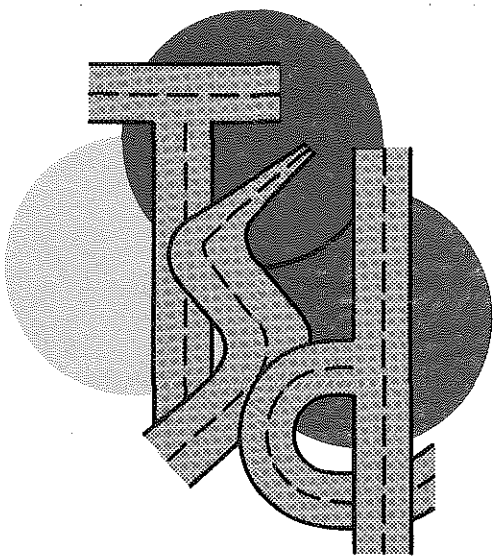
AN INVESTIGATION OF WEATHER FACTOR EFFECTS ON TRAFFIC ACCIDENTS

TSD-TR-196-72



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

65-8875

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January 1972

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SECTION 1.0

INTRODUCTION

The work reported here began with the idea that traffic accidents are related in some way to weather phenomena. Other investigations* have shown weather to be important in influencing physiological characteristics of people and it was believed that the same effects might contribute to abnormal driving behavior. The theory is reinforced by personal subjective observations that weather system activity, such as passage of a cold front, produce noticeable behavior changes in people.

Thus, a statistical study was designed to perform a preliminary pilot investigation of the theory.

Data was available for the study area in sufficient detail to perform a statistically sound analysis.

For Ingham County Michigan accident information on state trunkline highways was on file hour by hour for the entire 1968 calendar year. Permanent traffic recorder data, at a station in the southern part of the county was also on hand for the same hours. Further, weather bureau data from an airport weather station in the northwest corner of the county provided hourly details of wind speed, temperature, humidity, barometric pressure and precipitation.

Using this data base several estimates and statistical tests were possible.

* See Reference 6.2.2 and 6.2.6

The following detailed analysis demonstrates the relationships which were found and suggests that further work will build on the findings in devising counter measures for the ever increasing incidence of traffic accidents.

SECTION 2.0

DISCUSSION OF PROJECT

2.1 APPROACH

One of the practical problems in testing the theory that there is a relationship between atmospheric conditions and traffic accidents is the relatively infrequent occurrence of accidents coupled with the rapid change in weather over short periods of time. A basic assumption is that any correlation which might exist is very sensitive to short time changes in the variables.

Another problem is the number of variables which might contribute to accidents. Not only are temperature, pressure, wind speed, humidity and precipitation of interest, but season, light conditions, traffic volumes and rates of change of these factors may be important.

It is difficult to perform studies of this type, of a sufficiently microscopic nature, that will provide insight into some of the more subtle and obscure interrelationships.

Fortunately, in the present study, a very large and detailed data base is available which greatly increases the accuracy of the estimates. In fact, 8,784 data points, each containing one dependent and eight independent variables, are used in the analysis.

The analysis uses techniques of both polynomial regression and stepwise regression.

2.2 STUDY AREA

The area selected for the study was Ingham County, Michigan, (Figure 1) which had an estimated 3,599,000 average daily vehicle miles traveled in the year 1968. This includes 1,608,000 vehicle miles on the state trunkline system and 1,991,000 vehicle miles on local roads and streets.

Some other statistical factors for the County are:

Population: 261,000

Area: 535 square miles

Altitude: 863 feet above sea level

Topography: Gently rolling glacial till

Location: South Central Michigan

Urbanization: More than half of the population is concentrated in Metropolitan Lansing in the County's northwest corner.

2.3 DATA RESOURCES

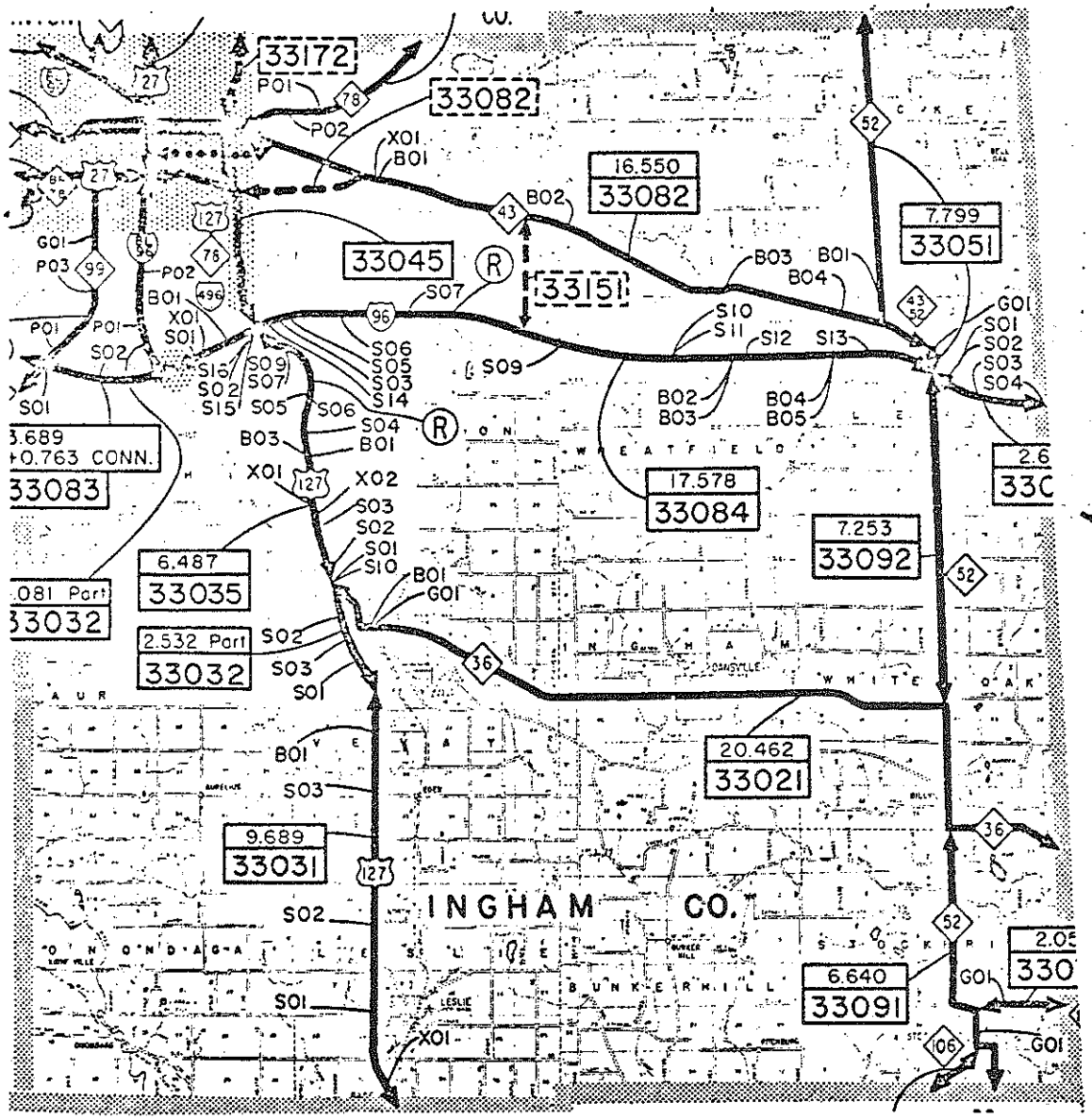
Base data was obtained from the following three sources:

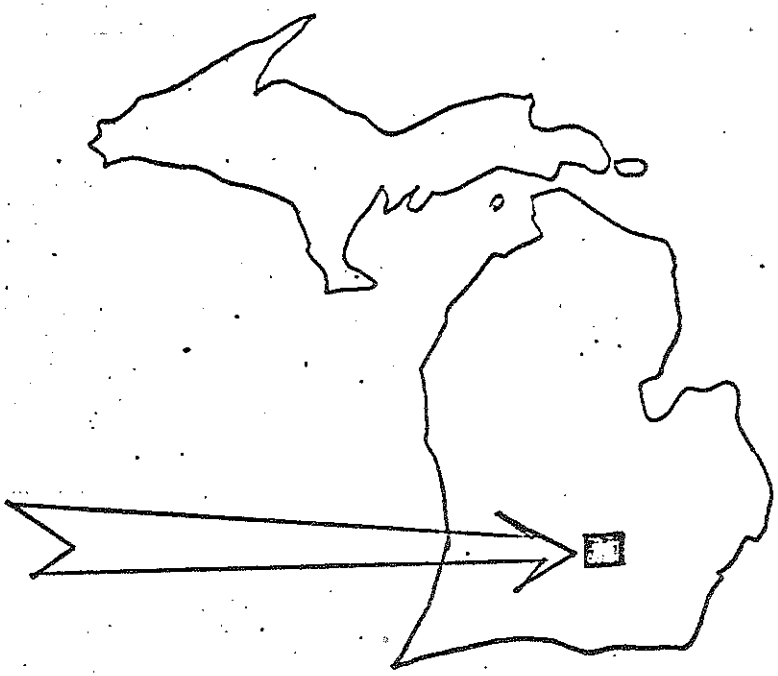
1. Hourly distribution of accidents in Ingham County for the year 1968 was obtained from Michigan Department of State Highways New Accident Master file 1968 which is a magnetic tape record of each accident as obtained from police records. This data was tabulated hourly

and graphed daily for the study (Appendix 7.5).

2. All the information on weather conditions came from WBAN Forms 10A and 10B 1968 (see Appendix 7.2) and table of local climatological data (Appendix 7.3) obtained from the ESSA weather station at Lansing's Capital City Airport.

3. Data for total hourly vehicle miles traveled in Ingham County 1968 were received from Michigan Department of State Highways Planning Division estimates based on data accumulated at a permanent traffic recorder station on US-127 in the Southwestern part of the County.





INGHAM COUNTY

- FIGURE 1 -

SECTION 3.0

STATISTICAL ANALYSIS

The major objective of this statistical investigation is to establish relationships which make it possible to predict accident rates in terms of weather factors.

In any system in which variable quantities change, it is of interest to examine the effects that some variables exert on others. There may, in fact, be a simple functional relationship between variables.

More often, there exists a functional relationship which is too complicated to grasp or to describe in simple terms. In the latter case, we may wish to approximate this relationship by some simple mathematical function such as a polynomial, which contains the appropriate variables and which graduates to or approximates the true function over some limited ranges of the variables involved. By examining such a graduating function we are able to learn more about the underlying true relationship and to appreciate the separate and joint effects produced by changes in certain important variables.

3.1 STEPWISE REGRESSION

To choose weather variables which contribute to the best regression equation for accident rates, stepwise regression has been selected as one means of performing the analysis.

This technique is a method which inserts variables, in turn, until the regression equation is satisfactory. The order of insertion is determined by using the partial correlation coefficient. Also the partial F criterion for each variable in the regression at any stage of calculation can be evaluated and compared with a preselected percentage point of the appropriate F distribution as a measure of the importance of variables.

All of the data for accident rate, temperature, pressure, wind speed, precipitation, pavement condition (wet or dry) and relative humidity were calculated in this way and some of the results follow. The detailed computer program is shown in Appendix 7.4 and outputs are included in Appendix 7.6.

3.1.1 Selected Outputs of Stepwise Regression Analysis

VARIABLES

1 Accident Rate (588.528 accidents/100MVM*)
2 Wind Speed (kts/hr)
3 Pressure (inches of Mercury)
4 Temperature (degrees Fahrenheit)
5 Precipitation (Yes [1] and No [0])
6 Pavement (Wet [1] and Dry [0])
7 Season (Spring [1], summer [2], fall [3], winter [4])
8 Light (Day [1], night [0])
9 Relative humidity (%)

* For calculating convenience the scale of accident rate used was 588.528 accidents/100MVM which was derived by dividing total county accidents by the total vehicle miles traveled on state trunkline highways. Adjustment will be needed in the later regression equation.

	1	2	3	4	5	6	7	8	9
1	1.00000								
2	0.03206	1.00000							
3	0.01171	0.05991	1.00000						
4	-0.07540	-0.03600	0.11856	1.00000					
5	0.10185	0.21762	-0.01710	-0.19056	1.00000				
6	0.09840	0.25211	-0.00189	-0.20874	0.57521	1.00000			
7	0.04067	0.06934	0.13566	-0.46055	0.18655	0.18896	1.00000		
8	-0.02737	0.27444	0.04975	-0.15519	0.02805	0.02506	-0.02386	1.00000	
9	0.06517	-0.19853	-0.03237	-0.28965	0.28630	0.31024	0.40482	-0.29777	1.00000

CORRELATION MATRIX

TABLE I

The correlation matrix (Table I) indicates the correlation coefficients between each two variables. Those numbers whose absolute value is greater than 0.1 are considered to have a significant linear correlation. Significance at this low level is because of the large sample size. Part of the weather phenomena can be explained (Table II) by the matrix.

Matrix Cell	Coefficient	Factors with Significant Correlation
r_{25}	0.21762	High wind during precipitation
r_{28}	0.27444	Average wind speed was higher in the daytime
r_{29}	-0.19853	Relative humidity was higher during low wind periods
r_{37}	0.13566	Relatively lower pressures in the winter
r_{39}	-0.03237	Station pressure and relative humidity were not linearly related
r_{45}	-0.19056	Temperature was lower during precipitation
r_{49}	-0.28965	High relative humidity is associated with low temperature
r_{89}	-0.29777	Relative humidity was much higher at night

RELATED VARIABLES

TABLE II

3.1.2 Predictor Equations

The stepwise regression analysis (for details, see Appendix 7.6) shows the best linear estimating regression equation contains five independent variables. The variables are: precipitation, temperature, pavement condition, lighting and pressure. The predictor equation is

$$Z = 401.61162 + 21.18455\ x_3 - 4.76194\ x_4 + 321.85034\ x_5 + 206.92091\ x_6 - 92.29595\ x_8 \quad \text{----------(I)}$$

Where Z = accidents/100MVM

x_3 = pressure

x_4 = temperature

x_5 = precipitation

x_6 = pavement condition

x_8 = light

Relative humidity, season variation and wind speed are less significant and can be neglected in the present regression model. However, for the record, a regression equation containing all the variables has been obtained as follows.

$$Z = 188.21844 + 6.40217\ x_2 + 23.90953\ x_3 - 5.14056\ x_4 + 302.82151\ x_5 + 181.14274\ x_6 - 32.22558\ x_7 - 80.86255\ x_8 + 2.90268\ x_9 \quad \text{----------(II)}$$

Where x_2 = wind speed

x_7 = season

x_9 = relative humidity

The practical range of possible accident rates (Z) from the model, controlled by the range of independent variables, is of interest and will be shown below.

In equation (I) Z maximum = 1630.74086 accidents/100MVM and occurs at:

x_3 = 30 (High pressure)

x_4 = -10 (Low temperature)

x_5 = 1 (Precipitation)

x_6 = 1 (Wet pavement)

x_8 = 0 (Night time)

Z minimum = 467.109 accidents/100MVM and occurs at:

x_3 = 28 (Low pressure)

x_4 = 95 (High temperature)

x_5 = 0 (No precipitation)

x_6 = 0 (Dry pavement)

x_8 = 1 (Day time)

It should be noted that the range of x_3 is very small in relation to the other factors but yet when multiplied by its coefficient produces a relatively large effect on Z. Above, in calculating Z maximum the highest observed pressure was used but the lowest observed pressure would only decrease the theoretical maximum by less than three percent. In nature it is unlikely, based on our data, that high pressure will be found with low temperatures. This point

is important because the above calculations might be misleading in trying to determine causes and effects. In fact, it will be shown later in the polynomial regression analysis that pressure is negatively, but significantly, related to accidents. Also, the added sensitivity of the polynomial equation will likely produce results of a higher accuracy level.

3.2 POLYNOMIAL REGRESSION

For further refinement of our analysis we will now turn to higher order calculations.

Most physical relationships between two variables can be approximated quite adequately by a polynomial of sufficiently high degree, at least within limited ranges of the variables under consideration.

Polynomial Regression Analysis up to the 4th power will be used to find single factor relationships between accident rate and 1) wind speed, 2) station pressure and 3) temperature, respectively.

