and b_{ij} are therefore the unique cell estimates of the model parameters a and b, road class and time of day having been accounted for. α_i^a, β_j^a, γ_{ij}^a, α_i^b, β_j^b, and γ_{ij}^b estimate the main effect of time of day, the main effect of road class, and their interactions on a and b, respectively.

APPLICATION OF THE MODEL

Possible applications of the accident model of the traffic mix include the following:

1. The model can be used to assess the relative involvement rates of any two different classes of vehicles that have different characteristics, taking into account the effect of any number of environmental factors. This will help minimize the undesirable "Simpson's Paradox" caused by confounding factors not otherwise considered.
2. The model can be used to predict the reduction (or the increase) in the number of accidents that results from altering the travel pattern (or the amount of travel) of some vehicles on certain roads and at certain times of day. These results can then be used as input for evaluating various highway-safety policy options concerning the use of certain types of vehicles.

CONCLUSIONS

The accident model of the traffic mix as developed might be expected to predict well when applied to a traffic situation in which the mix of any two different vehicle classes and the overall traffic volume are relatively uniform. The model can potentially be extended to include any number of environmental factors without altering the basic model presented in Equations 10-14. These factors are incorporated into the model in such a way that they partition the accident and exposure data into cells with relatively uniform traffic mix and overall traffic volume. The factors that can be included in the model, of course, depend on the level of detail of the available exposure and accident data. The stability of the estimated model for prediction depends on the ability to search for environmental factors that strongly influence the accident rates of the vehicle classes being investigated. The reliability of the estimated model is a function of the accuracy in measuring exposure. Future research efforts should therefore also be directed to acquiring reliable exposure data with a greater level of detail than is generally available now. Furthermore, there is a need for compatible definitions of the variables in both the accident and exposure data sets.

Computer programs to perform model estimation and prediction are available at the University of Michigan Transportation Research Institute in Ann Arbor.

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Microcomputer-Based Traffic Records System for Small Police Agencies

WILLIAM E. KELSH

In Virginia, there are many small cities, towns, and counties that maintain manual traffic records systems to meet their traffic safety data needs. Of these, the larger localities have a sufficiently high number of motor vehicle crashes and traffic violations to justify the need for automated record-keeping systems. However, the high cost of computer hardware and required technical expertise have discouraged these localities from acquiring the record management capability they need. The advent of the microcomputer has now brought sophisticated record-keeping technology within reach of even the smallest budgets. Still, lacking the staff support and the required applications software, most localities are unable to take advantage of the benefits of the new technology. In an effort to solve the problem, the Virginia Highway and Transportation Research Council, with funding support from the Virginia Department of Transportation Safety, has developed a model user-oriented local traffic records software system for small localities. The system accepts, stores, and recalls data for accidents and traffic offenses rapidly, accurately, and inexpensively. With further development, it will have the capability to be run on most currently marketed microcomputers.

An effective local program for reducing traffic accidents requires the capability to (a) identify traffic safety problems, (b) develop and implement appropriate countermeasures, and (c) evaluate the results of the chosen strategies. To achieve this capability, localities must keep records on the incidence of motor vehicle crashes and violations of traffic ordinances. Further, these records must be organized so they can be easily accessed and analyzed.

Localities also need to keep traffic records for the efficient management and operation of safety programs. Clearly, the key to maximizing the use of limited resources is information about the nature and scope of the traffic safety problem to be addressed. With this information, traffic safety administrators presumably can direct their resources toward the most serious problems or toward those problems that have the highest potential for payoff.

Finally, during these times of economic hardship for local governments, it is important for traffic safety officials to be able to justify traffic safety programs that compete for a share of the local budget or to obtain grant money from other sources. Again, traffic records are essential because they are the source of the information needed to support the requests for funds.

Many localities lack the capability to store, recall, and analyze traffic records for application to safety programs. This is particularly true of the smaller communities that lack the wherewithal to develop sophisticated and often expensive record-keeping systems. It would appear that this is an activity for which federal and state agencies could render assistance. However, such federal and state involvement has been and continues to be extremely limited. Direct federal involvement has been principally confined to improving state record-keeping systems through the NHTSA state and community highway safety grant program. The federal government has indirectly assisted some of the larger localities by providing grant money to pay for development of systems; however, many of the smaller localities cannot take advantage of this aid because the amount of money available for grants is limited and a grant requires a substantial local matching contribution.

In Virginia, the state provides no direct financial assistance to localities for traffic records but does provide some traffic safety statistics based on data reported to the Department of State Police. This information is of limited use, however, because (a) the data are not location specific, (b) they are up to 18 months out of date by the time they are received, (c) the reports do not cover accidents that are not legally reportable, (d) the report formats are too highly aggregated to be useful for detailed analysis, and (e) the quality of the data is suspect because state quality control is somewhat lax. Finally, neither the federal nor the state government keeps comprehensive statistical data on traffic violations.

