately 40 percent of the sites are checked four times during the year, and the others are monitored only once. All sites are selected randomly from 5-mile segments of 55 mph state highways and interstates. The information generated from every monitoring session consists of hourly volume counts and the numbers of vehicles traveling in each 5-mph speed increment. The raw data are transmitted four times a year to the FHWA which compiles them and produces a quarterly report. This report also contains a summary, compiled by the state police, of speeding citations issued on 55 mph roads.

The equipment used to monitor speeds[1] on Connecticut highways has the additional capability of estimating vehicle type or length by measuring the number and spacing between axles. The state does not utilize this feature at the present time.

Information on vehicle speed on other than 55-mph roads is available only in Connecticut where the average speed on major state highways and interstates during off-peak daylight hours is measured. This information is recorded in non-automated form on straight line diagrams. North Carolina terminated their statewide speed monitoring program (which covered all roads and vehicle types) when the 55 mph Compliance Program was initiated.

[1]This equipment is the same type as that being implemented in Connecticut and Minnesota to measure traffic volumes.

HIGHWAY INVENTORY

Each of the states surveyed maintain a computerized file of highway inventory information and manual files of roadway alignment (straight line diagrams) and roadway photographs (photologs). The computerized file is made up of records (one for each road segment) containing information on the general physical characteristics of state highways and local roads. Data items include the length, width and surface type of each segment, information on the existance of bridges, tunnels, railroad crossings and intersection control, and the existance of sidewalks and roadway appurtenances. Straight line diagrams are pictorial representations of roadway alignment and also contain information on the grade and superelevation of road segments. In Connecticut, average speed information, when available, is written on these diagrams. Photologs are wide angle photographs taken from the center of the road (in each direction) every 100th of a mile.

The states also maintain separate computerized data bases on railroad grade crossings, as part of the National Grade Crossing Inventory and on bridges, as part of the National Bridge Inspection File. In addition, Connecticut maintains special files on the type and location of traffic signals (state highways are computerized, local roads are not). Both Connecticut and Minnesota have computerized files which contain current information on road condition.

Speed limit information is available in all three states, but it is only maintained for major roads in Minnesota, it is not computerized in Connecticut and it is unreliable (often out of date) in North Carolina. Two states maintain an information system which permits the exact location of vehicular accidents to be determined and correlated with roadway characteristics. In North Carolina, the University of North Carolina's Highway Statistical Research Center has developed an analytical system (MERGE) which uses state accident and highway inventory files. Minnesota is in the process of developing a similar capability as part of their Transportation Information System development program.

The states also maintain and annually update inventory information on a sample of highway segments for the Highway Performance Monitoring System (HPMS), which is described in Section 2.0. For the most part, the information supplied to HPMS is extracted from existing state maintained data sources. Therefore, most but not necessarily all of the data required by HPMS is currently being supplied by the states. For example, North Carolina does not calculate curve and grade information for all HPMS sections. The estimates of average daily traffic (ADT) for HPMS sections are collected through the regular highway counting program and factored in the usual manner using current data from the permanent counting stations. However, all HPMS sections (especially local roads) have not necessarily had a current coverage count and, therefore, reported ADT might be based on estimated or previous years counts.

SPECIAL STUDIES

None of the three states are actively engaged in any special data collections, with the exception of a child restraint study being conducted in Minnesota. All states had previously conducted origin/destination studies, roadside surveys and observations or other unique data collections. Due to Federal and state budget reductions, Connecticut and North Carolina are not currently engaged in these types of activities. Minnesota's child restraint program is funded by the state share of a NHTSA grant.

The Minnesota child restraint study collected data at 10 sites throughout the state which were likely to have young children as occupants of automobiles, e.g. shopping centers and amusement parks. Observers recorded information on the age of occupants, the type of cars and whether child restraints and seatbelts were used or not. Between 1,000 to 1,500 observations were made in 1981 and again in 1982, an interval which corresponds to the introduction of the state child restraint law. Observational data are currently being computerized and results of the study are expected this year.

FINDINGS AND CONCLUSIONS

As a result of these interviews, the following major findings are derived:

(1) There is very little state highway exposure data generated and/or reported on a monthly basis. The major exceptions to this are estimates of average daily traffic at permanent counting stations, which are developed each month. This information is not used to produce monthly estimates of vehicle miles travelled at the state level.

(2) Most highway exposure data generated at the state level is communicated to the Federal Government. These include monthly vehicle counts and annual estimates of VMT, annual updates of Highway Performance Monitoring System information, annual bridge and grade crossing inventories, quarterly information related to compliance with the 55 mph speed limit and speeding citations, and annual vehicle and driver registration summaries.