3.2.1 Wind Speed

Predicted Equation

$$Y = 732.17527 - 7.62502\ x + 3.63592\ x^2 - 0.20107\ x^3 + 0.00299\ x^4 \quad \text{----------(III)}$$

Where $0 \leq x \leq 35$

Y = Hourly Accident Rate (# of accidents/100MVM)

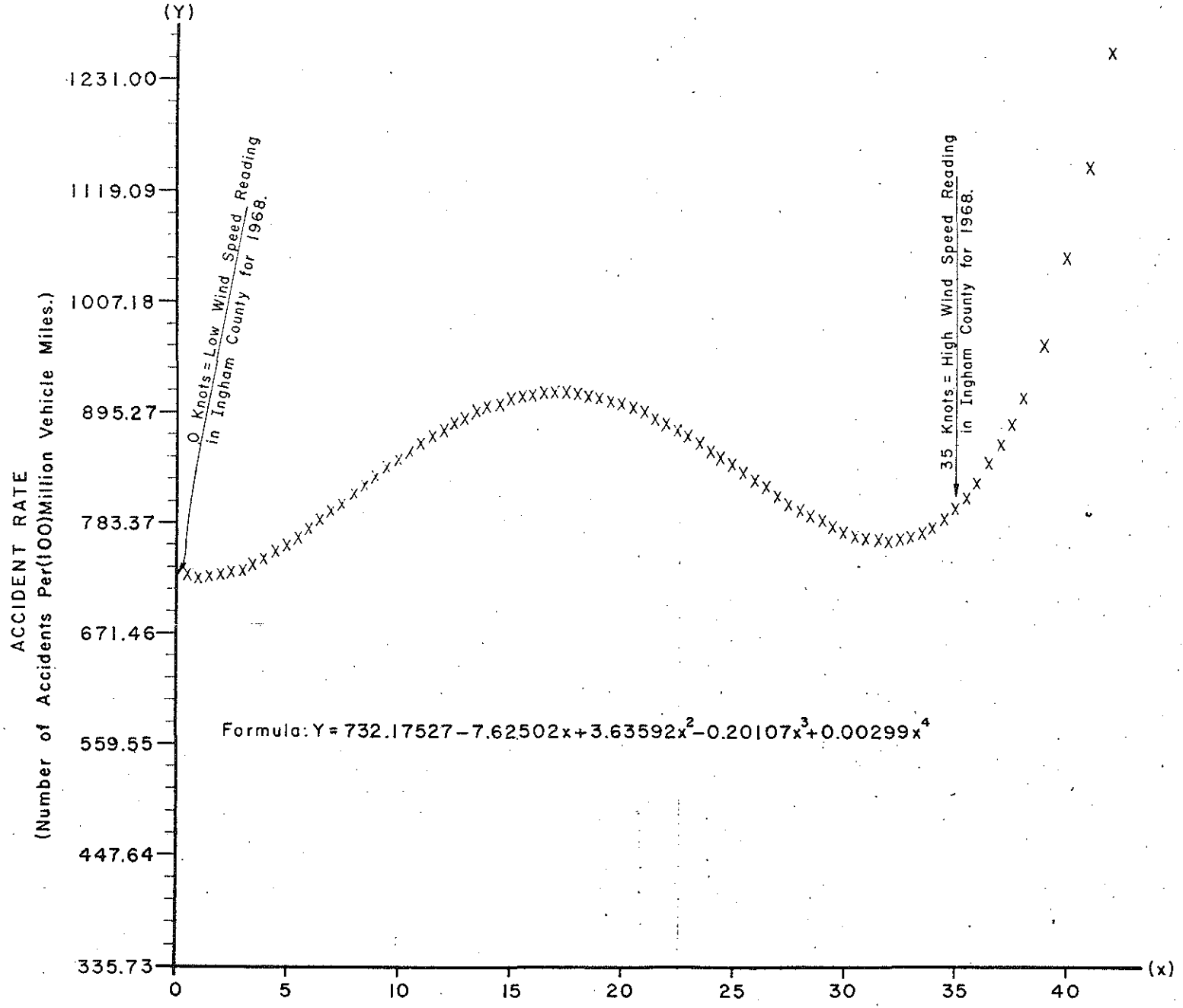
x = Wind Speed in kts/hr*

Yields Y max. = 917.65544

Y min. = 727.4098

(See Figure 2)

* 1 knot = 1.15 miles



WIND SPEED RANGE - 0 KNOTS TO 42 KNOTS
(NOTE: 0 Knots to 35 Knots = Wind Speed Range in Ingham County for 1968.)

Figure 2

Source of Variation	D.F.	Mean Squares	F
Treatment	4	332091605.250	2.51038
Error	8620	132287269.497	
Total	8624	132378943.122	

$$F_{.01,4,8620} = 3.40 > 2.51038$$

ANOVA TABLE (ANALYSIS OF VARIANCE)

TABLE III

Therefore, do not reject H_a: The change of wind speed did not affect accident rate significantly. However, equation III gives a general picture of wind speed related to the accident rate.

In further review of the data it was thought rate of change of short time data fluctuations might be important.

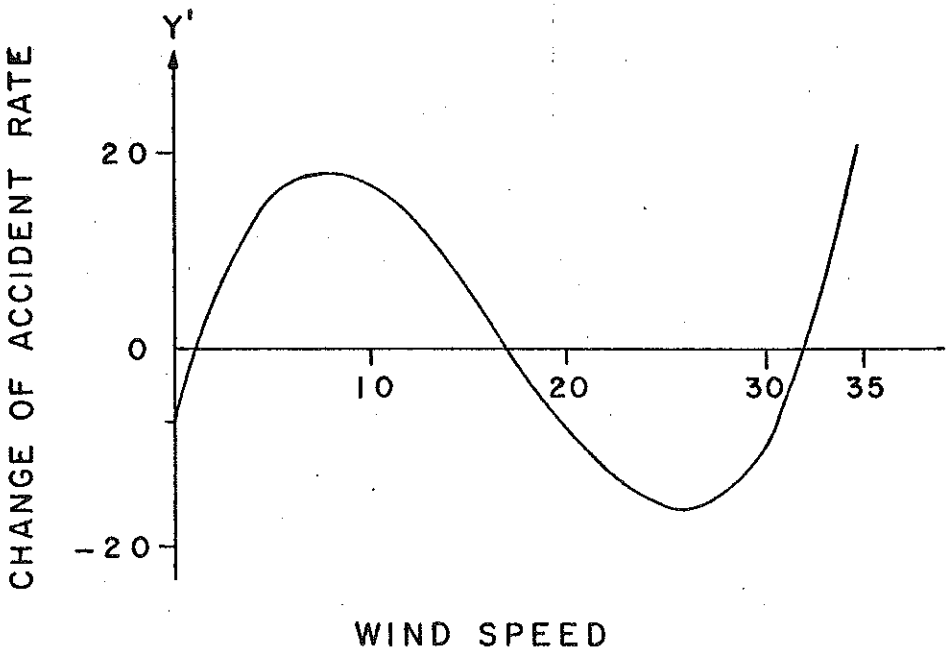


Figure 3

Figure 3 gives the change of accident rate with respect to the wind speed.

$$Y' = -7.6332 + 7.27185\ x - 0.60323\ x^2 + 0.01199\ x^3$$

This means the largest change of accident rate occurs at 8 kts/hr, which increases almost 20 accidents/100MVM by adding one knot of wind speed.

3.2.2 Station Pressure

Predicted Equation

$$Y = 500.04193 + 309.06988\ y - 0.53548\ y^3 + 0.00626\ y^4 \quad \text{----------(IV)}$$

Where $28 \leq y \leq 30$

Y = Accident rate (# of accidents/100MVM)

y = Inches of mercury of station pressure

Yields Y max. = 1250.92103

Y min. = 391.6822

Source of Variation	D.F.	Mean Squares	F
Treatment	3	1237808078.838	9.37767
Error	8621	131995269.490	
Total	8624	132379944.190	

Where $F_{.01,\ 3,\ 8621} = 2.6 < 9.37767$

ANOVA TABLE

TABLE IV

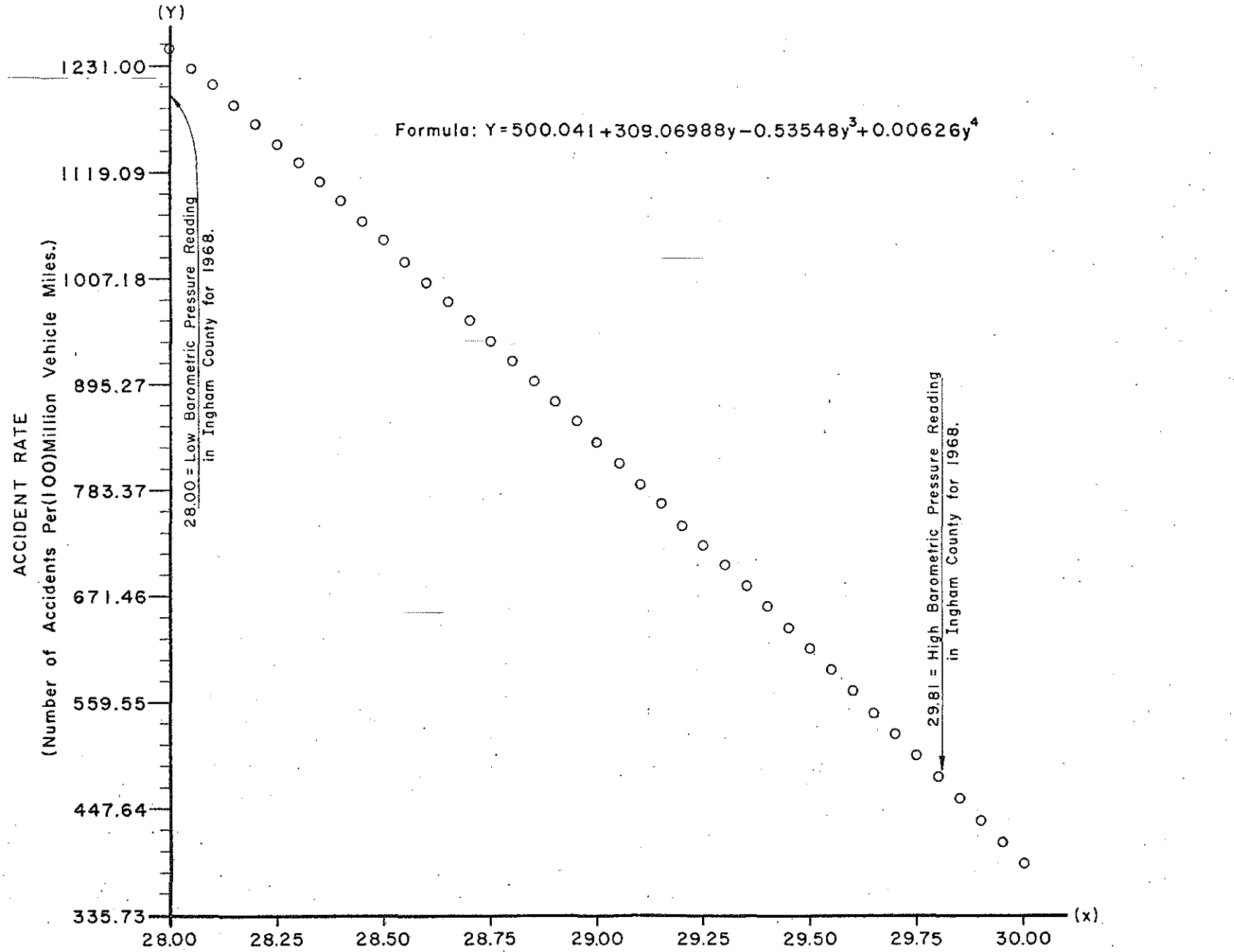

(Y)
1231.00
1119.09
1007.18
895.27
783.37
671.46
559.55
447.64
335.73
ACCIDENT RATE
(Number of Accidents Per(100)Million Vehicle Miles.)
Formula: Y=500.041+309.06988y−0.53548y³+0.00626y⁴
28.00 = Low Barometric Pressure Reading in Ingham County for 1968.
29.81 = High Barometric Pressure Reading in Ingham County for 1968.
(x)
28.00
28.25
28.50
28.75
29.00
29.25
29.50
29.75
30.00
BAROMETRIC PRESSURE RANGE - 28.00 TO 30.00 INCHES OF MERCURY.
(NOTE: 28.00 Low to 30.00 High-Inches of Mercury = Barometric Pressure Range in Ingham County for 1968.)

Figure 4

Hence reject H_0 : y = o. Station pressure then has a significant effect on the accident rate with the predictor equation IV. Y monotonically decreases which means low air pressure is related to higher numbers of accidents. The relationship is plotted in Figure 4.

Figure 5 shows the change of accident rate decreases from -400 to -460 accidents/100MVM when the pressure goes up from 28 to 30 inches of mercury. It indicates accident rates decrease faster as the pressure goes up.

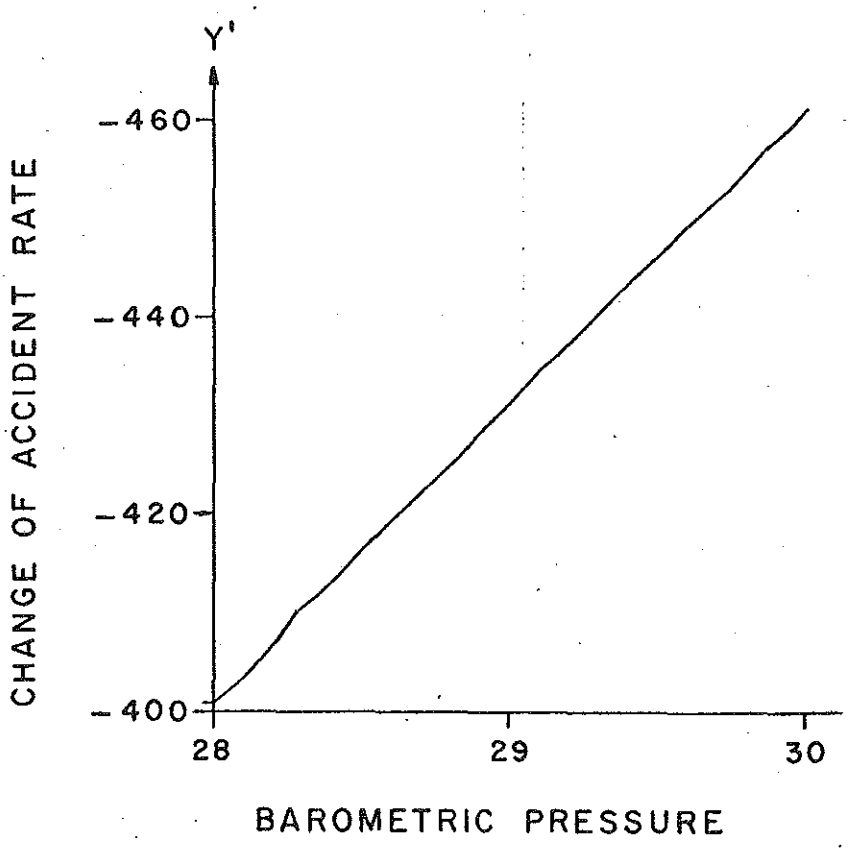


Figure 5

3.2.3 Temperature

Predictor Equation

$$Y = 964.32829 + 13.50999\ z - 0.68689\ z^2 + 0.00874\ z^3 - 0.0000367\ z^4 \quad \text{(V)}$$

Where $-10 \leq z \leq 95$

Y = Accident rate (# of accidents/100MVM)

z = Degree of temperature Fahrenheit

Yields Y max. = 1042.09847

Y min. = 514.78232

Source of Variation	D.F.	Mean Squares	F
Treatment	4	1709098907.946	12.98231
Error	8620	131648289.707	
Total	8624	131785407.720	

Where $F_{.01,4,8620} = 3.80 < 12.98231$

ANOVA TABLE

TABLE V

Reject H_0 : z = o which shows temperature is an important significant factor related to accidents. It ranged from $-10^{o}F$ to $95^{o}F$ during the year and the highest accident rate happened around $13^{o}F$. The lowest accident rate occurred during warmer weather (See Figure 6).