The problems facing the smaller localities that desire to enhance their record-keeping capabilities are twofold: they lack the technical expertise to develop a system, and they lack the money to purchase the required equipment and services. It would appear that an appropriate solution to their problems would be the development of a model microcomputer-based system for traffic records that would be both productive and inexpensive to procure and maintain. Because little attention has been given to meeting this need of small localities, the development and implementation of such a system would be a novel and significant solution.

Thus, the goal of the project reported here was to design, develop, and implement a model microcomputer-based traffic records system (MTRS) for small localities. It was planned that the MTRS should provide the capability to enter, edit, store, and recall data on traffic accidents and violations on demand in a variety of formats. The system should be user-friendly and reasonably efficient with respect to response time and storage of information, require little or no maintenance, and above all be conceptually simple and practical to use. In addition, because the intent was to develop a model system, it should be designed so that any appropriately qualified and needy locality could implement it with minimal effort.

MTRS PROJECT DESCRIPTION

The project began in April 1981 with a review of available microcomputer technology. This was followed by selection of a pilot implementation site in June 1981 and the hardware purchase in October 1981. The MTRS was implemented in the Staunton, Virginia, Police Department (SPD) in March 1982. The project is now in the testing and evaluation phase.

Pilot Implementation Site

It was clear that, if the major goal of ensuring practicality for the system was to be attained, the MTRS should be implemented in a suitable locality on a pilot basis. The SPD agreed to participate in the project. It is believed that the operational setting of the pilot MTRS is typical of that of most small localities in Virginia. The SPD has a staff of 46 full-time uniformed personnel and a civilian support staff of 10. The 1978-1981 accident and traffic arrest patterns for the city, which has a population of 25 000, are indicated below (the data were obtained from the SPD manual record-keeping system):

Year	No. of Traffic Summons Issued	No. of Motor Vehicle Crash Investigations
1978	NA	803
1979	NA	840
1980	NA	691
1981	1939	696

Before the introduction of the MTRS, the SPD had no automated system for processing accident or traffic summons statistics nor any imminent prospects of obtaining this capability. It did, however, maintain a manual record-keeping system for both traffic accidents and arrests. This function was the responsibility of one full-time clerk. A limited range of reports, including monthly and annual accident and traffic arrest summaries, were produced from the manual statistical tallies. The hard copies of all accident reports and traffic citations were also kept on file for reference and distribution to appropriate interested parties.

Limitations of SPD System

The basic deficiency of the SPD's manual system was that a great deal of information was retained on file but little was used. In addition, the periodic reports issued were too highly aggregated and too limited in scope to be of use in the planning and allocation of police resources. Another deficiency was that the manual system was labor-intensive and prone to error. Finally, the record-keeping system, although fairly current, was unresponsive to ad hoc information needs. The preparation of nonstandard reports was extremely time-consuming because all work had to be done by hand. Thus, all but the most urgent requests for data were discouraged. It was clear that a more productive, accurate, and efficient means for gathering and analyzing traffic safety statistics was desirable.

Data Elements Captured by MTRS

The MTRS captures and reports on data from two forms: the Virginia uniform traffic summons and the Virginia FR-300P police accident report form. After negotiation with the SPD, certain data elements were selected from these forms for inclusion in the MTRS data files. The following accident data base elements were selected:

1. FR-300P report number;
2. Date of accident (month, day, and year);
3. Day of the week;
4. Hour of the day;
5. Weather conditions;
6. Investigating officer badge number;
7. Location and/or patrol zone;

8. Number of vehicles involved;
9. Vehicle type(s), each vehicle;
10. Vehicle speed(s), each vehicle;
11. Vehicle maneuver(s), each vehicle;
12. Type of collision;
13. Number of pedestrian(s) and bicyclist(s) injured or killed;
14. Age of pedestrian(s) and bicyclist(s) injured or killed, each pedestrian;
15. Sex of pedestrian(s) and bicyclist(s) injured or killed, each pedestrian;
16. Pedestrian actions, each pedestrian;
17. Pedestrian drinking, each pedestrian;
18. Number of vehicle occupants killed or injured, each vehicle;
19. Safety equipment used, each occupant;
20. Age and sex of occupants injured or killed, each occupant;
21. Driver age, each driver;
22. Driver sex, each driver;
23. Driver action, each driver; and
24. Driver drinking, each driver.

The traffic summons data base elements selected were as follows:

1. Traffic summons report number,
2. Date of offense (month, day, and year),
3. Day of the week,
4. Hour of the day,
5. Whether an accident was involved,
6. Court to which referred,
7. Number of violations,
8. Violation type(s),
9. Violator's age,
10. Violator's sex,
11. Officer badge number,
12. Weather conditions, and
13. Location and/or patrol zone.