(3) Some states are currently installing more sophisticated volume counting equipment which will, in the near future, provide the capability of generating volume counts by several speed range and vehicle classifications. The states contacted, however, did not have plans to institute programs to take advantage of these new capabilities.

(4) Due to budget cutbacks in both state and Federal programs, many special surveys and data collections are being rapidly eliminated. In addition, several state representatives expressed reticence about providing additional information without new Federal funding.

(5) The states' vehicle miles of travel estimates are accurately reported in the FHWA publication, Highway Statistics. Not enough information was generated by these interviews to assess the accuracy of the various methods used by the states to estimate VMT.

The major conclusion drawn from these findings is that there is little to gain from instituting a large scale data collection effort directly with the states because most exposure information important to TSP is already available from Federal sources, has not been collected, or is not in easily accessible form at the state level.

4.0 THE EXPOSURE DATA BASE

The state exposure data base will be confined to information in existing Federal data sources since the pilot study did not indicate that additional relevant data was available from state sources. The data base, initially assembled on the TSC Decsystem-10 machine, has subsequently been copied to the Tektronix 4081 minicomputer graphics systems located at NCSA and also at TSC. The copy procedure utilized the communications software on the 4081 which permits data transfer between the 4081 and outside computers.

The data file is arranged conceptually in the form of a matrix of 88 rows (one row for each data item) and 52 columns (one column for each of the 50 states, plus an additional column for DC and a U.S. summary column). The file is stored sequentially on the 4081 since there is no data base management system available on that machine. The data elements (1-88) are listed in Table 4.1. Data items (1-26) and (76-88) are obtained from the 1980 FHWA Highway Statistics publication. The subjects covered include: compliance, licensed drivers' age distribution, population, registration, speed data and VMT by functional class of highway. Data file items (27-65) obtained form the U.S. Weather Bureau (NOAA), contain monthly totals for normal daily maximum and minimum temperature and monthly and annual precipitation totals. Data items (66-75) contain per capita alcohol consumption totals for each year 1970-79 from the NIAAA report Alcohol Epidemiologic Data Reference Manual.

Some of the potential capabilities of the data/graphic system were demonstrated at NCSA in early September. Figures 4.1 through 4.4 provide representative samples of the pie chart, bar chart, line graph and tabular output capabilities. A principal advantage of having the data stored on the 4081 is that data retrieval and display can be performed very quickly. In the event that future work required that the accident data be combined with state exposure data, the 4081 communications software could be utilized to transfer accident files such as FARS from the NIH computer to the 4081.

Additional years of exposure data could be added to the 4081 data system to provide time series comparisons such as accident histories normalized by VMT. This process could use FARS data from 1975-80 and FHWA estimates for VMT for 1975-80. However, not all data items available in the 1980 file are available for earlier years so care should be taken in restricting any multi-year exposure file to include only those data items which are reported consistently. Speed data and compliance totals are examples of items which have not been recorded consistently over the years. At the September project review, it was suggested that additional years of data not be added at this time.

A word about data units is useful at this stage. Data items are included in the state exposure data file in the same units as they are recorded in their principal source. Combining data items can be tricky. An example may clarify the point. VMT is recorded in the file, to the nearest million miles, while registrations are recorded to the nearest whole number. The derived variable, VMT per vehicle, is not simply the ratio of the two numbers, since the units are so dissimilar.

Implementation of the exposure data file on the Tektronix 4081 system provides a number of opportunities for NCSA to develop quick response graphic and tabular representations of safety and exposure data. General purpose graphic routines are resident on the 4081 to display data by modifying standard Fortran programming instructions. Since the 4081 is itself a minicomputer, programs can be customized and data combined for specific NCSA applications. The data communication feature permits other data sources, located on other computers, to be linked to the exposure data already loaded on the 4081.