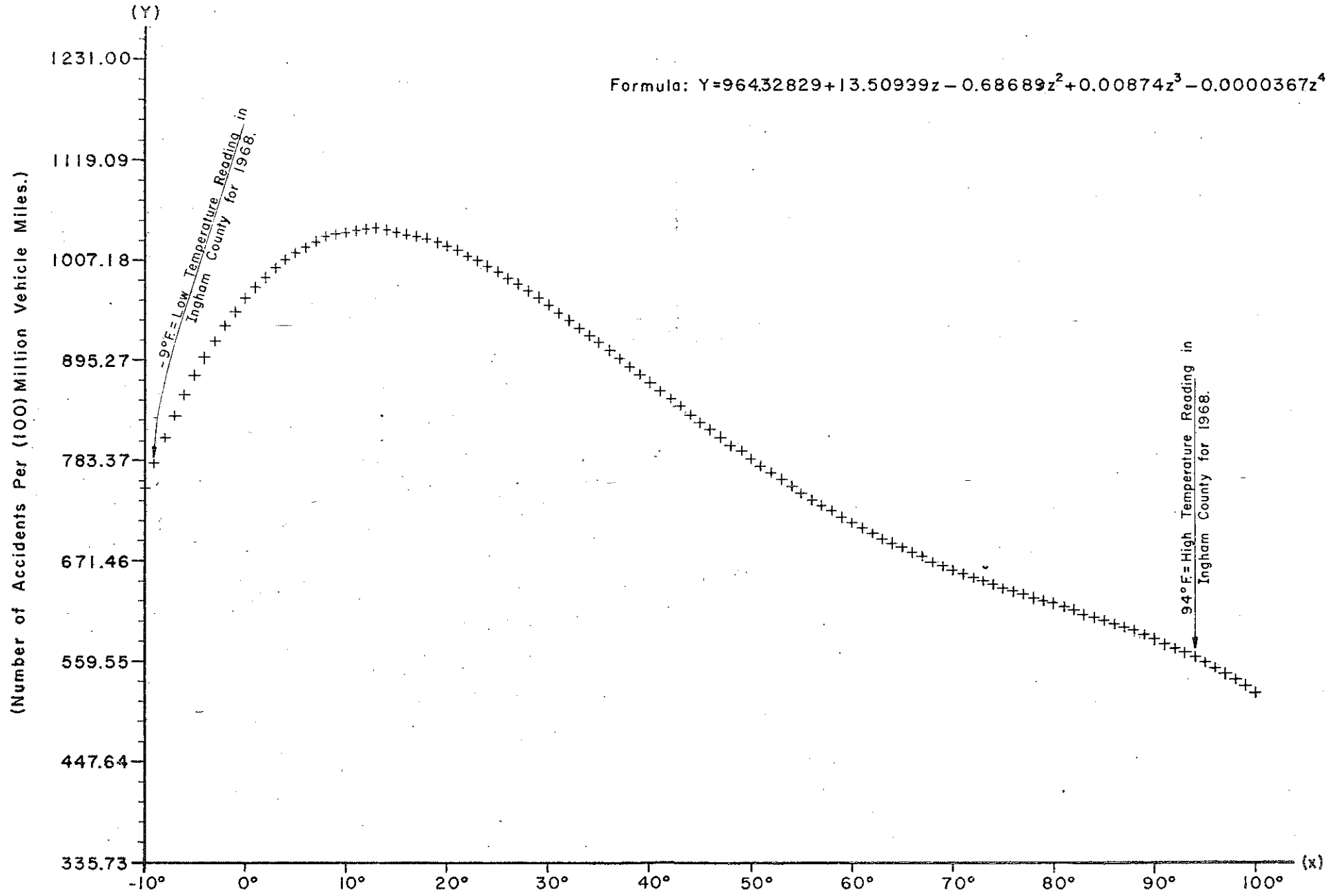

(Y)
1231.00
1119.09
1007.18
895.27
783.37
671.46
559.55
447.64
335.73
ACCIDENT RATE
(Number of Accidents Per (100) Million Vehicle Miles.)
Formula: Y=964.32829+13.50999z−0.68689z²+0.00874z³−0.0000367z⁴
-9°F.=Low Temperature Reading in Ingham County for 1968.
94°F.=High Temperature Reading in Ingham County for 1968.
-10°
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
(x)
TEMPERATURE RANGE -10°F. to 100°F.
(NOTE: Low -9°F. to High 94°F.=Temperature Range in Ingham County for 1968.)

Figure 6

$$Y' = 13.50999 - 1.37379\ y + 0.0262471\ y^2 - 0.0001468\ y^3$$

Change of accident rate with respect to the temperature is very high during the low temperature area which ranges from -10 to 5. It becomes relatively stable after the temperature reaches around 20°F (See Figure 7).

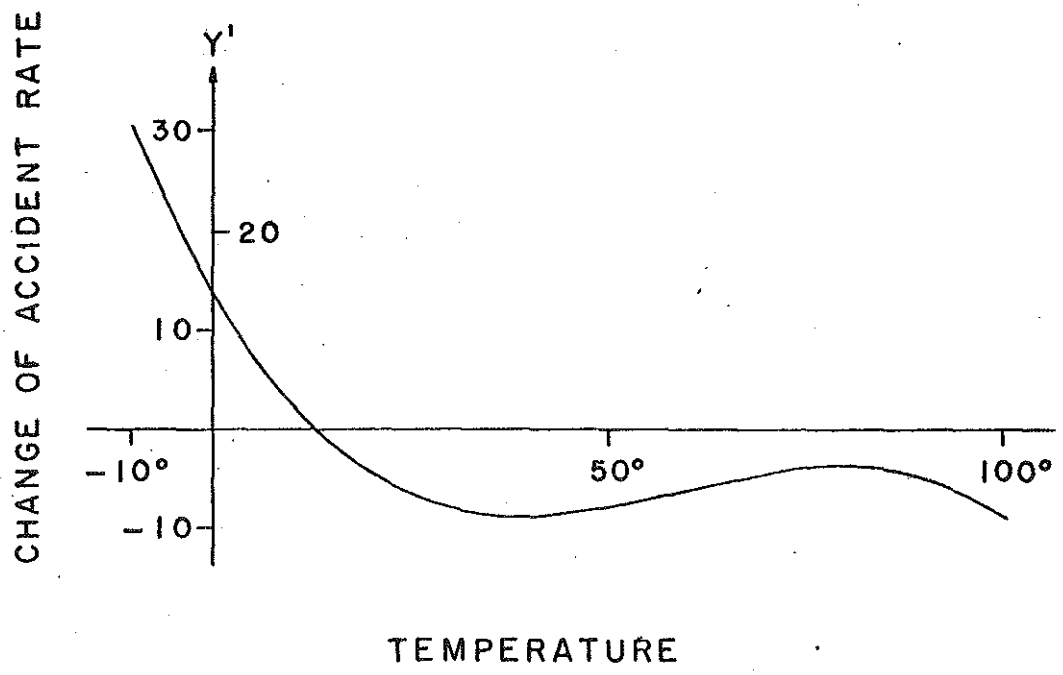


Figure 7

3.3 RATE OF CHANGE

In addition to the previous analysis further visual inspection of graphical material was tried to see if other rate of change relationships could be detected. This differs from the earlier calculations on rate of change since a direct side by side comparison of drastic change will be attempted. Before, by the nature of the analysis, means of change of accident rates related to a specific weather factor value were used. Here, rate of change of both independent and dependent variables will be viewed simultaneously.

It seems important to inspect appropriate graphs (Figures 8-1, 8-2, 8-3) to detect if there are direct effects of accident rate during sudden changes of pressure and temperature. These sudden changes may have been obscured by the numerical analysis. Nine days have been randomly selected for the graphs whose data are plotted hourly. All the graphs are in the same scale even though range of the data may be different each day.

By inspecting these nine sets of charts, specific relationships between accident rate and the sudden change of pressure or temperature could not be found.

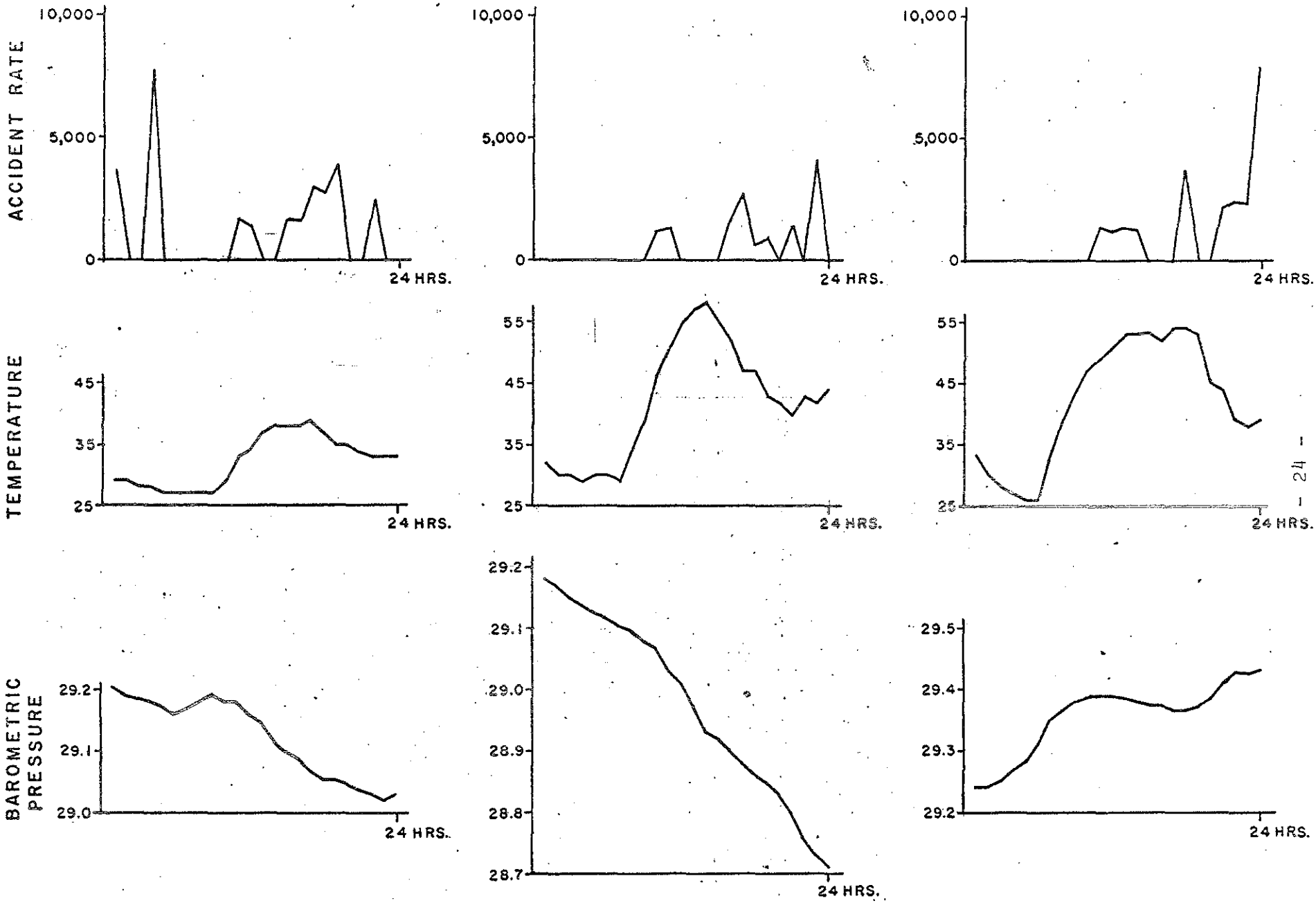
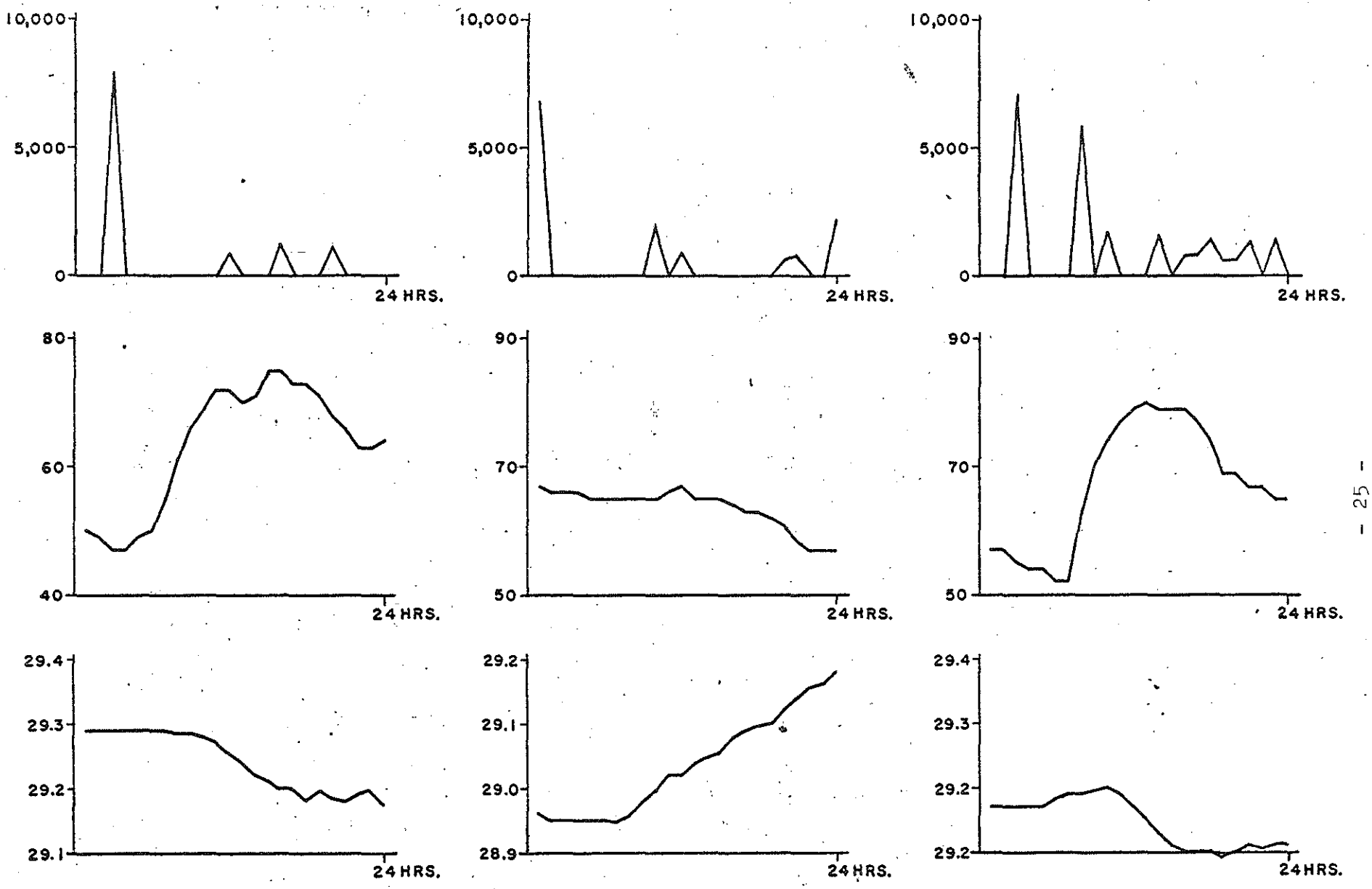
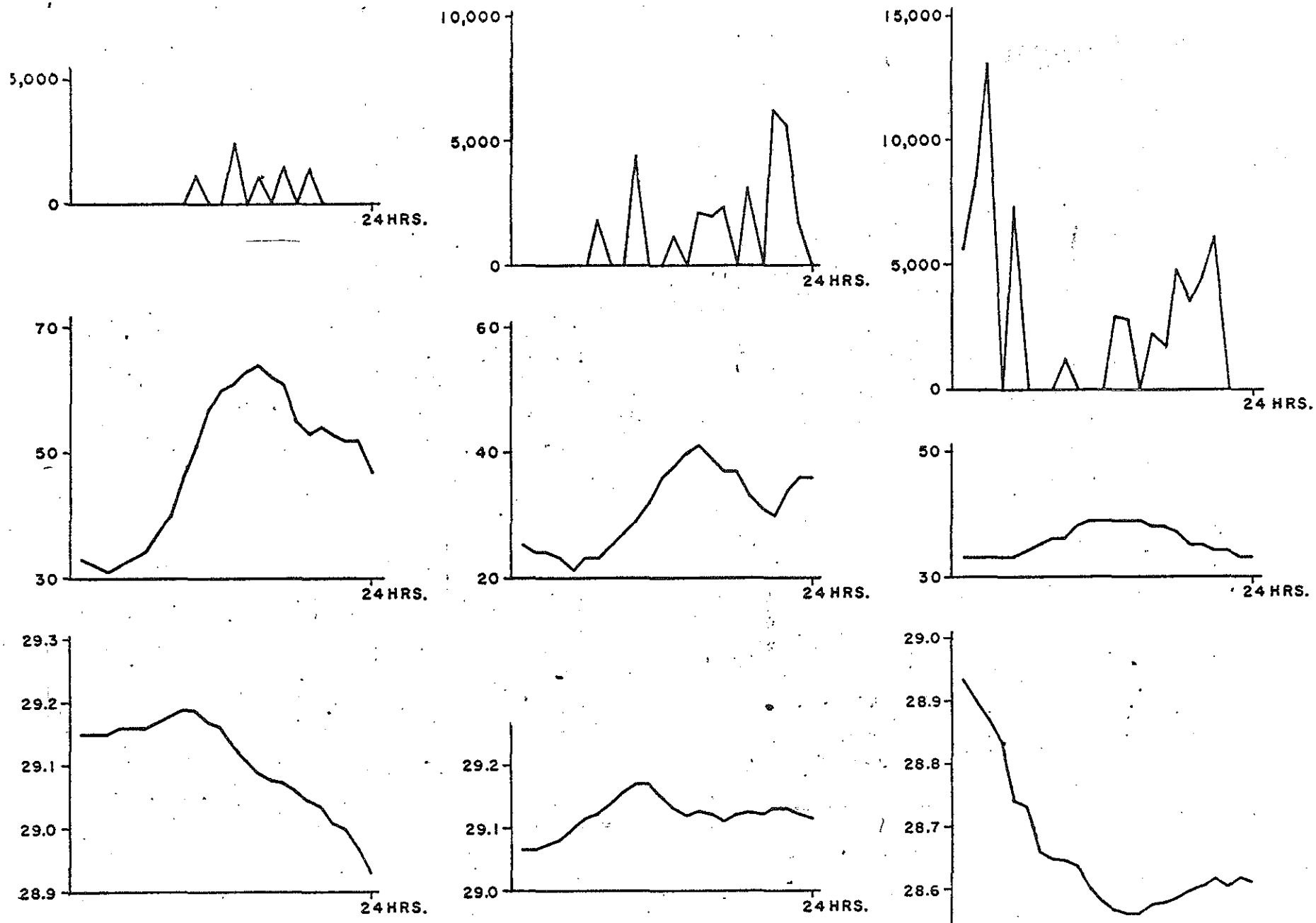

ACCIDENT RATE
10,000
5,000
0
24 HRS.
TEMPERATURE
55
45
35
25
24 HRS.
BAROMETRIC PRESSURE
29.5
29.4
29.3
29.2
29.1
29.0
28.9
28.8
28.7
24 HRS.
JANUARY 20,1968.
MARCH 8,1968.
MAY 6,1968.