These elements were selected to meet the following information needs:

1. For accidents--(a) Date, time, and location, (b) severity, (c) contributing factors, and (d) police investigation activity; and
2. For traffic violations--(a) Date, time, and location, (b) selected characteristics of violations, (c) selected characteristics of violators, and (d) police arrest activity.

MTRS Hardware

The MTRS was implemented on an Ohio Scientific Industries (OSI) C-3 OEM microcomputer, which featured 48K Static RAM, 6502A CPU, 2.2-MHz clock, dual 8-in floppy disks (single-sided), a total of 500K bytes of secondary storage, a 9600-baud Microterm ACT-5A CRT terminal, and an 80-cycle/s Epson MX-80 printer. The C-3 OEM comes standard with the manufacturer's OS-65U Ver. 1.3 operating system, which features microsoft interpreted BASIC. Because of the overhead associated with the operating system and the language interpreter, only 24K of main memory is available for user programs. The total purchase price for this unit, including related supplies, was $7300.

Overview of MTRS Functions

The MTRS provides the capability to enter, edit, and store encoded descriptions of each traffic accident and arrest. It features the capability to link traffic incidents (accidents or violations) to street locations and to individual officers. It can also produce a variety of fixed-format reports based on key file variables.

The MTRS is a menu-driven, interactive software system designed to permit even the novice to add and extract traffic safety information with minimal effort. After insertion of either volume 1 or volume 2 (software diskettes) in the computer's A drive, followed by a reset, a system master menu is displayed on the CRT console. After the display, the system prompts for a selection. Depending on the choice, the system either displays another menu, informs the user of a required disk change or insertion, or begins to prompt the user for specific information. This continues until all the parameters necessary to perform a task are identified. After completion of each task, the system returns to the menu last displayed. Each menu is back-linked to its parent menu and ultimately to the master menu.

By using this menu scheme, the user may move around among any of the subsystems. For most functions the user never has to issue an operating system command. The user does, however, have to contend with the operating system in three situations: (a) the initial creation of data disks for MTRS files, (b) preparation of backup copies of MTRS files, and (c) dumps of MTRS files. However, OS-65U system functions are also implemented in a menu-driven scheme similar to that of the MTRS; thus, little user knowledge of system details is required for any task.

The MTRS is divided into three subsystems: the accident subsystem, the traffic summons subsystem, and the auxiliary file subsystem. Each subsystem consists of a data file, file maintenance software module(s), and one or more report-producing programs. The software is physically divided among two diskettes, volumes 1 and 2. Volume 1 contains all auxiliary file subsystem data and programs in addition to all accident subsystem and traffic summons subsystem software that requires access to any of the auxiliary files. Volume 2 contains only accident subsystem and traffic summons subsystem software. Because of their size, the accident records and the traffic summons data files reside on separate diskettes; thus, the entire system resides on a total of four 8-in diskettes.

MTRS File Descriptions

The MTRS software system revolves around creating, maintaining, and accessing data in the files listed below:

File	Length (K bytes)
Accident records	230
Traffic summons	230
Officer badge	7
Street index	32

The file sizes given are those of the Staunton files. There are no software restrictions on the length of these files.

The accident records file (ARF) contains encoded values for each of the elements contained in the listing of accident data base elements given previously, organized in hierarchical, sequential records. Each accident case is represented by one master record, up to 10 vehicle/driver records, up to 10 injured occupant records per vehicle, and up to 3 injured pedestrian or bicyclist records. Table 1 gives the layouts for each of the various record types. Up to approximately 1000 accident cases may be accommodated in the ARF.

The traffic summons file (TSF) contains encoded values for each of the elements contained in the listing of traffic summons data base elements given earlier, organized into sequential records. Each TSF record may accommodate as many as 3 violations per arrest incident (multiple summonses may be issued by the arresting officer). The record layout for the TSF is given in Table 2. As many as 3000 traffic summons records may be accommodated in the TSF.

The officer badge file (OBF) contains the badge number and name of each police officer in the SPD, organized as an indexed sequential (ISAM) file. Badge numbers and names of as many as 150 police officers can be accommodated. This file is used to check the validity of badge numbers entered in the ARF or the TSF and to provide alphabetic counterparts for the badge numbers for certain outputs. The record layout for the OBF is also given in Table 2.

The SIF contains the street name and a three-digit code (index) in the range 100-998 for each of the 450 streets in Staunton, organized as an ISAM file. As many as 899 street names and indices can be accommodated. Like the OBF, the SIF is used to check the validity of encoded accident locations in the TSF or the ARF and to provide alphabetic counterparts to the street codes for certain outputs. The record layout for the SIF is given in Table 2.

Table 1. ARF record layout.