TABLE 4.1

1980 EXPOSURE DATA VARIABLE LIST

Item #	Description		Units
1.	Mileage subject to 55 mph speed monitoring		---
2.	Driver's licenses by age:	19 and under	---
3.		20-24	---
4.		25-29	---
5.		30-34	---
6.		35-39	---
7.		40-44	---
8.		45-49	---
9.		50-54	---
10.		55-59	---
11.		60-64	---
12.		65-69	---
13.		70 and over	---
14.	Total licensed drivers		---
15.	Total population		Thousands
16.	Persons of driving age (15 and over)		Thousands
17.	Total motor vehicle registrations		---
18.	Total motorcycle registrations ---		
19.	Total rural mileage		---
20.	Total urban mileage		---
21.	Total urban and rural mileage ---		
22.	Statewide average speed		---
23.	Statewide 85th percentile speed---		
24.	% exceeding 55 mph		---
25.	% exceeding 60 mph		---
26.	% exceeding 65 mph		---
27.	Normal daily max. temp.	- January	degrees F
28.	"	- February	degrees F
29.	"	- March	degrees F
30.	"	- April	degrees F
31.	"	- May	degrees F
32.	"	- June	degrees F
33.	"	- July	degrees F
34.	"	- August	degrees F
35.	"	- September	degrees F
36.	"	- October	degrees F
37.	"	- November	degrees F
38.	"	- December	degrees F
39.	Annual average maximum temperature		degrees F
40.	Normal daily min. temp.	- January	degrees F
41.	"	- February	degrees F
42.	"	- March	degrees F
43.	"	- April	degrees F
44.	"	- May	degrees F
45.	"	- June	degrees F

46.	"	- July	degrees F
47.	"	- August	degrees F
48.	"	- September	degrees F
49.	"	- October	degrees F
50.	"	- November	degrees F
51.	"	- December	degrees F
52.	Annual avg. min. temperature		degrees F
53.	Normal monthly and annual precipitation		
	"	- January	inches
54.	"	- February	inches
55.	"	- March	inches
56.	"	- April	inches
57.	"	- May	inches
58.	"	- June	inches
59.	"	- July	inches
60.	"	- August	inches
61.	"	- September	inches
62.	"	- October	inches
63.	"	- November	inches
64.	"	- December	inches
65.	Annual total precipitation		inches
66.	Total per capita alcohol consumption	- 1970	gallons
67.	"	- 1971	gallons
68.	"	- 1972	gallons
69.	"	- 1973	gallons
70.	"	- 1974	gallons
71.	"	- 1975	gallons
72.	"	- 1976	gallons
73.	"	- 1977	gallons
74.	"	- 1978	gallons
75.	"	- 1979	gallons
76.	Rural VMT - principal arterial		
		- interstate	millions
77.	"	- other	millions
78.	Rural VMT minor arterial		millions
79.	Rural VMT collector major		millions
80.	Rural VMT collector minor		millions
81.	Rural VMT local		millions
82.	Urban VMT principal arterial/freeway and expressway	" - interstate	millions
83.	"	" - other	millions
84.	"	/other	millions
85.	Urban VMT minor arterial		millions
86.	Urban VMT collector		millions
87.	Urban VMT local		millions
88.	Total VMT		millions