Figure 8-1



JULY 4,1968. AUGUST 25,1968. SEPTEMBER 15,1968.

Figure 8-2



OCTOBER 21, 1968.

NOVEMBER 13, 1968.

DECEMBER 19, 1968.

Figure 8-3

SECTION 4.0

CONCLUSIONS

From the data and the derived estimates the following may be concluded:

1. Stepwise regression analysis showed the priority rankings, among weather factors having an effect on traffic accidents, were 1) precipitation, 2) temperature, 3) pavement condition, 4) lighting, 5) pressure, 6) relative humidity, 7) season variation and 8) wind speed. The last three factors were less significant.

2. Polynomial regression analysis for station pressure alone showed a strong effect on accident rate due to the change of pressure. Low air pressure corresponded with higher accident rates and the change of accident rate was higher during low pressure periods.

3. Low temperature periods had much higher accident rates. Change of accident rate dropped sharply from $-10^{\circ}F$ to $+15^{\circ}F$ and then became stable all the way to $+95^{\circ}F$.

4. Sudden changes of either pressure or temperature could not be shown through visual inspection of plotted data to have a direct effect on the accident rate.

SECTION 5.0

RECOMMENDATIONS

As stated at the outset, this has been a very preliminary study to test the idea that weather is associated with traffic accidents.

Important findings are that 1) change of temperature at low temperature ranges, 2) precipitation and 3) change of pressure are indeed related to accidents.

It is suggested these findings warrant further detailed investigation. Since the three factors may be all related to storm systems an additional study of electromagnetic effects may be in order.

Once underlying causes and effects are better understood countermeasures can then be devised. For instance, artificial pressurization in vehicles may be warranted. This can be better evaluated by comparing accident rates, in cooler weather when vehicles are likely to be closed, between urban and rural areas. Rural driving is faster and thus passenger compartment pressure should be higher.

Another possible countermeasure would be public advisories of high risk driving hours.

At any rate, the work reported here provides evidence that weather affects accidents. The work should be carried further.

SECTION 6.0

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SECTION 7.0

APPENDICES

Appendix 7.1: Form 2350 G, Table of Michigan Highway Accident Master Tape

Appendix 7.2: WBAN Form A & B, Table of Surface Weather Observation at Lansing

Appendix 7.3: Table of Local Climatological Data at Lansing

Appendix 7.4: B5500 Computer Cobol Disk Compiler

Appendix 7.5: Daily Accident Distribution Chart of Ingham County 1968

Appendix 7.6: Output of the Stepwise Multiple Linear Regression Analysis

APPENDIX 7.1

FORM 2350 G, TABLE OF MICHIGAN HIGHWAY ACCIDENT MASTER TAPE

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
MANAGEMENT SERVICES DIVISION
DATA PROCESSING SECTION

Accident Master (New) _____ (year)

Q24001 (converted to 800 cpi)
Q24010 Create & Merge
Q24005 Conversion to New (years 1963→196
Q24020 Gen. Acc. Prog

Form 2350G

Tape _____ RECORD – TITLE _____ PROGRAM NO. _____ PAGE 1 of 1

CHAR		FIELD DESCRIPTION	CHAR		FIELD DESCRIPTION	CHAR		FIELD DESCRIPTION
1		District	41		TEA	81		Fatalities LS-7 (OTHER DIST. VEH. also)
2			42		Traffic Control	82		
3		Control Section Number	43			83		Injuries LS-7
4			44		Special Tags	84		
5			45			85 114 143		Vehicle Subscript
6			46		S.P. Acc. Type (STATE POLICE)	86 115 141		Vehicle Make
7			47			87 116 145		
8		Mileage Location on Control Section	48		where SP Acc Analysis	88 117 146		Age
9			49		how	89 118 147		
10			50			90 119 148		Residence
11			51		Hwy. Acc. Type	91 120 149		Sex
12			52		No. of Moving Vehicles	92 121 150		Degree of Injury
13		Hwy Area Type	53			93 122 151		Intent or Action
14		Hwy Area Code	54		SP-1	94 123 152		
15			55		SP-2	95 124 153		Violation
16		Day of Week	56		Population Code	96 125 154		
17		Time of Day	57		Fatalities LS-1 (CARS/TRUCKS/BUSES/CONSTR. EQUIP.)	97 126 155		Circumstance
18			58			98 127 156		
19		Month	59		Injuries LS-1 (CARS/TRUCKS/BUSES/CONSTR. EQUIP.)	99 128 157		Visual Obstruction
20			60			100 129 158		
21		Day Date	61		Fatalities LS-2 (PASSENGERS TOTAL VEHICLES)	101 130 159		Restriction
22			62			102 131 160		Drinking
23		Year	63		Injuries LS-2 (PASSENGERS TOTAL VEHICLES)	103 132 161		
24			64			104 133 162		Object Hit
25		County Code SP City Code	65		Fatalities LS-3 (PEDESTRIANS)	105 134 163		
26			66			106 135 164		Situation
27		City or Twp Code	67		Injuries LS-3 (PEDESTRIANS)	107 136 165		
28			68			108 137 166		Vehicle Type
29		Route Class	69		Fatalities LS-4 (MOTORCYCLES BICYCLES)	109 138 167		Vehicle Style
30		Route Number	70			110 139 168		Vehicle Condition
31			71		Injuries LS-4 (MOTORCYCLES BICYCLES)	111 140 169		Trailer
32			72			112 141 170		Yr. Vehicle Mfgd.
33		Weather	73		Fatalities LS-5 (FARM TOTAL VEHICLES (also))	113 142 171		
34		Light	74			172		Hwy City Code
35		Surface Condition	75		Injuries LS-5 (FARM TOTAL VEHICLES (also))	173		
36		Road Gradient	76			174		
37		Road Defect	77		Fatalities LS-6	175		
38		Road Design	78			176		
39			79		Injuries LS-6			Filler
40		Road Alignment	80					
						195		Accident Report Numbers
						196		
						197		
						198		
						199		
						200		

effective = 1968, 1969 data
old yrs 1963→1967 data converted to this format with proper Type ID's.

DATE: _____ QT 24031 = Acc. Report No. Sequence

RECORD NO: QT 24041 = Miles/CS/Dist Seq. TAPE DENSITY: 800 cpi

RECORD LENGTH: 200 BLOCKING: 10

PAPER FORMS: _____ NO. OF COPIES: _____

COLOR OF CARDS: _____ LINED or UNLINED: _____

VOLUME OF DATA: _____ LS = Location Subscript

LS1 = DRIVER in car, truck, school bus, comm. bus, constr. equip LS6 = FARM equip

SPECIAL INSTRUCTIONS: LS2 = Passenger in " " " " LS7 = other

Screendown 4/15/69 LS3 = PEDESTRIAN LS4 = BICYCLE LS5 = MOTORCYCLE

APPENDIX 7.2

WBAN FORM A & B, TABLE OF SURFACE WEATHER OBSERVATIONS AT LANSING

WBAN FORM 10A (REV. 11-1-60) U.S. DEPARTMENT OF COMMERCE - WEATHER BUREAU

STATION: LANSING, MICH.-AIRP

DATE: JUN 15 1968

SURFACE WEATHER OBSERVATIONS

Type (1)	Time (LST) (2)	Sky and ceiling (Hundreds of Feet) (3)	Visibility (Statute Miles) Surface (4)	Visibility (Statute Miles) Tower (4a)	Weather and obstructions to vision (5)	Sea level press. (Mbs.) (6)	Temp. (°F) (7)	Dew pt. (°F) (8)	Wind Direction (9)	Wind Speed (Kts) (10)	Wind Character and shifts (11)	Altimeter setting (Ins.) (12)	Remarks and supplemental coded data (13)
RS	0058	E10 ⊕	10		T	155	63	50	03	05		999	TB50 217 L300 81
/	/												T S MOVG E FQT
✓	0128	M32 ⊕	3	3	TRW				16	04		003	RB21
RS	0258	U ⊕	10			159	60	49	04	05		000	TE45 TMOVD E RB
R	0258	U ⊕	10			155	59	48	06	03		999	
R	0358	E5 ⊕	10			168	59	48	28	04		003	RB27 E35 OCNL LTG N
RS	0458	E5 ⊕	10		T	175	58	48	34	03		005	TB45 TSW MOVG E
/	/												N-SW RB01E13
RS	0558	E6 ⊕	10		RW-	175	58	48	16	03		005	RB38 TE40
R	0658	E8 ⊕	10			185	59	49	35	04		008	RE10 31715 107/
S	0718	4 ⊙ E6 ⊕	10						01	05			
RS	0757	6 ⊙ E6 ⊕	10			190	58	49	02	05		009	
✓	0847	6 ⊙ E8 ⊕	10		RW--								BINOVC
R	0857	6 ⊙ E8 ⊙/⊕	10			189	60	50	03	08		009	RB10E49
R	0958	8 ⊙ E8 ⊙/⊙	10			195	62	50	07	04		010	207 1178
✓	1035	18 ⊙ E8 ⊙/⊙	15										
R	1056	E20 ⊙ 8 ⊙ ⊙/⊙	15			198	65	51	05	04		011	
R	1157	E20 ⊙/⊙	15			199	68	52	04	05		012	
R	1255	E25 ⊙	15			201	69	53	05	04		012	20700 1100
R	1355	E40 ⊙	15			201	70	51	00	00		012	
R	1456	E45 ⊙	15			197	72	53	08	04		011	
R	1558	E45 ⊙	15			197	72	52	34	06		011	603 1102
R	1658	45 ⊙/-⊙	15			199	71	52	36	03		011	
R	1758	45 ⊙ U ⊕	15			197	71	51	30	03		011	
R	1858	U ⊕	15			190	69	53	01	03		009	FEW SC / 807 14
R	1958	U ⊕	15			194	67	52	01	03		010	
R	2058	100 ⊙ U ⊕	15			202	64	52	01	03		012	
R	2158	E100 ⊙/⊕	15			205	63	49	30	05		013	3 1 4 107
R	2258	E100 ⊕	15			205	63	48	01	14		013	
R	2358	E100 ⊕	15			211	59	46	36	06		015	

code format FM11A, is entered on line following related aviation observation.

WBAN FORM 10B
(REV. 1-65)

U.S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

STATION: LANSING, MICH.-AIRPORT

DATE: JAN 4 1968

TIME (L.S.T.)	STATION PRESSURE (Ins.)	DRY BULB (°F)	WET BULB (°F)	REL. HUMIDITY (%)	TOTAL SKY COVER	CLOUDS AND OBSCURING PHENOMENA: LOWEST LAYER AMT.	LOWEST LAYER TYPE	LOWEST LAYER HEIGHT	SECOND LAYER AMT.	SECOND LAYER TYPE	SECOND LAYER HEIGHT	SUMMATION TOTAL	THIRD LAYER AMT.	THIRD LAYER TYPE	THIRD LAYER HEIGHT	SUMMATION TOTAL	FOURTH LAYER AMT.	FOURTH LAYER TYPE	FOURTH LAYER HEIGHT	TOTAL OPAQUE SKY COVER
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
0058	28.995	14	V	/	10	3	S	-	7	SC	E20	10	U	4			U	0		10
0153	28.990	11	V	/	3									4				0		3
0257	28.990	12	V	/	10									4				0		10
0355	28.965	11	V	/	10	10	SC	M28	U				U	4			U	0		10
0455	28.945	10	V	/	10									4				0		10
0555	28.940	10		/	10									4				0		10
0657	28.925	9		/	10	10	SC	M29	U				U	4			U	0		10
0758	28.910	11		/	10									4				1		10
0855	28.920	11		/	10									4				1		10
0956	28.920	9		/	10	1	S	-	3	SC	25	4	6	CS4	1	10	0	1		4
1056	28.920	10		/	10									4				1		8
1156	28.915	10		/	8									4				1		8
1257	28.920	11		/	6	3	S	-	3	SC	E20	6	0	4			6	0	/	6
1358	28.960	10		/	6									4				1		6
1458	29.015	9		/	6									4				1		6
1557	29.055	7		0	6	6	SC	E15	0			6	0	4			6	0	/	6
1658	29.120	6		0	4									4				1		4
1758	29.170	4		0	3									4				0		3
1858	29.220	1		0	1	1	Sc	20	0			1	0	4			1	0	0	1
1958	29.270	0		0	0									4				0		0
2058	29.300	0		0	0									4				0		0
2158	29.325	-1		0	0	0			0			0	0	4			0	0	0	0
2258	29.355	-2		0	0									4				0		0
2358	29.370	-3		0	0									4				0		0

SYNOPTIC OBSERVATIONS

TIME (G.M.T.)	TIME (L.S.T.)	NO.	PRECIP. (Ins.)	SNOW FALL (Ins.)	SNOW DEPTH (Ins.)	MAX. TEMP. (°F)	MIN. TEMP. (°F)	HEIGHT 850 MB. SURFACE	STATE OF GRND.	SEA STATE & DIR.	SWELL HGT. & DIR.	SWELL PERIOD	SURF H_S H_S M_S P_S D_S	WATER TEMP.	SOIL TEMP.	57	58
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56		
	MID. 0047	X	T	T	X	16	14	X	X	X	X	X	X	X	X		
	0047	1	T	T	1	20	14		9								
	0643	2	.01	0.2	1	15	9		9								
	1242	3	.02	0.4	1	12	9		7								
	1844	4	.03	0.4	2	12	1		9								
	MID.	X	0	0	2	2	-4	X	X	X	X	X	X	X	X		

STATION PRE

TIME (L.S.T.) 59	0052
ATT. THERM. 60	
OBSRVD. BAR. 61	
TOTAL CORR. 62	
STA. PRESS. 63	28.995
BAROGRAPH 64	28.990
BAR. CORR. 65	+.005

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

24-HR. MAX. TEMP. (°F)	24-HR. MIN. TEMP. (°F)	24-HR. PRECIP. WATER EQUIV. (Ins.)	24-HR. SNOWFALL UNMLTD (Ins.)	SNOW DEPTH (Ins.)	PEAK GUSTS: SPEED	PEAK GUSTS: DIRECTION	PEAK GUSTS: TIME (L.S.T.)	THICKNESS OF ICE ON WATER (Ins.)	FROZEN GROUND LAYER (Ins.): TOP	FROZEN GROUND LAYER (Ins.): BASE	RIVER GAGE	SKY COVER: SUNRISE TO SUNSET	SKY COVER: MIDNIGHT TO MIDNIGHT	WATER EQUIV. (Ins.)	81
66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	
16	-4	.06	1.0	1							3.6	7	6		