Element	No. of Positions	Data Type	Possible Values[a]
Master record			
Record type	2	Alpha	A = master
Report number	5	Numeric actual	1-9999
Location type	2	Alpha	I = intersection, S = segment
Street index			
#1	4	Numeric code	100-999
#2	4	Numeric code	100-999
#3	4	Numeric code	100-999
Month of accident	3	Numeric actual	1-12
Day of accident	3	Numeric actual	1-31
Year of accident (last two digits)	3	Numeric actual	1-99
Day of week	2	Numeric code	1-7
Hour of occurrence	3	Numeric actual	1-12
Minute of occurrence	3	Numeric actual	00-59
AM or PM	2	Numeric code	1 = AM, 0 = PM
Zone of occurrence	3	Numeric code	1-28
Weather conditions	2	Numeric code	1-7
Badge number	4	Numeric actual	1-150
Number of vehicles	3	Numeric actual	1-10
Number of pedestrians	2	Numeric actual	1-3
Driver/vehicle record layout			
Record type	2	Alpha	V = vehicle
Vehicle type	2	Numeric code	1-7
Vehicle speed	2	Numeric code	1-5
Vehicle collision type	3	Numeric code	1-13
Vehicle maneuver	3	Numeric code	1-15
Age of driver	3	Numeric actual	1-99

Element	No. of Positions	Data Type	Possible Values[a]
Sex of driver	2	Alpha	M = male, F = female
Driver alcohol involvement	2	Numeric code	1-4
Driver action	3	Numeric code	1-18
Driver injury	2	Numeric code	1 = killed, 2 = injured, 3 = not injured
Driver restraint use	2	Numeric code	1-6
Number of vehicle occupants killed or injured	3	Numeric actual	1-10
Occupant record layout			
Record type	2	Alpha	O = occupant
Occupant age	3	Numeric actual	1-99
Occupant sex	2	Alpha	M = male, F = female
Occupant injury	2	Numeric code	1 = killed, 2 = injured
Occupant restraint use	2	Numeric code	1-6
Pedestrian record layout			
Pedestrian type	2	Alpha	P or B = pedestrian or bicyclist
Pedestrian age	3	Numeric actual	1-99
Pedestrian sex	2	Alpha	M = male, F = female
Pedestrian alcohol involvement	2	Numeric code	1-4
Pedestrian injury	2	Numeric code	1 = killed, 2 = injured
Pedestrian action	2	Numeric code	1-7
Vehicle hit by	3	Numeric actual	1-10 (vehicle number)

[a] For numeric-type elements, 0 = unknown/not stated/missing, deleted/not applicable; for alpha-type elements, U = unknown/not stated/missing/not applicable.

Table 2. Record layouts for TSF, OBF, and SIF.

File	Element	No. of Positions	Data Type	Possible Values[a]
TSF	Report number	5	Numeric actual	1-9999
	Location type	2	Alpha	I = intersection; S = segment
	Street index			
	#1	4	Numeric code	100-999
	#2	4	Numeric code	100-999
	#3	4	Numeric code	100-999
	Court of record	2	Alpha	G = general district, J = juvenile
	Violation			
	#1	3	Numeric code	1-18
	#2	3	Numeric code	1-18
	#3	3	Numeric code	1-18
	Total violations	2	Numeric actual	1-3
	Badge number	4	Numeric actual	1-150
	Violator			
	Sex	2	Alpha	M = male, F = female
	Month of birth	3	Numeric actual	1-12
	Day of birth	3	Numeric actual	1-31
	Year of birth (last two digits)	3	Numeric actual	1-99

File	Element	No. of Positions	Data Type	Possible Values[a]
	Violation			
	Zone	3	Numeric actual	1-28
	Month	3	Numeric actual	1-12
	Day	3	Numeric actual	1-31
	Year (last two digits)	3	Numeric actual	1-99
	Day of week	2	Numeric code	1-7
	Hour of occurrence	3	Numeric actual	1-12
	Minute of occurrence	3	Numeric actual	00-59
	AM or PM	2	Numeric code	1 = AM, 0 = PM
	Weather conditions	2	Numeric code	1-7
	Whether accident related	2	Alpha	Y = yes, N = no
OBF	Badge number	4	Numeric actual	1-150
	Officer name	21	Alpha	Any string
SIF	Street index	4	Numeric code	100-999
	Street name	21	Alpha	Any string

[a] For numeric-type elements, 0 = unknown/not stated/missing, deleted/not applicable; for alpha-type elements, U = unknown/not stated/missing/not applicable.

Overview of Major MTRS Functions

MTRS programs can be categorized broadly as file maintenance software or report-generating software. File maintenance programs and their basic functions are summarized in Table 3 and the report-generating programs and their basic functions in Table 4. To better illustrate how the MTRS works, several example functions are discussed in detail below.