SCALE FACTOR IS 100.0

FIGURE 4.1

TOTAL RURAL AND URBAN MILEAGE

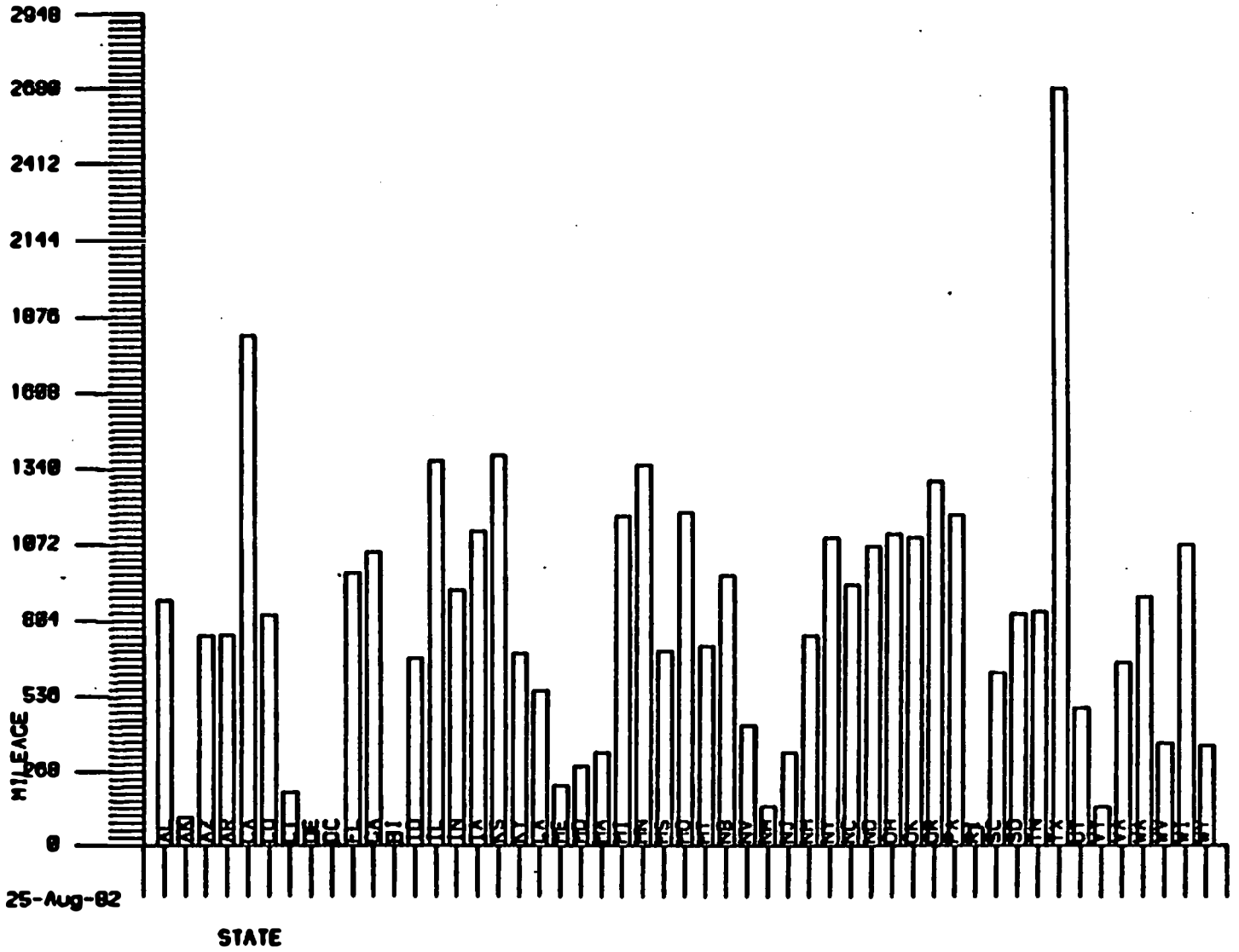
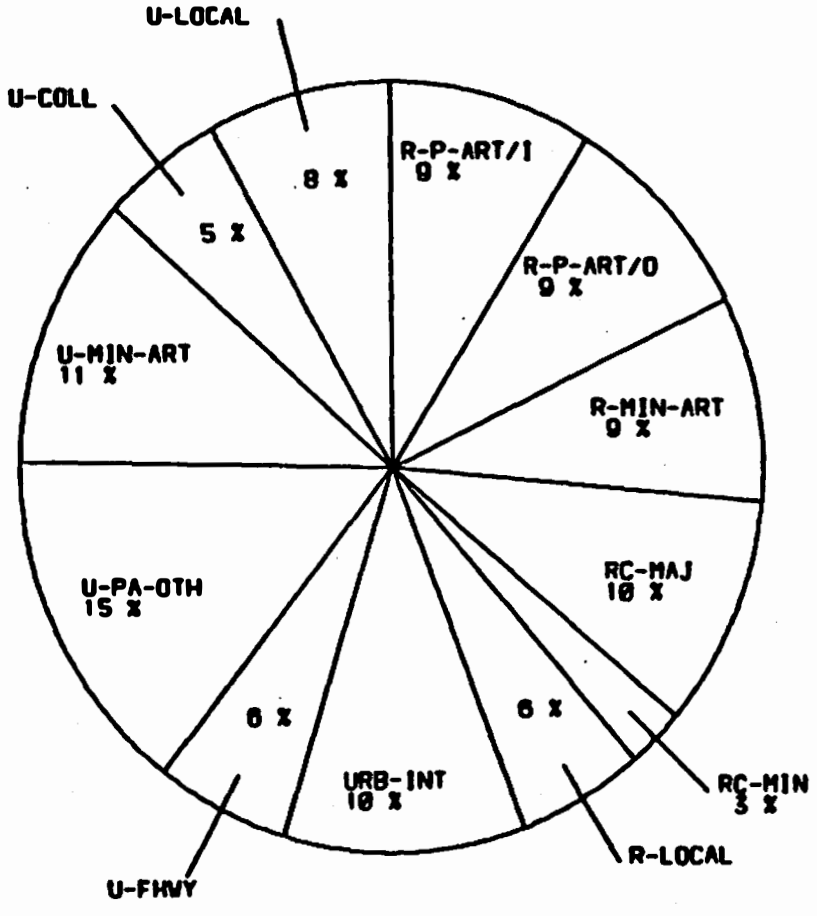