PRECIP. AND THDRSTM. 82	BEGAN 83	ENDED 84
SW --	Cont'd	0005
SW -	0005	0120
SW --	0120	0250
SW -	0250	1846

90. REMARKS, NOTES AND MISCELLANEOUS PHENOMENA

TOTAL SUNSHINE 6.7

PERCENT OF POSSIBLE SUNSHINE 67

CHARACTER OF SUNRISE OBSC

CHARACTER OF SUNSET HZE CLR

FASTEST OBSERVED 1-MINUTE WIND SPEED ___ M.P.H. OR FASTEST ___ MILE ___ M.P.H. ASSOCIATED DIRECTION ___ TIME ___

EXCESSIVE PRECIPITATION

Δt (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (Inches)												

SRcor 0

SScor +37

Pavel 331

Sobol 368

APPENDIX 7.3

TABLE OF LOCAL CLIMATOLOGICAL DATA AT LANSING

LOCAL CLIMATOLOGICAL DATA

U. S. DEPARTMENT OF COMMERCE - C. R. SMITH, Secretary

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION -- ENVIRONMENTAL DATA SERVICE

LANSING, MICHIGAN
CAPITAL CITY AIRPORT
FEBRUARY 1968

Latitude 42° 47' N Longitude 84° 36' W Elevation (ground) 841 ft. Standard time used: EASTERN

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days (Base 65°)	Weather types shown by code 1-9 on dates of occurrence 1 Fog 2 Heavy Fog 3 Thunderstorm 4 X 5 Sleet 6 Hail 7 Glaze 8 Drifting Snow 9 Blowing Snow	Snow, Sleet, or Ice on ground at 07AM (In.)	Precipitation Total (Water equivalent) (In.)	Snow, sleet (In.)	Avg. station pressure (In.) Elev. 874 feet m.s.l.	Wind Resultant direction	Resultant speed (m.p.h.)	Average speed (m.p.h.)	Fastest mile Speed (m.p.h.)	Fastest mile Direction	Sunshine Total (Hours and tenths)	Sunshine Percent of possible	Sky cover (Tenths) Sunrise to sunset	Sky cover (Tenths) Midnight to midnight	Date
1	52*	39	46	22	43	19	1	0	.96	0	28.86	17	11.5	12.1	18	SE	0.0	0	10	10	1
2	50	21	36	12	26	29	1	T	.46	.7	28.68	27	18.0	19.6	39	NW	0.0	0	10	10	2
3	33	17	25	1	18	40		T	T	T	29.10	30	15.0	15.2	29	NW	5.9	59	6	6	3
4	39	13	26	2	16	39		T	0	0	29.48	29	2.0	2.7	4	N	10.0	99	7	3	4
5	42	18	30	6	16	35		T	0	0	29.46	29	4.0	4.3	9	NW	9.2	91	2	2	5
6	46	20	33	9	20	32		0	0	0	29.19	25	6.7	7.1	14	W	9.3	91	1	3	6
7	37	24	31	7	23	34	8	0	T	T	29.09	03	8.8	9.8	17	NE	3.5	34	9	9	7
8	30	22	26	2	20	39	1 8	0	T	T	29.10	29	7.9	11.2	17	W	1.2	12	9	9	8
9	30	6	18	-6	6	47		T	T	T	28.87	31	14.1	16.4	24	N	4.3	42	8	8	9
10	13	2	8	-16	- 3	57		T	T	T	28.86	32	12.0	12.7	20	NW	7.1	69	4	3	10
11	16	7	12	-12	6	53	9	T	.06	.6	28.75	28	14.2	14.7	24	W	2.2	21	10	9	11
12	16	5	11	-13	2	54	8	1	.01	.1	28.89	31	11.2	12.4	24	NW	5.8	55	7	8	12
13	23	1	12	-12	3	53		T	T	T	29.23	29	10.0	12.5	26	W	9.8	93	2	3	13
14	29	18	24	0	15	41		T	0	0	29.05	27	17.9	18.3	26	W	8.1	77	5	5	14
15	29	19	24	0	15	41		T	.01	T	28.89	29	11.6	12.7	21	NW	3.1	29	10	8	15
16	37	20	29	5	17	36		T	T	T	28.80	25	14.6	16.1	38	W	6.5	61	6	8	16
17	23	1	12	-12	1	53		T	T	T	28.97	28	24.3	24.9	47	W	7.3	69	6	4	17
18	26	10	18	-6	3	47		T	T	T	29.04	28	16.3	16.5	36	W	8.9	83	3	4	18
19	29	7	18	-6	9	47		T	.01	.5	28.95	26	9.7	10.4	22	W	4.9	45	9	7	19
20	19	0	10	-15	1	55		1	T	T	28.82	35	8.2	8.9	17	N	4.5	41	9	6	20
21	14	-5*	5	-20	- 5	60		T	T	T	28.97	28	11.6	11.9	23	NW	7.5	69	7	4	21
22	25	3	14	-11	7	51		T	0	0	28.89	27	14.5	14.8	31	W	10.7	98	3	1	22
23	31	10	21	-4	13	44		T	T	T	29.07	32	5.1	7.8	16	W	4.2	38	7	4	23
24	30	6	18	-7	9	47	8	T	0	0	29.22	06	5.6	5.8	10	NE	11.0	100	0	1	24
25	34	3	19	-6	8	46	8	T	0	0	29.26	06	.9	1.0	6	W	11.0	100	0	0	25
26	32	7	20	-6	13	45	8	T	T	T	29.20	29	3.3	3.3	12	NW	5.9	53	9	7	26
27	34	24	29	3	23	36	1 8	T	.03	.5	28.98	25	10.3	10.5	21	SW	0.3	2	10	10	27
28	31	19	25	-1	19	40	8	1	.02	.5	28.85	28	7.3	9.2	17	W	4.3	38	9	10	28
29	25	13	19	-7	14	46	8	T	T	T	28.95	33	9.8	9.9	16	NW	3.5	31	10	10	29

	Sum	Sum				Total	Dep.	Temperature: Number of days				Total	Total	For the month:				Total	%	Sum	Sum	
	875	350				1266	86					1.56	2.9	29.02	29	8.6	11.5	47	W	170.0	for	188	272
	Avg.	Avg.	Avg.	Dep.	Avg.	Season to date		Max.	Max.	Min.	Min.	Dep.						Date: 17		Possible	month	Avg.	Avg.
	30.2	12.1	21.2	-3.0	12	Total	Dep.	< 32°	≥ 90°‡	< 32°	< 0°	-0.39								306.6	55	6.5	5.9
						5515	500	19	0	28	2	Greatest in 24 hours and dates						Greatest depth on ground of					
												Precipitation		Snow, Sleet				snow, sleet or ice and date					
												.97	1- 2	.7	27-28+			1	28+				

* Extreme for the month. May be the last of more than one occurrence.

\- Below zero temperatures or negative departure from normal.

T In columns 9, 10, and 11 and in the Hourly Precipitation table indicates an amount too small to measure.

X Heavy fog — visibility ¼ mile or less.

‡ ≥ 70° at Alaskan stations.

\+ Also on an earlier date, or dates.

HOURLY PRECIPITATION (Liquid in Inches)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1	.02	T	.19	.10	.17	.03	.04	.08	.04	.04	.02	.02	.02	T	.06	.01	T	.01	.04	T	.01	T	.03	.03	1
2	.01	.02	.15	.09	.05	.05	.04	.01	T	T	T	T	T	T	T	T	.01	.01	.02	T	T	T	T	T	2
3	T	T	T	T																					3
4																									4
5																									5
6																									6
7																			T	T	T	T	T	T	7
8									T	T	T	T	T	T											8
9				T	T	T	T	T							T	T	T	T			T	T		T	9
10						T	T	T										T							10
11						T	T	.01	.01	T	T	.01	T	T	.01	T	T	.01	T	T	.01	T				11
12	T	T		.01	T	T	T	T									T		T	T		T	T	T	12
13	T	T																	T						13
14																									14
15									T	T	T		T	T	.01	T	T	T	T	T				T	15
16	T	T	T			T	T		T																16
17	T	T					T			T			T	T				T	T	T					17
18								T	T	T															18
19															T	T	T	T	T		.01	T	T	T	19
20							T	T	T	T			T			T	T	T	T			T			20
21									T	T			T	T		T	T	T	T						21
22																									22
23													T	T											23
24																									24
25																									25
26																				T	T	T	T	T	26
27	T							T	T	T	T					T	T	T	T	.01	.01	.01	T	T	27
28	T	.01	T	T	T	T	T	T	T						T	T	T	T		T	.01	T	T		28
29	T	T	T	T	T	T	T	T	T	T	T				T	T	T	T							29

Data in columns 6, 12, 13, 14, and 15 are based on 8 observations per day at 3-hour intervals. Wind directions are those from which the wind blows. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. Figures for directions are tens of degrees from true North: i.e., 09 = East, 18 = South, 27 = West, 36 = North, and 00 = Calm. When directions are in tens of degrees in Col. 17, entries in Col. 16 are fastest observed 1-minute speeds. If the / appears in Col. 17, speeds are gusts. Any errors detected will be corrected and changes in summary data will be annotated in the annual Summary if published.

AVERAGES BY HOURS

Hour (Local time)	Sky cover (In tenths)	Station press. (In.)	Dry bulb (°F)	Wet bulb (°F)	Rel. hum. %	Dew point (°F)	Wind speed (m.p.h.)	Resultant wind Direction	Resultant wind Speed (m.p.h.)
01	6	29.01	19	18	77	13	10.0	28	6.2
04	5	29.01	16	15	78	11	9.0	29	6.7
07	6	29.02	15	14	79	10	8.4	29	5.8
10	7	29.04	20	18	70	12	12.7	30	9.6
13	7	29.03	25	22	60	12	14.4	29	11.4
16	6	29.00	27	23	58	13	14.8	28	11.8
19	6	29.01	23	21	70	14	11.6	28	9.1
22	5	29.02	20	18	75	13	10.9	29	8.2

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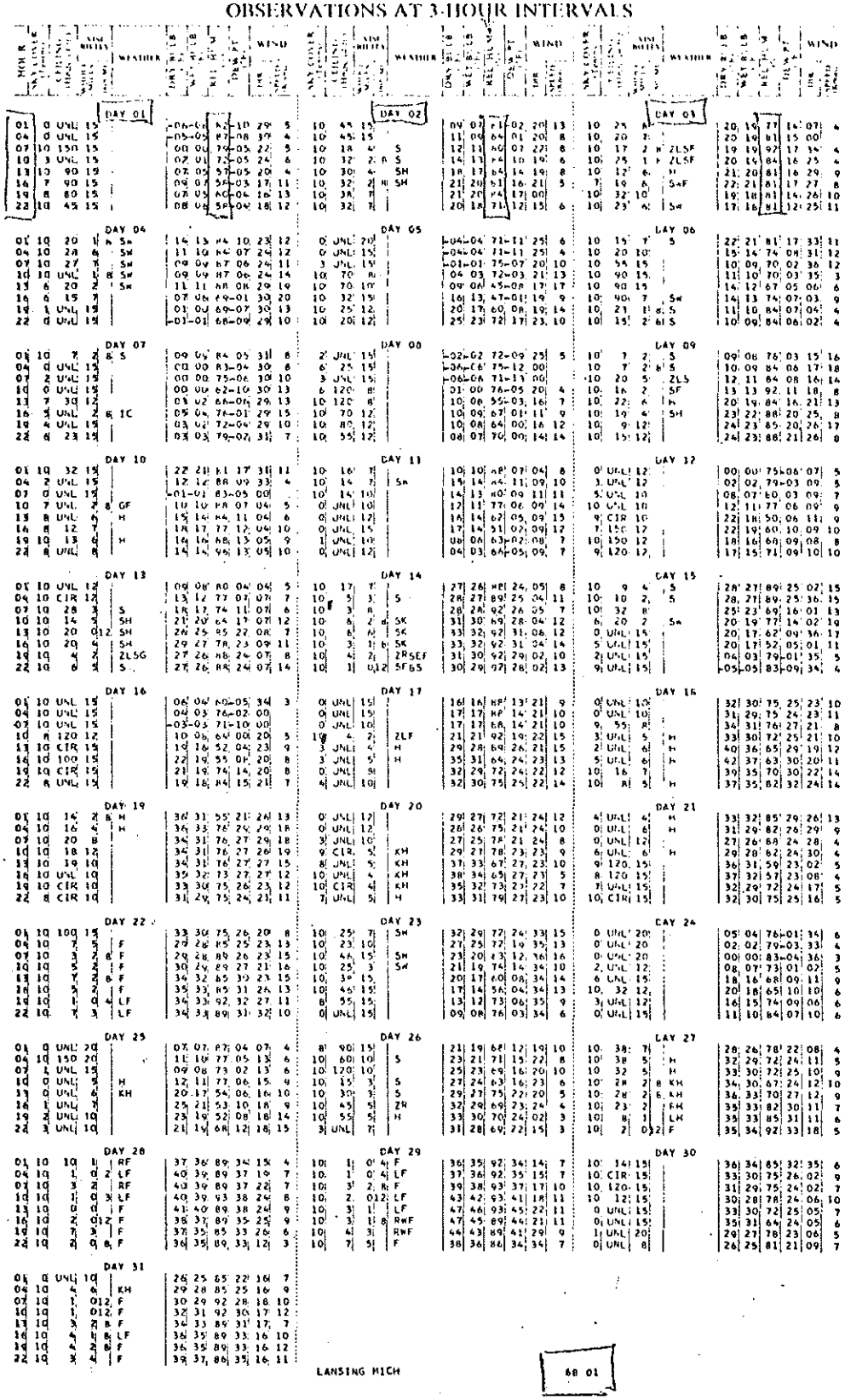
I certify that this is an official publication of the Environmental Science Services Administration, and is compiled from records on file at the National Weather Records Center, Asheville, North Carolina, 28801.

William H. Haggard

Director, National Weather Records Center

USCOMM—ESSA—ASHEVILLE 300

OBSERVATIONS AT 3-HOUR INTERVALS



LANSING MICH

68 01

REFERENCE NOTES

CEILING COLUMN -
UNL indicates an unlimited ceiling.
CIR indicates a cirriform cloud ceiling of unknown height.

WEATHER COLUMN -
+ Tornado
T Thunderstorm
Q Squall
R Rain
RW Rain showers
ZR Freezing rain
L Drizzle
ZL Freezing drizzle
S Snow
SP Snow pellets
IC Ice crystals
SW Snow showers
SG Snow grains
E Sleet
A Hail
AP Small hail
F Fog
HF Ice fog
GF Ground fog
BD Blowing dust
BN Blowing sand
BS Blowing snow
BY Blowing spray
K Smoke
H Haze
D Dust

WIND COLUMNS -

Directions are those from which the wind blows, indicated in tens of degrees from true North; i. e., 09 for East, 18 for South, 27 for West. Entry of 00 in the direction column indicates calm.

Speed is expressed in knots; multiply by 1.15 to convert to miles per hour.