Traffic Summons and Accident File Maintenance

ACENTR and TSENTR are the ARF and TSF maintenance modules. Each program has three major components: (a) a data element input and edit component, (b) an element verification feature, and (c) a record deletion facility. The data element entry and editing portion prompts the user with a series of questions regarding each of the elements to be entered in the file. The order of the questions occurs in direct correspondence with the locations of the data elements on the source report forms. Each element is edited at the time of entry for validity and, in some cases, for consistency with other elements. To speed the entry process, system prompts are brief, usually 5-6 words in length. If the user is at a loss as to what is a legal response, he simply hits <CR> in response to any system prompt to produce a brief description of the response options. The original prompt is then reissued by the system. In this way, the user can teach himself how to enter data simply by responding to all system prompts with a <CR>.

The element verification portions of ACENTR and TSENTR permit modification of any element entered during the session for each incident before its entry in the file. After the last system prompt for data, the program displays all of the elements entered for this case and asks whether they are correct. If not, the user may specify the element(s) he wishes to change (one at a time); the system reissues the prompt for each element, edits the response as before, and returns to the verification mode with the now modified element displayed as prescribed. This procedure may be repeated as often as necessary. Eventually, the data will be made correct and the user may release the case to be written to the disk file or reject the case. In the latter situation, no data are written to the file and the program returns to its parent function menu.

ACENTR and TSENTR also permit deletion of a record (by report number only). When the record is found, its report number field is set to zero, which signifies that the record is no longer valid. (Report-generating programs skip over all deleted records.) The rest of the data in the now deleted record remain intact. The result of this procedure is that, over time, garbage records will accumulate in the files as deletions are made. The garbage accumulation problem is handled by execution of the program UTIL, which copies an accident or traffic summons file from one disk to another while eliminating deleted records as it proceeds. The frequency of use is left to the user and depends on the frequency of record deletions.

Table 3. MTRS file maintenance and supervisory software.

Program Name	Description
ACENTR	ARF editing routine: add/verify/delete accident case data
TSENTR	TSF editing routine: add/verify/delete traffic summons data
EDOBF	OBF editing routine: adds, deletes, modifies, lists OBF records
EDSIF	SIF editing routine: adds, deletes, modifies, lists SIF records
UTIL	General file maintenance utility: initializes ARF, TSF, OBF, and SIF prior to first use; copies ARF and TSF; physically deletes "deleted" records
BEXEC	Simulates menu scheme; initializes system; sets up printer and console; toggles certain system features; calls required programs

Auxiliary File Maintenance

The programs EDOBF and EDSIF provide for the addition, deletion, or modification of records in the OBF and SIF, respectively. In addition, these programs can produce a listing of the contents of these files in a directory format. All file transactions result in physical changes on the disk; thus, no garbage records accumulate in these files as in the ARF or the TSF. Records in both files consist of a numeric element (badge numbers or street index) followed by an alpha element (officer name or street

Table 4. MTRS report-producing software.

Program Name	Description of Program
ACACTV	Produces report of accident investigation frequencies by month of year, time of day, day of week, accident severity, and total investigations for given officer
TSACTV	Produces traffic arrest frequencies by month of year, time of day, day of week, court of record, violation type, and total arrests for given officer
HILOC	Identifies streets with more than mean number of traffic incidents
HILST	Produces report of details for locations of incidents occurring on high-incident streets
ACLOC	Produces report of accident frequencies by month, time of day, day of week, driver action, severity, weather conditions, collision type, vehicle maneuver, and total crashes at given location
TSLOC	Produces report of traffic arrest frequencies by month, time of day, day of week, court of record, violation type, and total violations at given location
ACGEN	Produces report of accident frequencies by month, time of day, day of week, severity, driver action, weather conditions, collision type, location type, and total crashes
TSGEN	Produces report of traffic arrest frequencies by month, time of day, day of week, court of record, total violations, violations by type, and weather conditions
ACAGSX	Produces report of frequencies of accidents involving at least one driver with age and sex characteristics specified by the user by month, time of day, day of week, severity, driver action, location type, collision type, weather conditions, and total crashes
TSAGSX	Produces report of traffic arrest frequencies of drivers with age and sex characteristics specified by the user by month, time of day, day of week, court of record, violation type, weather conditions, and total violations
ACALSP	Produces report of frequencies of accidents involving at least one driver with user-specified alcohol involvement characteristics and/or at least one vehicle traveling at user-specified speed by month, time of day, day of week, severity, driver age, driver sex, collision type, weather conditions, and total crashes
TSVIOL	Produces report of traffic arrest frequencies for user-specified violation type by month, time of day, day of week, court of record, driver age, driver sex, weather conditions, and total violations
ACPED	Produces report of frequencies of pedestrian-involved accidents by month; time of day; day of week; severity; pedestrian action, age, sex, and alcohol involvement; vehicle maneuver, vehicle type, and total crashes
ACREST	Produces report of occupant restraint use in injury and fatal crashes by occupant type, age, sex, and type of restraint used

name). Thorough edit checking is provided at the time of entry on the numeric element; however, the alpha element is checked only for length (fewer than 20 characters). Thus, it is up to the user to spell names properly, include punctuation, etc. It is also left to the user to make sure that there are no duplicate names in these files.