FIGURE 4.2 VMT DISTRIBUTION BY HIGHWAY FUNCTIONAL CLASS



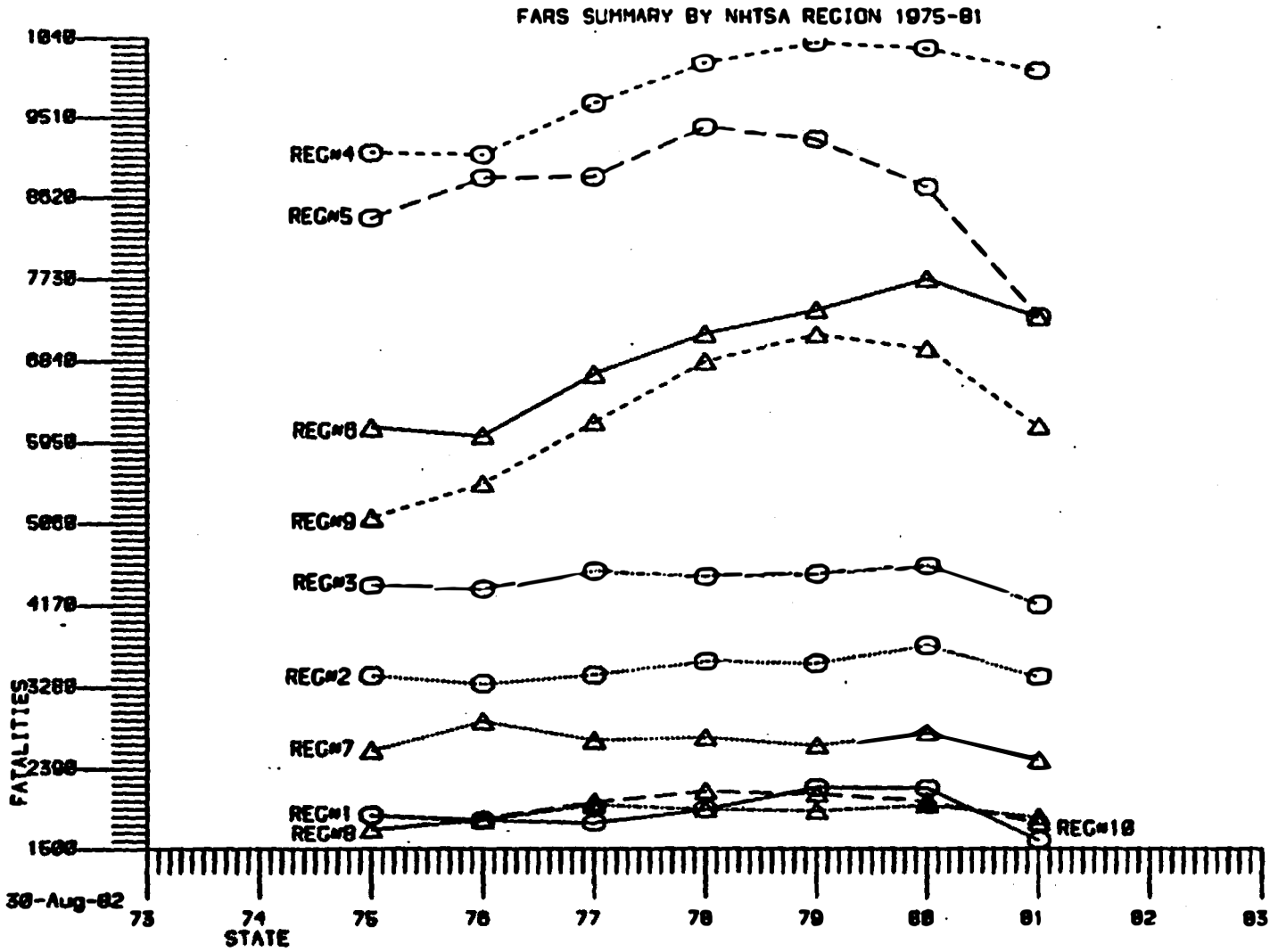
UNITED STATES

FUGURE 4.3 TABULAR OUTPUT OF SELECTED DATA ITEMS

	1	10	80	80	90
ALABAMA	16103.0	143.0	20027.0	7462.0	9030.4
ALASKA	1762.1	10.0	2665.0	6645.9	10133.1
ARIZONA	6029.2	117.0	18016.0	6922.7	9380.4
ARKANSAS	12796.6	96.0	16232.0	7100.6	10095.3
CALIFORNIA	27756.0	1065.0	155090.0	6586.3	8847.9
COLORADO	6336.0	114.0	22411.0	7757.4	9128.0
CONNECTICUT	472.7	169.0	19409.0	6244.9	8741.4
DELAVARE	183.1	29.0	4232.0	7112.6	10361.6
DIST.OF COL.	0.0	23.0	3293.0	5161.4	12125.6
FLORIDA	12071.0	498.0	79002.0	8111.1	10085.8
GEORGIA	27549.6	205.0	43188.0	7904.1	10096.4
HAVAII	277.7	38.0	5585.0	5787.6	9684.7
IDAHO	4237.7	37.0	6943.0	7354.9	7796.6
ILLINOIS	14318.0	481.0	65006.0	5699.8	8364.6
INDIANA	11220.0	245.0	37110.0	6759.6	9262.1
IOVA	22267.0	135.0	18971.0	6512.5	7442.7
KANSAS	18825.7	111.0	17200.0	7317.0	8191.8
KENTUCKY	12699.0	132.0	25233.0	6892.4	9499.3
LOUISIANA	9929.0	145.0	24417.0	5808.0	8543.4
MAINE	1121.4	50.0	7465.0	6635.6	9678.1
MARYLAND	801.3	187.0	28585.0	6788.1	9989.0
MASSACHUSETTS	888.0	255.0	35390.0	6168.7	9192.5
MICHIGAN	20807.0	427.0	82059.0	6703.3	9203.3
MINNESOTA	24452.0	157.0	28515.0	6994.1	8744.8
MISSISSIPPI	16995.0	95.0	16514.0	6550.6	10287.6
MISSOURI	23572.0	218.0	34061.0	6927.2	10085.8
MONTANA	9386.0	41.0	6623.0	8415.5	9273.7
NEBRASKA	11827.0	69.0	11255.0	7168.8	8412.8