ADDITIONAL DATA

Other observational data contained in records on file can be furnished at cost via microfilm or microfiche copies of the original records. Inquiries as to availability and costs should be addressed to:

Director
National Weather Records Center
Federal Building
Asheville, N. C. 28801

APPENDIX 7.4

B5500 COMPUTER COBOL DISK COMPILER

```
000010 IDENTIFICATION DIVISION.                                          0002-0001
000020 PROGRAM-ID. 16051.                                                0002-0001
000030 AUTHOR. CARTER.                                                   0002-0001
000040 INSTALLATION. MICHIGAN DEPARTMENT OF STATE HIGHWAYS.              0002-0001
000050 DATE-WRITTEN. MAR 70.                                             0002-0001
000060 DATE-COMPILED.  4-17-70, 9:36 PM.                                 0002-0001
000070 SECURITY.                                                         0002-0001
000080 REMARKS.                                                          0002-0001
000110 ENVIRONMENT DIVISION.                                             0007-0001
000120 CONFIGURATION SECTION.                                            0007-0001
000130 SOURCE-COMPUTER. B-5500.                                          0007-0001
000140 OBJECT-COMPUTER. B-5500, MEMORY SIZE 5000 WORDS.                  0007-0001
000180 INPUT-OUTPUT SECTION.                                             0007-0001
000190 FILE-CONTROL.                                                     0007-0001
001010     SELECT KARD1 ASSIGN TO READER.                                0007-0001
001020     SELECT KARD2 ASSIGN TO READER.                                0007-0001
001030     SELECT KARD3 ASSIGN TO READER.                                0007-0001
001040     SELECT KARD4 ASSIGN TO READER.                                0007-0001
001050     SELECT DATAPE ASSIGN TO TAPE.                                 0007-0001
001070     SELECT SORT-FILE ASSIGN TO SORT DISK AND 3 SORT-TAPES.        0007-0001
002010 I-O-CONTROL.                                                      0007-0001
002020     APPLY TECHNIQUE-A ON DATAPE.                                  0007-0001
002030 DATA DIVISION.                                                    0007-0001
002040 FILE SECTION.                                                     0007-0001
002100 FD  KARD1                                                         0007-0001
002110     LABEL RECORD STANDARD                                         0007-0001
002120     VALUE ID "QA16051"                                            0007-0001
002130     DATA RECORD CARD-LINE1.                                       0007-0001
002140 01  CARD-LINE1    SIZE 80.                                       0007-0001
003060 FD  KARD2                                                         0007-0001
003070     LABEL RECORD STANDARD                                         0007-0001
003100     VALUE ID "QA16051"                                            0007-0001
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003120     01  CARD-LINE2    SIZE 80.                                    0007-0001
003130     FD  KARD3                                                     0007-0001
003140         LABEL RECORD STANDARD                                     0007-0001
003150         VALUE ID "QC16051"                                        0007-0001
003160         DATA RECORD CARD-LINE3.                                   0007-0001
003170     01  CARD-LINE3    SIZE 80.                                    0007-0001
003180     FD  KARD4                                                     0007-0001
003190         LABEL RECORD STANDARD                                     0007-0001
003200         VALUE ID "QD16051"                                        0007-0001
003210         DATA RECORD CARD-LINE4.                                   0007-0001
003220     01  CARD-LINE4    SIZE 80.                                    0007-0001
004150     FD  DATAPE                                                    0007-0001
004160         LABEL RECORD STANDARD                                     0007-0001
004170         VALUE ID "QT16051"                                        0007-0001
004180         SAVE-FACTOR 99                                            0007-0001
004190         BLOCK CONTAINS 5 RECORDS                                  0007-0001
004200         RECORD CONTAINS 48 CHARACTERS                             0007-0001
004210         DATA RECORD T-REC.                                        0007-0001
004220     01  T-REC     SIZE 48.                                       0007-0001
005180     SD  SORT-FILE                                                 0007-0001
005190         DATA RECORD SORT-REC.                                     0007-0001
005200     01  SORT-REC      SIZE 48.                                   0007-0002
005210         02  FILLER    SIZE 2.                                    0007-0002
006020         02  MONTH     PICTURE 99.                                0007-0002
006030         02  DAY-S     PICTURE 99.                                0007-0002
006040         02  HOUR      PICTURE 99.                                0007-0002
006043         02  FILLER    SIZE 23.                                   0007-0002
006045         02  TIPE      PICTURE 9.                                 0007-0002
006050         02  FILLER    SIZE 16.                                   0007-0002
006060     WORKING-STORAGE SECTION.                                      0007-0002
006070     77  SUB           PICTURE 99 CMP-1 VALUE 1.                  0007-0002
006075     77  SUB2          PICTURE 99 CMP-1 VALUE 12.                 0007-0002
```

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006060     77  I                  PICTURE 99 COMP-1 VALUE 0.                0007-0003
006130     01  STORE-A                SIZE 168.                             0007-0004
006140         02  STOR-A OCCURS 12 SIZE 14.                                0007-0004
006150             03  MON-A          PICTURE 99.                           0007-0004
006160             03  DAY-A          PICTURE 99.                           0007-0004
006170             03  YER            PICTURE 99.                           0007-0004
006180             03  TIME-A         PICTURE 99.                           0007-0004
006190             03  MIN-A          PICTURE 99.                           0007-0004
006200             03  W-DRT          PICTURE 99.                           0007-0004
006210             03  W-SPD          PICTURE 99.                           0007-0004
007020     01  ACCID-CARD             SIZE 80.                              0007-0004
007040         02  FILLER             SIZE 2.                               0007-0004
007050         02  MON-AC             PICTURE 99.                           0007-0004
007060         02  DAY-AC             PICTURE 99.                           0007-0004
007070         02  NO-ACC OCCURS 24 PICTURE 999.                            0007-0004
007080         02  FILLER             SIZE 2.                               0007-0004
007090     01  A-CARD                 SIZE 80.                              0007-0004
007140         02  DAT-A              SIZE 14.                              0007-0004
007150         02  FILLER             SIZE 66.                              0007-0004
007180     01  B-CARD                 SIZE 80.                              0007-0004
007190         02  MON-B              PICTURE 99.                           0007-0004
007200         02  DAY-B              PICTURE 99.                           0007-0004
007210         02  FILLER             SIZE 2.                               0007-0004
008010         02  TIME-B             PICTURE 99.                           0007-0004
008020         02  FILLER             SIZE 2.                               0007-0004
008030         02  B-VALUES           SIZE 11.                              0007-0004
008090         02  FILLER             SIZE 59.                              0007-0004
008110     01  VEH-CARD               SIZE 80.                              0007-0004
008120         02  FILLER             SIZE 2.                               0007-0004
008130         02  MON-VH             PICTURE 99.                           0007-0004
008140         02  DAY-VH             PICTURE 99.                           0007-0004
008150         02  VEH-MILES OCCURS 12 PICTURE V999999.                     0007-0004
008160         02  FILLER             SIZE 2.                               0007-0004
```

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009010         02  FIREC                   SIZE 48.                    0007-0004
009020         02  VALUE-PART              SIZE 32.                    0007-0004
009030             03   DATE               SIZE 8.                     0007-0004
009040                  04   YR            PICTURE 99 VALUE 68.        0007-0004
009050                  04   MON           PICTURE 99.                 0007-0007
009060                  04   DAY           PICTURE 99.                 0007-0007
009070                  04   HR            PICTURE 99.                 0007-0007
009080             03   WIND               SIZE 4.                     0007-0007
009090                  04   W-DIRECT      PICTURE 99.                 0007-0007
009100                  04   W-SPEED       PICTURE 99.                 0007-0007
009110             03   CARD-4VAL          SIZE 11.                    0007-0007
009120                  04   PRESSURE      PICTURE 99V999.             0007-0007
009130                  04   TMPT          PICTURE S99.                0007-0007
009140                  04   PRCPT         PICTURE 9.                  0007-0007
009150                  04   PAVE          PICTURE 9.                  0007-0007
009160                  04   SEASON        PICTURE 9.                  0007-0007
009170                  04   LIGHT         PICTURE 9.                  0007-0007
009175             03   NO-ACC-T           PICTURE 99.                 0007-0007
009180             03   VEH-MI             PICTURE V9(6).              0007-0007
009190             03   TYP                PICTURE 9.                  0007-0007
009200         02  FILLER                  SIZE 16.                    0007-0007
010010    01   FOUR-REC                    SIZE 128.                   0007-0007
010020         02  4-REC OCCURS 4          SIZE 32.                    0007-0007
010030             03   DATE-4             PICTURE 9(8).               0007-0007
010040             03   WIND-4             PICTURE 9(4).               0007-0007
010050             03   4-CARD             SIZE 11.                    0007-0007
010060             03   NO-ACC-4           PICTURE 99.                 0007-0007
010070             03   VEH-M4             PICTURE V9(6).              0007-0007
010080             03   TYP4               PICTURE 9.                  0007-0007
011010    PROCEDURE DIVISION.                                          0009-0001
011020    SORT-PAR.                                                    0009-0001
011030        SORT SORT-FILE ON ASCENDING KEY MONTH DAY-S HOUR TIPE     0010-0001
011040             INPUT PROCEDURE READ-IN OUTPUT PROCEDURE WRITE-OUT.  0010-0001
```

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011060     READ-IN SECTION.                                              0011-0002
011070     1ST-OPEN.                                                     0011-0002
011080         OPEN INPUT KARD1.                                         0012-0001
011090     RD1.                                                          0012-0002
011100         READ KARD1 INTO ACCID-CARD AT END GO TO N-1ST-FILE.       0013-0006
011105         MOVE SPACES TO TTREC.                                     0013-0007
011110         MOVE MON-AC TO MON.                                       0013-0010
011120         MOVE DAY-AC TO DAY.                                       0013-0013
011125         MOVE 1 TO TYP.                                            0013-0015
011130     M1. MOVE NO-ACC(SUB) TO NO-ACC-T                              0014-0004
011150         MOVE SUB TO HR.                                           0014-0005
MOVE TRUNCATION
011160         RELEASE SORT-REC FROM TTREC.                              0014-0011
011170         IF SUB < 24 ADD 1 TO SUB GO TO M1.                        0014-0018
011180         MOVE 1 TO SUB.                                            0014-0019
011190         GO TO RD1.                                                0014-0019
011200     N-1ST-FILE.                                                   0014-0021
011210         CLOSE KARD1.                                              0015-0001
012010         OPEN INPUT KARD2.                                         0015-0002
012020     RD2.                                                          0015-0004
012030         READ KARD2 INTO VEH-CARD AT END GO TO N-2ND-FILE.         0016-0006
012040         MOVE SPACES TO TTREC.                                     0016-0007
012050         MOVE 2 TO TYP.                                            0016-0010
012060         MOVE MON-VH TO MON.                                       0016-0012
012070         MOVE DAY-VH TO DAY.                                       0016-0015
012080     M2. MOVE VEH-MILES(SUB) TO VEH-MI.                            0017-0004
012090         MOVE SUB TO HR.                                           0017-0008
012100         RELEASE SORT-REC FROM TTREC.                              0017-0011
012110         IF SUB < 12 ADD 1 TO SUB GO TO M2.                        0017-0017
012120         MOVE 1 TO SUB.                                            0017-0018
012140     RD2A.                                                         0017-0018
012150         READ KARD2 INTO VEH-CARD AT END GO TO N-2ND-FILE.         0018-0006
```

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012165     M2A. MOVE VEH-MILES(SUB) TO VEH-MI.                          0019-0004
012165          ADD 1 TO SUBQ.                                          0019-0008
012170          MOVE SUBQ TO HR.                                        0019-0009
012180          RELEASE SORT-REC FROM TTREC.                            0019-0012
012190          IF SUB < 12 ADD 1 TO SUB GO TO M2A.                     0019-0018
012200          MOVE 1 TO SUB.                                          0019-0019
012205          MOVE 12 TO SUBQ.                                        0019-0019
012210          GO TO RD2.                                              0019-0020
013010     N-2ND-FILE.                                                  0019-0021
013020          CLOSE KARD2.                                            0020-0001
013030          OPEN INPUT KARD3.                                       0020-0002
013040     RD3.                                                         0020-0004
013050          READ KARD3 INTO A-CARD AT END GO TO N-3RD-FILE.         0021-0006
013060          MOVE DAT-A TO STOR-A(SUB).                              0021-0007
013070          ADD 1 TO TIME-A(SUB).                                   0021-0019
013080     D1. ADD 1 TO SUB.                                            0022-0001
013090          READ KARD3 INTO A-CARD AT END GO TO N-3RD-FILE.         0022-0007
013100          MOVE DAT-A TO STOR-A(SUB).                              0022-0008
013110          ADD 1 TO TIME-A(SUB).                                   0022-0020
013120          IF TIME-A(SUB) = TIME-A(SUB - 1) GO TO D1               0022-0043
013130              ELSE SUBTRACT 1 FROM SUB.                           0022-0044
013140          IF SUB = 1 GO TO D3.                                    0022-0047
013150     D2. IF W-DRT(SUB - I) = 0 OR W-SPD(SUB - I) = 0 NEXT SENTENCE 0023-0014
013160              ELSE GO TO D3.                                      0023-0020
013170          ADD 1 TO I.                                             0023-0021
013180          IF I < SUB GO TO D2 ELSE GO TO D4.                      0023-0025
013185     D3. MOVE SPACES TO TTREC.                                    0024-0001
013190          MOVE MON-A(SUB) TO MON.                                 0024-0008
013200          MOVE DAY-A(SUB) TO DAY.                                 0024-0015
013210          MOVE TIME-A(SUB) TO HR.                                 0024-0023
014010          MOVE W-DRT(SUB) TO W-DIRECT.                            0024-0030
014020          MOVE W-SPD(SUB) TO W-SPEED.                             0024-0038
014030          MOVE 3 TO TYP.                                          0024-0041
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014060 D4. MOVE STOR-A(SUB + 1) TO DAT-A.                    0026-0005
014070     MOVE SPACE TO STORE-A.                            0026-0008
014080     MOVE 0 TO I.                                      0026-0011
014090     MOVE 1 TO SUB.                                    0026-0012
014110     MOVE DAT-A TO STOR-A(SUB).                        0026-0013
014120     GO TO D1.                                         0026-0024
014130 N-3RD-FILE.                                           0026-0026
014180     SUBTRACT 1 FROM SUB.                              0027-0001
014190     PERFORM D3.                                       0027-0002
014195     RELEASE SORT-REC FROM TTREC.                      0027-0004
014200     MOVE 1 TO SUB.                                    0027-0008
015010     CLOSE KARD3.                                      0027-0008
015020     OPEN INPUT KARD4.                                 0027-0010
015030 RD4.                                                  0027-0011
015040     READ KARD4 INTO B-CARD AT END GO TO N-4TH-FILE.   0028-0006
015045     MOVE SPACES TO TTREC.                             0028-0007
015050     MOVE 4 TO TYP.                                    0028-0010
015060     MOVE MON-B TO MON.                                0028-0012
015070     MOVE DAY-B TO DAY.                                0028-0015
015080     ADD 1 TO TIME-B.                                  0028-0018
015090     MOVE TIME-B TO HR.                                0028-0022
015100     MOVE B-VALUES TO CARD-4VAL.                       0028-0025
015150     RELEASE SORT-REC FROM TTREC.                      0028-0028
015160     GO TO RD4.                                        0028-0032
015170 N-4TH-FILE.                                           0028-0032
015180     CLOSE KARD4.                                      0029-0001
015190 WRITE-OUT SECTION.                                    0029-0002
015195 OPENN.  OPEN OUTPUT DATAPE.                           0030-0001
015200 B1. MOVE 1 TO I.                                      0031-0001
015210 RETURN-1.                                             0031-0001
016010     RETURN SORT-FILE INTO TTREC  AT END GO TO DUN.    0032-0005
016020     IF TYP = 1 GO TO MISSING-VALUE.                   0032-0010
```