Traffic Summons Subsystem Report Generation

Six types of traffic summons reports can be produced by the MTRS:

1. General traffic arrest statistics,
2. Officer activity statistics,
3. Statistics by age and sex of violator,
4. Statistics by type of violation,
5. High-incidence locations, and
6. Traffic arrests at particular locations.

Each report-producing program permits the user to restrict the report content based on the value of certain key variables in the file. All reports can be restricted to any of Staunton's 28 patrol areas, restricted to any block of contiguous months of the year, and routed to the CRT console or Epson printer. The printer output is formatted slightly differently from CRT output in that relative percentages are computed in addition to the frequencies for each variable. A sample traffic summons subsystem report is shown in Figure 1.

Accident Records Subsystem Reports Generation

Eight types of accident reports can be produced by the MTRS:

1. General accident statistics,
2. Officer activity statistics,
3. Statistics by driver age and sex,
4. Statistics by alcohol and speed involvement,
5. Pedestrian and bicyclist accident statistics,
6. Occupant restraint use in accidents,
7. High-accident locations, and
8. Accident statistics at particular locations.

As in the traffic summons subsystem, the report content may be restricted based on the value of key file variables. In addition, reports may be restricted to patrol areas or blocks of contiguous months and may be routed to the CRT console or printer. A sample accident records subsystem report is shown in Figure 2.

FUTURE DIRECTIONS FOR MTRS

Because of funding limitations, full development of the MTRS concept was not achieved in the first-generation model. An application for the funding of a second-generation development effort is pending approval by the Virginia Department of Transportation Safety. The most important area in need of attention is system transportability. Because the system was initially developed for the OSI hardware and operating system, its diskettes cannot be read by non-OSI hardware. This means that any locality that desires to obtain the system will have to either purchase OSI equipment or convert and enter the source code from hard copy. The latter would be very time-consuming because the MTRS consists of several thousand lines of BASIC code.

Figure 1. Sample traffic summons subsystem report.

STAUNTON POLICE DEPARTMENT MAY 2, 1982
TRAFFIC SAFETY INFORMATION SYSTEM

VIOLATIONS BY LOCATION

VIOLATIONS ON AUGUSTA ST.

MONTH OF VIOLATION

	NUMBER	PCT.
MAR	17	33.33
APR	34	66.66
TOTAL	51	

TIME OF DAY

A.M.	NUMBER	PCT.	P.M.	NUMBER	PCT.
12-2	5	9.80	12-2	0	0.00
2-4	12	23.52	2-4	0	0.00
4-6	0	0.00	4-6	2	3.92
6-8	24	47.05	6-8	0	0.00
8-10	0	0.00	8-10	6	11.76
10-12	1	1.96	10-12	1	1.96

TOTAL 51

DAY OF WEEK

	NUMBER	PCT.
MON	20	39.21
TUE	18	35.29
WED	1	1.96
THU	2	3.92
FRI	2	3.92
SAT	3	5.88
SUN	5	9.80
TOTAL	51	

COURT REFERRED

	NUMBER	PCT.
GENERAL DISTRICT	50	98.03
JUVENILE	1	1.96
TOTAL	51	

ACCIDENT INVOLVED?

	NUMBER	PCT.
YES	1	1.96
NO	50	98.03
TOTAL	51	

VIOLATION TYPE

	NUMBER	PCT.
D.U.I.	4	7.84
RECKLESS DRIVING	0	0.00
FAIL STOP FOR POLICE	0	0.00
FAIL OBEY HIWAY MARKING	3	5.88
DEFECTIVE VEH. EQUIP	2	3.92
FAILED TO YIELD	0	0.00
FAIL TO KEEP PROPER LOOKOUT	1	1.96
NO/EXP. INSP. STICKER	1	1.96
NO/IMPROPER REGISTRATION	2	3.92
NO CITY TAG	0	0.00
NO STATE TAG	1	1.96
NO OPERATOR'S LICENSE	2	3.92
HIT AND RUN	0	0.00
SPEEDING	29	56.86
DRIVE ON SUSPENDED LIC.	1	1.96
IMPROPER TURN	0	0.00
FOLLOWED TOO CLOSELY	0	0.00
ALL OTHERS	5	9.80
TOTAL	51	

WEATHER CONDITIONS

	NUMBER	PCT.
CLEAR	28	57.14
CLOUDY	18	36.73
FOG	0	0.00
MIST	0	0.00
RAINING	3	6.12
SNOWING	0	0.00
SLEETING	0	0.00
TOTAL	49	

TOTAL VIOLATIONS 51
TOTAL VIOLATORS 44

Figure 2. Sample accident records subsystem report.