NEVADA	4289.5	41.0	6187.0	7643.3	9853.3
NEW HAMPSHIRE	668.1	41.0	6427.0	6978.3	8688.2
NEW JERSEY	968.8	377.0	58264.0	6825.6	10326.6
NEW MEXICO	7818.0	46.0	11388.0	8698.5	10118.3
NEW YORK	15886.0	666.0	77622.0	4421.1	9468.6
NORTH CAROLINA	14788.0	243.0	41346.0	7838.8	8897.3
NORTH DAKOTA	18828.8	26.0	5284.0	8891.9	8847.5
OHIO	18348.2	482.0	72888.0	6668.5	8947.1
OKLAHOMA	12353.8	133.0	27418.0	9861.2	9744.9
OREGON	13729.8	123.8	19888.8	7249.5	8789.8
PENNSYLVANIA	14313.8	568.8	71524.8	6827.1	18817.7
RHODE ISLAND	51.2	46.8	5424.8	5727.6	8371.9
SOUTH CAROLINA	12299.8	122.8	22719.8	7284.1	11164.2
SOUTH DAKOTA	12828.6	31.8	6195.8	8978.3	9735.8
TENNESSEE	14324.8	188.8	33585.8	7298.8	9984.8
TEXAS	56968.8	585.8	118381.8	7758.8	18228.9
UTAH	3788.8	47.8	18845.8	7423.8	18271.7
VERMONT	338.2	21.8	3788.8	7228.6	9952.2
VIRGINIA	14732.8	224.8	38532.8	7287.6	18381.2
VASHINGTON	4988.8	177.8	28922.8	7882.9	8592.6
WEST VIRGINIA	7981.7	182.8	18746.8	5518.8	7984.8
VISCONSIN	18298.8	198.8	31233.8	6638.3	18822.9
WYOMING	5812.5	18.8	5888.8	18632.7	18258.3
UNITED STATES	578584.4	9775.8	1528857.8	6714.5	9418.4

ENTER VARIABLE OF INTEREST-IF BLANK DISPLAY OUTPUT 8

FIGURE 4.4


FARS SUMMARY BY NHTSA REGION 1975-81
FATALITIES
10410
9510
8620
7730
6840
5950
5060
4170
3280
2390
1500
30-Aug-82
REG#4
REG#5
REG#6
REG#9
REG#3
REG#2
REG#7
REG#1
REG#8
REG#10
73
74
75
76
77
78
79
80
81
82
83
STATE