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016040          ADD 1 TO I.                                          0032-0021
016050      G1. GO TO G2.                                            0033-0001
016060      G2. IF I = 4 ALTER G1 TO PROCEED TO G3.                  0034-0002
016070          GO TO RETURN-1.                                      0034-0003
016080      G3. MOVE NO-ACC-4(1) TO NO-ACC-T.                        0035-0005
016090          MOVE VEH-M4(2) TO VEH-MI.                            0035-0012
016100          MOVE WIND-4(3) TO WIND.                              0035-0018
016110          MOVE 4-CARD(4) TO CARD-4VAL.                         0035-0026
016115          MOVE 68 TO YR.                                       0035-0029
016120          WRITE T-REC FROM TTREC.                              0035-0031
016125          ALTER G1 TO PROCEED TO G2.                           0035-0035
016130          GO TO B1.                                            0035-0036
016140      MISSING-VALUE.                                           0035-0037
016160          IF TYP  = 1 GO TO MV1.                               0036-0008
016170          RETURN SORT-FILE INTO TTREC AT END GO TO DUN.        0036-0014
016180          GO TO MISSING-VALUE.                                 0036-0016
016190      MV1.                                                     0036-0016
016200          MOVE ZEROS TO FOUR-REC.                              0037-0001
016210          MOVE TTREC TO 4-REC(1).                              0037-0004
017010          MOVE 2 TO I.                                         0037-0010
MOVE TRUNCATION
017020          GO TO RETURN-1.                                      0037-0013
017030      DUN.                                                     0037-0015
017050          CLOSE DATAPE.                                        0038-0001
017060      X-IT SECTION.                                            0038-0002
017070      FIN.  EXIT.                                              0038-0002
017080      END-OF-JOB.                                              0000-0000
COMPILE 0 K , B-5500 10-13-67
PRT SIZE 0184
NO. SEGS. 060
COMPILE TIME 00050 SECS.
[illegible], SIZE 00015
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000000 IDENTIFICATION DIVISION.                                    0002-0001
000020 PROGRAM-ID. 16051.                                          0002-0001
000030 AUTHOR. CARTER.                                             0002-0001
000040 INSTALLATION. MICHIGAN DEPARTMENT OF STATE HIGHWAYS.        0002-0001
000050 DATE-WRITTEN. FEB 70.                                       0002-0001
000060 DATE-COMPILED.  2-28-70,  5:19 AM.                          0002-0001
000070 SECURITY.                                                   0002-0001
000080 REMARKS.                                                    0002-0001
000110 ENVIRONMENT DIVISION.                                       0007-0001
000120 CONFIGURATION SECTION.                                      0007-0001
000130 SOURCE-COMPUTER. B-5500.                                    0007-0001
000140 OBJECT-COMPUTER. B-5500, MEMORY SIZE 5000 WORDS.            0007-0001
000160 INPUT-OUTPUT SECTION.                                       0007-0001
000190 FILE-CONTROL.                                               0007-0001
000200     SELECT ACC-MASTER ASSIGN TO TAPE.                       0007-0001
000210     SELECT PRT ASSIGN TO PRINTER.                           0007-0001
000220     SELECT SORT-FILE ASSIGN TO SORT DISK AND 3 SORT-TAPES.  0007-0001
001010     SELECT PUN ASSIGN TO PUNCH.                             0007-0001
001020 I-O-CONTROL.                                                0007-0001
001030     APPLY TECHNIQUE-A ON ACC-MASTER.                        0007-0001
001040 DATA DIVISION.                                              0007-0001
001050 FILE SECTION.                                               0007-0001
001060 FD  ACC-MASTER                                              0007-0001
001070     LABEL RECORD STANDARD                                   0007-0001
001080     VALUE ID "BT24001"                                      0007-0001
001090     BLOCK CONTAINS 10 RECORDS                               0007-0001
001100     RECORD CONTAINS 200 CHARACTERS                          0007-0001
001110 DATA RECORD AC-REC.                                         0007-0001
001120 01  AC-REC          SIZE 200.                              0007-0001
001130     02  FILLER      SIZE 2.                                0007-0001
001140     02  COUNTY      PICTURE 99.                            0007-0001
001150     02  FILLER      SIZE 12.                               0007-0001
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001160          02  TIME       PICTURE 99.                          0007-0001
001170          02  MONTH      PICTURE 99.                          0007-0001
001180          02  DAY        PICTURE 99.                          0007-0001
001190          02  FILLER     SIZE 178.                            0007-0001
001200      FD  PRT                                                  0007-0001
001210          VALUE ID "OP160S1"                                   0007-0001
001220          LABEL RECORD STANDARD                                0007-0001
002010          DATA RECORD LINE-PT.                                 0007-0001
002020      01  LINE-PT        SIZE 132.                            0007-0001
002030      FD  PUN                                                  0007-0001
002040          VALUE ID "QD160S1"                                   0007-0001
002050          LABEL RECORD STANDARD                                0007-0001
002060          DATA RECORD PUNCH-LINE.                              0007-0001
002070      01  PUNCH-LINE     SIZE 80.                             0007-0001
002080      SD  SORT-FILE                                            0007-0001
002090          DATA RECORD SORT-REC.                                0007-0001
002110      01  SORT-REC       SIZE 8.                              0007-0002
002120          02  TM         PICTURE 99.                          0007-0002
002130          02  MON        PICTURE 99.                          0007-0002
002140          02  DY         PICTURE 99.                          0007-0002
002150          02  FILLER     SIZE 2.                              0007-0002
002160      WORKING-STORAGE SECTION.                                 0007-0002
002170      77  PR-MON         PICTURE  99.                         0007-0002
002180      77  PR-DY          PICTURE  99.                         0007-0002
002185      77  SUB            PICTURE  99 VALUE 1.                 0007-0003
002190      01  SU             SIZE 96.                             0007-0005
002200          02  SUMX OCCURS 24 TIMES PICTURE 9(4).              0007-0005
003010      01  HEADING            SIZE 132.                        0007-0005
003020          02  FILLER         SIZE 10 VALUE SPACE.             0007-0005
003030          02  FILLER         SIZE 109 VALUE "MONTH   DAY     1   2   3
003040      -       "  4   5   6   7   8   9  10  11  12  13  14  15  16  17  18
003050      -       " 19  20  21  22  23  24".                       0007-0007
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003070    01  D-LINE                 SIZE 132.                          0007-0013
003080        02  FILLER             SIZE 12 VALUE SPACE.               0007-0013
003090        02  MN                 PICTURE Z9.                        0007-0016
003100        02  FILLER             SIZE 4 VALUE SPACE.                0007-0016
003110        02  DATE               PICTURE Z9.                        0007-0018
003120        02  FILLER             SIZE 3 VALUE SPACE.                0007-0018
003125        02  SUMM               SIZE 96.                           0007-0021
003130        03  SUM                PICTURE ZZZ9 OCCURS 24 TIMES.      0007-0021
003140        02  FILLER             SIZE 13 VALUE SPACE.               0007-0021
003150    01  CARD-PUNCH             SIZE 80.                           0007-0024
003160        02  FILLER             SIZE 2 VALUE "60".                 0007-0024
003170        02  MNTH               PICTURE 99.                        0007-0027
003180        02  DAT                PICTURE 99.                        0007-0027
003190        02  NUMB OCCURS 24 TIMES PICTURE 999.                     0007-0027
003200        02  FILLER             SIZE 2 VALUE SPACE.                0007-0027
004010    PROCEDURE DIVISION.                                            0009-0001
004020    SORT-PAR.                                                      0009-0001
004030        SORT SORT-FILE ON ASCENDING KEY MON DY TM                  0010-0001
004040        INPUT PROCEDURE SE-LECT OUTPUT PROCEDURE MAIN-PT.          0010-0001
004050    U2. STOP RUN.                                                  0011-0001
004060    SE-LECT SECTION.                                               0011-0002
004070    PAR-1.                                                         0011-0002
004080        OPEN INPUT ACC-MASTER.                                     0012-0001
004090    READ-1.                                                        0012-0002
004100        READ ACC-MASTER AT END GO TO FINIS.                        0013-0003
004110        IF COUNTY ≠ 33 GO TO READ-1.                               0013-0011
004120        MOVE TIME TO TM.                                           0013-0011
005055        IF TM < 1 OR > 24 GO TO READ-1.                            0013-0027
004130        MOVE MONTH TO MON.                                         0013-0027
SEQUENCE ERROR
004130        MOVE DAY TO DY.                                            0013-0030
004140        RELEASE SORT-REC.                                          0013-0033
              . . . . . .                                                0013-0038
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004170     FINIS.                                                          0013-0035
0041       CLOSE ACC-MASTER.                                               0014-0001
004190     MAIN-PT SECTION.                                                0014-0002
004200     PAR-2.                                                          0014-0002
004210         OPEN OUTPUT PRT PUN.                                        0015-0001
005010         WRITE LINE-PT FROM HEADING BEFORE ADVANCING 3 LINES.        0015-0006
005020         RETURN SORT-FILE AT END GO TO END-ALL.                       0015-0009
005040     M1. MOVE MON TO PR-MON.                                         0016-0001
005050         MOVE DY TO PR-DY.                                           0016-0003
005060     A1. ADD 1 TO SUMX(TH).                                          0017-0001
005070     RTN.                                                            0017-0012
005080         RETURN SORT-FILE AT END ALTER G1 TO PROCEED TO END-ALL GO TO 0018-0002
005085         S1.                                                         0018-0003
005090         IF DY = PR-DY AND MON = PR-MON GO TO A1.                    0018-0018
005110     S1. MOVE PR-MON TO MN MNTH.                                     0019-0001
005120         MOVE PR-DY TO DATE DAT.                                     0019-0007
005140     M2. MOVE SUMX(SUB) TO NUMB(SUB) SUM(SUB).                       0020-0018
MOVE TRUNCATION
005150         IF SUB < 24 ADD 1 TO SUB GO TO M2 ELSE MOVE 1 TO SUB.       0020-0059
005130         WRITE LINE-PT FROM D-LINE.                                  0020-0062
SEQUENCE ERROR
005160         WRITE PUNCH-LINE FROM CARR-PUNCH.                           0020-0066
005165         MOVE ZERO TO SUB.                                           0020-0070
005170     G1. GO TO M1.                                                   0021-0001
005180     END-ALL. EXIT.                                                  0021-0002
005200     DUMMY SECTION.                                                  0022-0001
005210     DUB.  EXIT.                                                     0022-0001
005220     END-OF-JOB.                                                     0000-0000
COMPILE O K , B-5500 10-13-67
PRT SIZE 0145
NO. SEGS. 042
COMPILE TIME 00033 SECS.
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DISK SIZE 01520
MEMORY SIZE 09208
******* *******
SEQUENCE ERROR 00002
CARDS    00123
```

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000010 IDENTIFICATION DIVISION.                                        0002-0001
000020 PROGRAM-ID. 16051.                                              0002-0001
000030 AUTHOR. CARTER.                                                 0002-0001
000040 INSTALLATION. MICHIGAN DEPARTMENT OF STATE HIGHWAYS.            0002-0001
000050 DATE-WRITTEN. FEB 70.                                           0002-0001
000060 DATE-COMPILED.  3-30-70, 11:15 AM.                              0002-0001
000070 SECURITY.                                                       0002-0001
000080 REMARKS.                                                        0002-0001
000110 ENVIRONMENT DIVISION.                                           0007-0001
000120 CONFIGURATION SECTION.                                          0007-0001
000130 SOURCE-COMPUTER. B-5500.                                        0007-0001
000140 OBJECT-COMPUTER. B-5500, MEMORY SIZE 5000 WORDS.                000  001
000180 INPUT-OUTPUT SECTION.                                           0007  01
000190 FILE-CONTROL.                                                   0007
000200     SELECT PTR ASSIGN TO TAPE.                                 0007-
000210     SELECT PRNT ASSIGN TO PRINTER.
000220     SELECT PUN ASSIGN TO PUNCH.                                0007-0001
000230     SELECT SORT-FILE ASSIGN TO SORT DISK AND 3 SORT-TAPES.     0007-0001
001010 I-O-CONTROL.                                                    0007-0001
001020     APPLY TECHNIQUE-A ON PTR.
001030 DATA DIVISION.                                                  0007-0001
001040 FILE SECTION.                                                   0007-0001
001050 FD  PTR                                                         0007-
001060     LABEL RECORD STANDARD
001070     VALUE ID "MT1624"                                          0007-0001
001080     BLOCK CONTAINS 10 RECORDS                                  0007-0001
001090     RECORD CONTAINS 152 CHARACTERS                             0007-0001
001100     DATA RECORD P-REC.                                         0007-0001
001110 01  P-REC              SIZE 152.                               0007-0001
001120     02  STAT-ND        PICTURE 9(4).                          0007-0001
001130     02  YR             PICTURE 9.                             0007-0001
                               PICTURE 99.                           0007-0001
```

```
001160         02  FILLER          SIZE 1.                          0007-0001
001165         02  VOL             SIZE 96.                         0007-0001
001170         03  VOLUME OCCURS 24 PICTURE 9(4).                   0007-0001
001180         02  TOTAL           PICTURE 9(6).                    0007-0001
001190         02  FILLER          SIZE 40.                         0007-0001
001200     FD  PRNT                                                  0007-0001
001210         VALUE ID "QP16051"                                    0007-0001
002010         LABEL RECORD STANDARD                                 0007-0001
002020         DATA RECORD LINE-PT.                                  0007-0001
002030     01  LINE-PT         SIZE 132.                            0007-0001
002040     FD  PUN                                                   0007-0001
002050         VALUE ID "QD16051"                                    0007-0001
002060         LABEL RECORD STANDARD                                 0007-0001
002070         DATA RECORD PUNCH-LINE.                               0007-0001
002080     01  PUNCH-LINE      SIZE 80.                             0007-0001
002100     SD  SORT-FILE                                             0007-0001
002110         DATA RECORD SORT-REC.                                 0007-0001
002120     01  SORT-REC            SIZE 104.                        0007-0002
002130         02  MON             PICTURE 99.                      0007-0002
002140         02  DY              PICTURE 99.                      0007-0002
002150         02  KTS             SIZE 96.                         0007-0002
002160             03   CNT  OCCURS 24 PICTURE 9999.                0007-0002
002180         02  FILLER          SIZE 4.                          0007-0002
002190     WORKING-STORAGE SECTION.                                  0007-0002
002200     77  TTV                 PICTURE 9(10) COMP-1.            0007-0002
002210     77  SUB                 PICTURE 99 COMP-1 VALUE 1.       0007-0002
002220     77  XSUB                PICTURE 99 COMP-1 VALUE 1.       0007-0002
003010     01  HALF-PUNCH          SIZE 144.                        0007-0003
003020         02  H-PUN OCCURS 24 PICTURE V999999.                 0007-0003
003030     01  RE-HALF REDEFINES HALF-PUNCH SIZE 144.               0007-0003
003040         02  1ST             SIZE 72.                         0007-0003
            02  2ND             SIZE 72.                         0007-0003
```

```
004060          02  FILLER          SIZE 2 VALUE SPACE.                    0007-0003
004070          02  D-MN            PICTURE Z9.                            0007-0005
004080          02  FILLER          SIZE 3 VALUE SPACE.                    0007-0005
004090          02  D-DY            PICTURE Z9.                            0007-0008
004100          02  FILLER          SIZE 3 VALUE SPACE.                    0007-0008
004110          02  DT OCCURS 12 PICTURE .999999.                          0007-0010
004115          02  FILLER          SIZE 24 VALUE SPACE.                   0007-0010
004120      01  LAST-LINE           SIZE 132.                              0007-0013
004130          02  TTL             PICTURE 9(10).                         0007-0013
GROUP SIZE ERROR
004140          02  FILLER          SIZE 122 VALUE SPACE.                  0007-0013
004150      01  PUNCH-LINE          SIZE 80.                               0007-0015
004160          02  FILLER          SIZE 2 VALUE "68".                     0007-0015
004170          02  N-PUN           PICTURE 99.                            0007-0018
004180          02  D-PUN           PICTURE 99.                            0007-0018
004185          02  V-P             SIZE 72.                               0007-0018
004190          03  V-PUN OCCURS 12 PICTURE V999999.                       0007-0018
004200          02  CARD-NO         PICTURE Z9.                            0007-0018
004210      01  MSG-LINE            SIZE 132.                              0007-0018
004220          02  MESSG           PICTURE X(13).                         0007-0018
004230          02  FILLER          SIZE 119 VALUE SPACE.                  0007-0018
005010  PROCEDURE DIVISION.                                                 0009-0001
005020  1ST-PAR.                                                            0009-0001
005050      SORT SORT-FILE ON ASCENDING KEY MON DY                          0010-0001
005060          INPUT PROCEDURE INPT OUTPUT PROCEDURE OPT.                  0010-0001
005070  N-O.  STOP RUN.                                                     0011-0001
005080  INPT SECTION.                                                       0011-0002
005090  OP-PO.  OPEN INPUT PTR.                                             0012-0001
005100  READ-1.                                                             0012-0002
005110      READ PTR AT END GO TO FINIS.                                    0013-0003
005120      IF SIM-NO ≠ 9029 GO TO READ-1.                                  0013-0010
005130      NO FIELD IN FIX SIZE ERROR GO TO SF ELSE NEXT SENTENCE.         0013-0012
```