STAUNTON POLICE DEPARTMENT
TRAFFIC SAFETY INFORMATION SYSTEM MAY 2, 1982

GENERAL ACCIDENT STATISTICS

CITY WIDE LEVEL

MONTH OF ACCIDENT

	NUMBER	PCT.
MAR	42	51.21
APR	40	48.78
TOTAL	82	

TIME OF DAY

A.M.	NUMBER	PCT.	P.M.	NUMBER	PCT.
12-2	8	10.25	12-2	6	7.69
2-4	5	6.41	2-4	7	8.97
4-6	0	0.00	4-6	10	12.82
6-8	7	8.97	6-8	7	8.97
8-10	6	7.69	8-10	7	8.97
10-12	10	12.82	10-12	5	6.41

TOTAL 78

DAY OF WEEK

	NUMBER	PCT.
MON	14	17.07
TUE	17	20.73
WED	10	12.19
THU	10	12.19
FRI	12	14.63
SAT	9	10.97
SUN	10	12.19
TOTAL	82	

ACCIDENTS BY TYPE OF LOCATION

	NUMBER	PCT.
INTERSECTION	32	42.66
SEGMENT	43	57.33
TOTAL	75	

ACCIDENTS BY COLLISION TYPE

	NUMBER
AUTO	77
TRUCK	4
MOTORCYCLE	1
MOPED	0
COMMERCIAL BUS	0
SCHOOL BUS	0
ANIMAL	0
BICYCLE	0
PEDESTRIAN	2
TRAIN	0
FIXED OBJECT	11
NON COLLISION	0
OTHER	3

ACCIDENTS BY WEATHER CONDITIONS

	NUMBER	PCT.
CLEAR	49	59.75
CLOUDY	20	24.39
FOG	0	0.00
MIST	4	4.87
RAINING	7	8.53
SNOWING	2	2.43
SLEETING	0	0.00
OTHER	0	0.00
TOTAL	82	

ACCIDENTS BY DRIVER ACTION

	NUMBER
D.U.I. - (C)	12
RECKLESS DRIVING - (C)	13
DISREGARD HIWAY MARKING - (C)	2
SPEEDING - (C)	0
HIT AND RUN - (C)	2
FOLLOWED TOO CLOSELY - (C)	3
FAILED TO YIELD - (C)	7
FAIL KEEP PROPER LOOKOUT - (C)	6
IMPROPER TURN - (C)	1
OTHER IMPROPER DRIVING - (C)	1
IMPROPER TURN - (NC)	1
TOO FAST FOR COND. - (NC)	1
DISREGARD HIWAY MARKING - (NC)	0
FOLLOWED TOO CLOSELY - (NC)	3
FAILED TO YIELD - (NC)	4
DRIVER INATTENTION - (NC)	9
OTHER	13

ACCIDENTS BY SEVERITY

	NUMBER	PCT.
FATAL CRASHES	0	0.00
INJ. CRASHES	10	12.19
PDO CRASHES	72	87.80
TOTAL CRASHES	82	

TOTAL KILLED	0
TOTAL INJURED	14

Another required enhancement of the first-generation MTRS is the removal of all hardware-dependent code, such as screen cursor control commands, idiosyncratic POKES and PEEKS, and nonstandard BASIC commands. These changes, combined with a conversion of the MTRS to a standardized operating system (such as CP/M), would greatly ease the burden of transferring MTRS code from one machine to another.

A second area for consideration is the removal of restrictions on the complexity of accident cases (e.g., restrictions on the number of vehicles, passengers, and pedestrians). This will require a redesign of the accident data entry module to free memory for storage of intermediate data.

A third area for further development is the enhancement of response times for system output. Several approaches are available: (a) conversion of the system to a compiled language, (b) restructuring the accident and traffic summons file to permit faster access to records of interest, and (c) use of preprocessing techniques at the time of data entry to hasten data interpretation at report production time.

A final area for investigation is the expansion of system capabilities to include full location editing at the time of data entry, incorporation of traffic count data for use in normalization of accident distributions for comparison purposes, expansion of the data element list to include more traffic engineering elements (roadway characteristics, traffic control, etc.), incorporation of a multiyear analysis capability, and inclusion of basic statistical functions (and perhaps graphics) to help localities scientifically evaluate traffic safety countermeasures.

CONCLUSIONS

The application of microcomputer technology to the traffic records needs of small-city police agencies appears to offer a practical solution to their information storage, management, and analysis problems. The MTRS produces a variety of outputs that are useful in monitoring general accident and traffic arrest levels; identifying the geographic distribution of accidents and traffic arrests; pinpointing the months, days of the week, and hours of the day when most accidents occur and traffic arrests are made; examining the characteristics of certain classes of accidents and traffic arrests that are of common and continuing interest to all safety agencies; and monitoring the field performance of officers assigned to traffic duties. In addition, the widespread availability of low-cost hardware brings the costs of microcomputer technology within reach of all but the smallest communities.

Such a purchase is even more sensible with the growing availability of software such as the MTRS. Coupled with modern management techniques, the information produced by the MTRS can enhance the efficiency and productivity of police agencies, provide support for justifying programs, and help to reduce the incidence of motor vehicle accidents and traffic violations.

In spite of the success of the first generation of MTRS, work remains to be done to make it an even better product. Areas that need to be investigated include improvement of the transportability of the software, removal of all software restrictions on accident case complexity, enhancement of system response times, and expansion of system capabilities to incorporate traffic engineering and statistical functions.

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Systematic Procedure for Incorporating Exposure Factors in Truck Accident Analysis

SNEHAMAY KHASNABIS AND T.R. REDDY

The development and testing of a methodology for assessing the involvement rate of trucks in highway accidents are described. Existing procedures for incorporating exposure factors in truck accident analysis have been reviewed and their merits and demerits are discussed. Three alternative approaches for analyzing truck accidents are discussed, and approach 3 is identified as the most logical one based on its ability to incorporate exposure factors for arriving at appropriate measures. In the suggested methodology, a set of three vehicle-accident categories are identified: truck-only accident (TOA), passenger-car-only accident (POA), and combined accident (CA). A procedure for developing rates (accidents per vehicle mile of travel) for each category is defined that incorporates appropriate exposure factors. To check the validity of the proposed approach, Michigan accident data for a 10-year period (1970-1979) have been used as a case study. Standard statistical techniques (ANOVA and t-test) were applied. A comparison of accident data among TOAs, CAs, and POAs indicated that there is a significant difference in fatal, personal-injury, and property-damage accident rates when the three vehicle categories are considered together. When a comparison is made between TOAs and POAs, TOA rates are significantly higher for fatal and property-damage accidents. In addition, the CA category, which comprises a significant number of trucks, has generally a higher accident rate compared with others. Overall, trucks appear to have experienced a higher accident rate.

Passenger cars and trucks are the prime users of highway facilities. For example, during the year 1977, a total of 65 000 million vehicle miles of travel (VMT) was generated by all motorized vehicles in the state of Michigan, approximately 11 335 by trucks and 49 000 by passenger cars (1). Thus, approximately 93 percent of all travel in the state is attributable to trucks and passenger cars alone, and the remaining 7 percent of the travel is generated by other vehicles, including buses, motorcycles, and other commercial vehicles. Furthermore, the fact that the relative proportion of travel for these vehicle categories has remained unchanged during the past 10 years indicates that the year 1977 is typical in this respect.

The relative involvement rate of trucks and passenger cars in the incidence of highway accidents has been a topic of research interest for a number of years. In Michigan in the year 1977, a total of 636 259 vehicles were involved in all highway accidents--91 000 trucks and 505 000 passenger cars. This indicates that more than 95 percent of all vehicles involved in accidents were either trucks or passenger cars (1). A review of the national accident data base for the year 1977 shows that the same proportion generally holds true when all accidents on the nation's highways are considered (2). Table 1 gives the data compiled for the nation and for Michigan. Furthermore, when one considers fatal accidents alone, similar trends generally hold true when nationwide data are compared with Michigan data. As Table 1 indicates, approximately 18 percent of all vehicles involved in fatal accidents in Michigan in 1977 were trucks and 62 percent passenger cars. Corresponding figures compiled on a nationwide basis are 22 and 67 percent, respectively.

PROBLEM STATEMENT

The intent of the above discussion was to present some basic accident and exposure data and to demonstrate that the state of Michigan is typical of most states in the nation relative to highway accidents and that in terms of both travel and accidents the role of trucks is significant. However, little research reported in the literature addresses the question of whether trucks are carrying a heavy or light share of highway accidents. The purpose of this paper is to develop and test a methodology for assessing the relative involvement of trucks in highway accidents.

As a part of this methodology, one must establish at the outset an appropriate measure that can be used to compare accident experience by different vehicle categories over an extended time period. The development of such a measure appears to be a simplistic task; however, certain conceptual and operational problems must be resolved when the objective is to separate accident data into two or more vehicle categories (i.e., trucks, passenger cars, etc.). The problem arises from an apparent lack of agreement among traffic experts as to what constitutes exposure to accident, particularly when a comparison of accident data by different vehicle categories is involved. Although limited research in the area of exposure estimation has been reported in the literature, there is little agreement among researchers on how to incorporate exposure factors in accident analysis (3-5).

The problem addressed in this study is the ques-