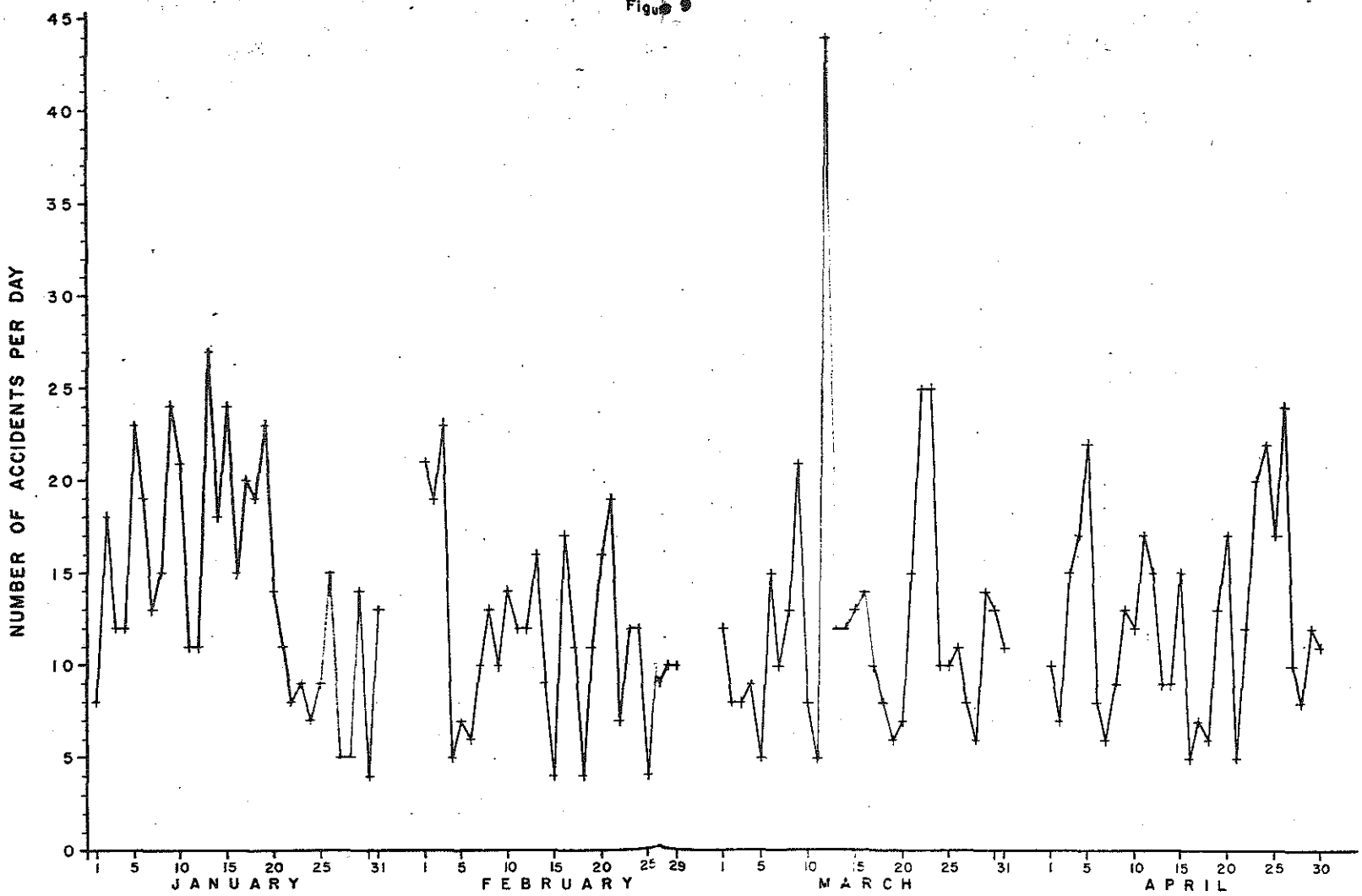
```
005140          MOVE MONTH TO MON.                                      0013-0019
005150          MOVE DAY TO DY.                                         0013-0022
005160          MOVE VOL TO KTS.                                        0013-0024
005170          RELEASE SORT-REC.                                       0013-0028
005180          GO TO READ-1.                                           0013-0030
005181      SE. OPEN OUTPUT PRNT.                                       0014-0001
005182          MOVE "SIZE ERROR" TO MESSG.                             0014-0002
005183          WRITE LINE-PT FROM MSS-LINE.                            0014-0006
005184          CLOSE PRNT, PTR.                                        0014-0010
005185          STOP RUN.                                               0014-0013
005190      FINIS.  CLOSE PTR.                                          0015-0001
005200      OPT SECTION.                                                0015-0002
005210      RTRN.                                                       0015-0002
006010          OPEN OUTPUT PRNT PUN.                                   0016-0001
006211          MOVE SPACES TO LINE-PT.                                 0016-0003
006212          WRITE LINE-PT BEFORE ADVANCING 2 LINES.                 0016-0007
006030      R1. RETURN SORT-FILE AT END GO TO END-ALL.                  0017-0002
SEQUENCE ERROR
006040          MOVE MON TO D-MN M-PUN.                                 0017-0004
006050          MOVE DY TO D-DY D-PUN.                                  0017-0010
006060      D1. DIVIDE TTY INTO CNT(SUB) GIVING H-PUN(SUB) ROUNDED.     0018-0010
006070          MOVE H-PUN(SUB) TO DT(SUB).                             0018-0021
006090          IF SUB < 12 ADD 1 TO SUB GO TO D1.                      0018-0041
006095          MOVE 13 TO SUB.                                         0018-0041
006100          WRITE LINE-PT FROM D-LINE.                              0018-0042
006101      D2. DIVIDE TTY INTO CNT(SUB) GIVING H-PUN(SUB) ROUNDED.     0019-0010
006102          MOVE H-PUN(SUB) TO DT(XSUB).                            0019-0021
006103          IF SUB < 24 ADD 1 TO SUB ADD 1 TO XSUB GO TO D2.        0019-0042
006104          WRITE LINE-PT FROM D-LINE.                              0019-0043
006105          MOVE 1 TO SUB XSUB                                      0019-0047
006110          MOVE 1ST TO V-P.                                        0019-0048
006115          MOVE 1 TO CARD-NO.                                      0019-0052
                WRITE LINE-PT FROM FIRST-LINE.                          0019-0055
```

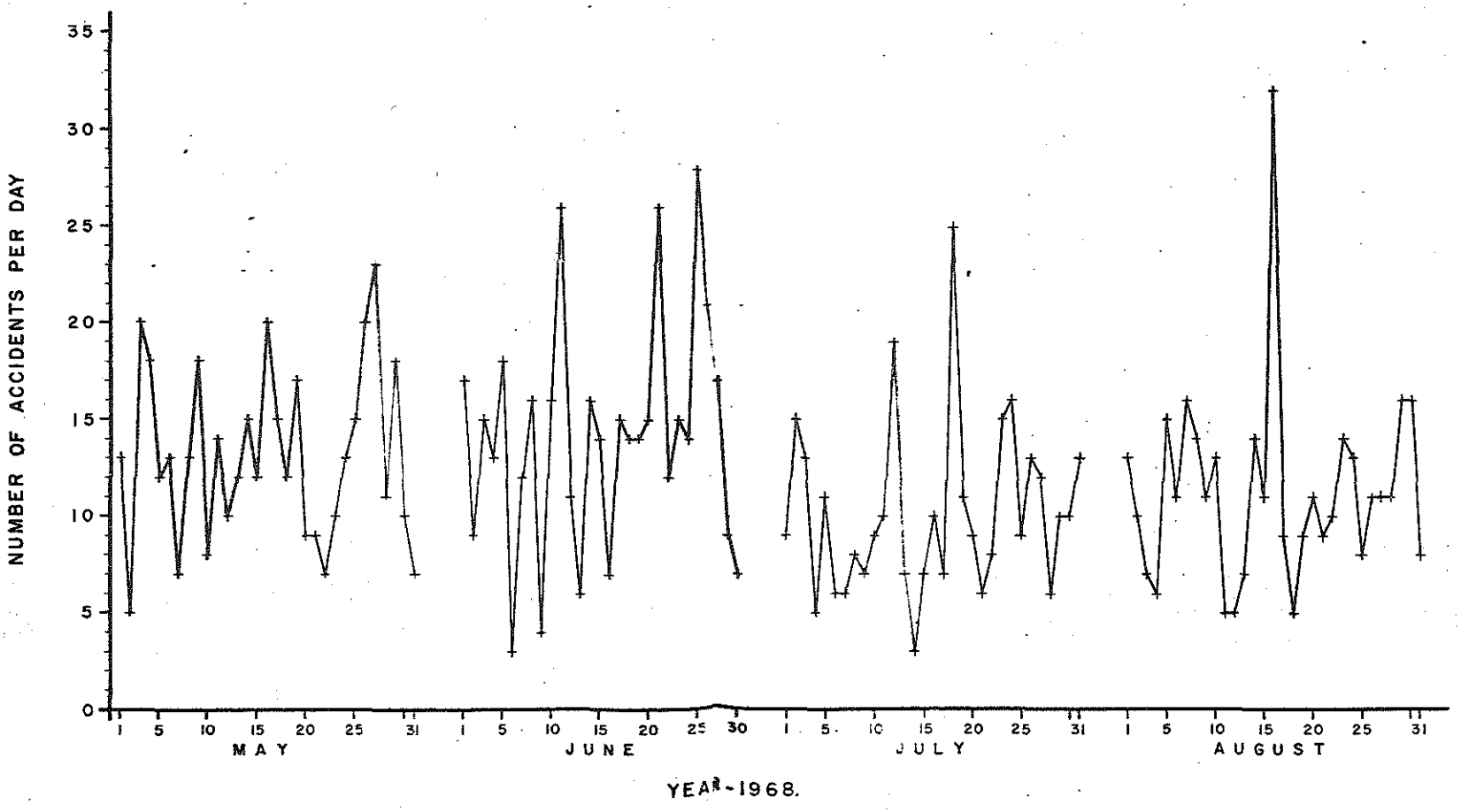
```
006130          MOVE 2 TO CARD-NO.                                      0019-0059
006140          WRITE PUNCH-LINE FROM PUNCX-LINE.                       0019-0063
006150          GO TO R1.                                               0019-0066
006160      END-ALL.                                                    0019-0070
006170          MOVE TTV TO TTI.                                        0019-0072
006180          WRITE LINE-PT FROM LAST-LINE.                           0020-0001
006190      DUMMY SECTION.                                              0020-0003
006200      DM. EXIT.                                                   0020-0007
006210      END-OF-JOB.                                                 0020-0007
COMPILE O K . B-5500 10-13-67                                         0000-0000
PRT SIZE 0146
NO. SEGS. 040
COMPILE TIME 00045 SECS.
TOTAL SEG. SIZE 00621
DISK SIZE 01560
MEMORY SIZE 09216
******* *******
SEQUENCE ERROR 00001
CARDS    00139
```

APPENDIX 7.5

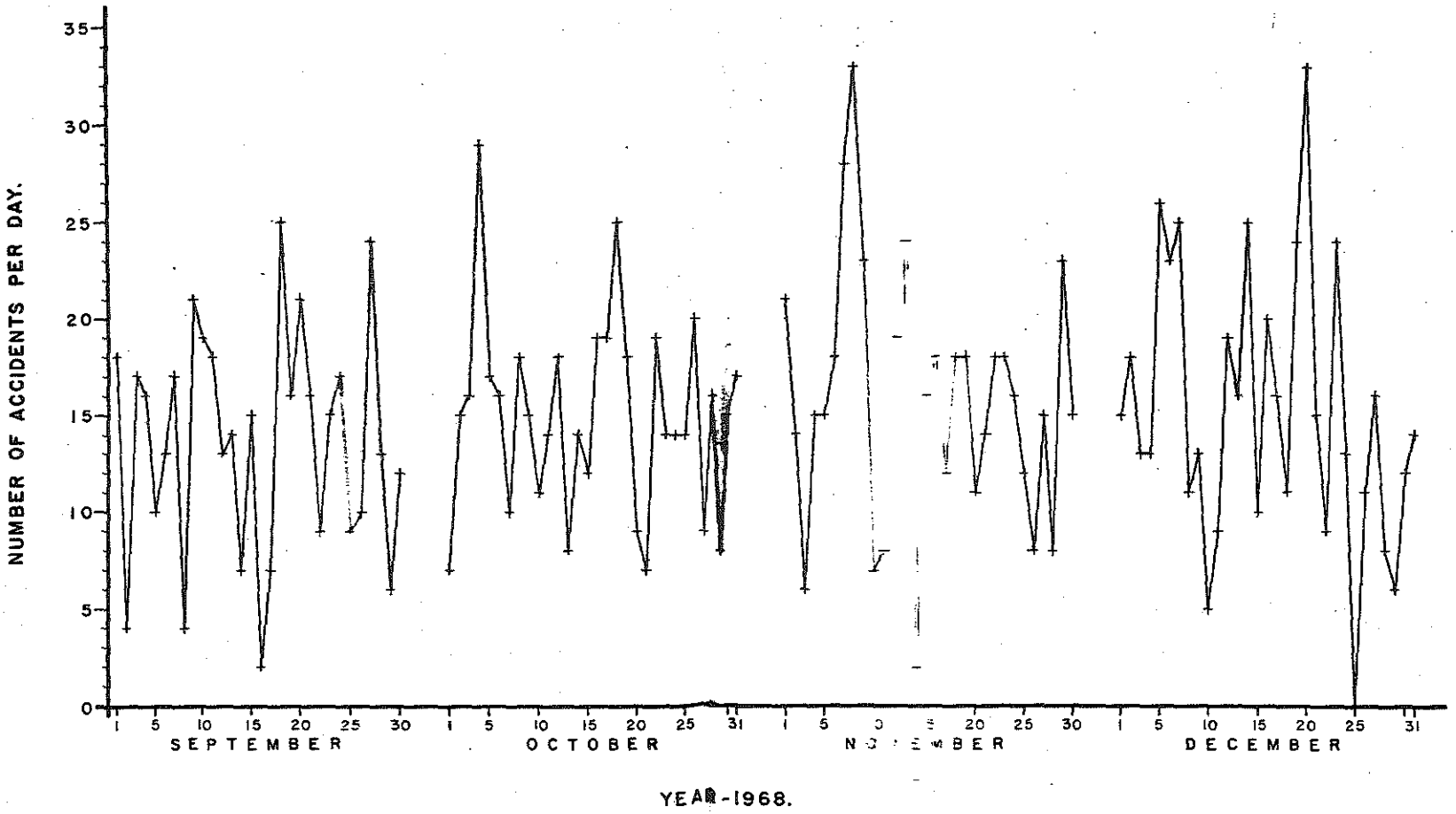
DAILY ACCIDENT DISTRIBUTION CHART OF INGHAM COUNTY 1968

Figure 9


NUMBER OF ACCIDENTS PER DAY
0
5
10
15
20
25
30
35
40
45
1 5 10 15 20 25 31
JANUARY
1 5 10 15 20 25 29
FEBRUARY
1 5 10 15 20 25 31
MARCH
1 5 10 15 20 25 30
APRIL
YEAR - 1968.


NUMBER OF ACCIDENTS PER DAY
0
5
10
15
20
25
30
35
1 5 10 15 20 25 31
MAY
1 5 10 15 20 25 30
JUNE
1 5 10 15 20 25 31
JULY
1 5 10 15 20 25 31
AUGUST

YEAR - 1968.


NUMBER OF ACCIDENTS PER DAY.
0
5
10
15
20
25
30
35
1 5 10 15 20 25 30
SEPTEMBER
1 5 10 15 20 25 31
OCTOBER
1 5 10 15 20 25 30
NOVEMBER
1 5 10 15 20 25 31
DECEMBER

YEAR-1968.

APPENDIX 7.6

OUTPUT OF THE STEPWISE MULTIPLE LINEAR REGRESSION ANALYSIS

Step #1

Variable entering	5 (precipitation)
F-level	90.3854
Standard error of Y	11446.4815
Degree of freedom	8623
Constant	4776.89944

Variable	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-5	3053.44807	321.17482	9.50712	0.10185

Step #2

Variable entering	4 (Temperature)
F-level	28.4353
Standard error of Y	11428.3155
Degree of freedom	8622
Constant	6332.13017

Variable	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-4	-31.77266	5.95833	-5.33248	-0.05810
X-5	2721.52641	326.65056	8.33161	0.09078

Step #3

Variable entering	6 (pavement)
F-level	15.4147
Standard error of Y	11418.7742
Degree of freedom	8621
Constant	5878.26296

Variable	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-4	-28.86486	5.99925	-4.81141	-0.05278
X-5	1860.53566	393.20891	4.73167	0.06206
X-6	1210.72321	308.37357	3.92616	0.05169

Step #4

Variable entering	8 (light)
F-level	4.4488
Standard error of Y	11416.4909
Degree of freedom	8620
Constant	6003.42908

Variables	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-4	-26.73231	6.08267	-4.39483	-0.04888
X-5	1886.81612	393.32768	4.79706	0.06294
X-6	1231.40020	308.46773	3.99199	0.05257
X-8	-528.68616	250.65604	-2.10921	-0.02286

Step #5

Variable entering	3 (pressure)
F-level	3.4970
Standard Error of Y	11414.8377
Degree of freedom	8619
Constant	2463.59685

Variables	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-3	124.67702	66.67152	1.87002	0.02014
X-4	-28.02536	6.12097	-4.57858	-0.05125
X-5	1894.17942	393.29044	4.81624	0.06318
X-6	1217.78750	308.50895	3.94733	0.05199
X-8	-543.18752	250.73969	-2.16634	-0.02349

Step #6

Variable entering	9 (relative humidity)
F-level	1.0947
Standard Error of Y	11414.7750
Degree of freedom	8618
Constant	1758.20848

Variables	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-3	124.23754	66.67248	1.86340	0.02006
X-4	-26.77920	6.23574	-4.29447	-0.04897
X-5	1837.28892	397.02920	4.62759	0.06128
X-6	1159.37357	313.51826	3.69795	0.04950
X-8	-460.47336	262.90571	-1.75148	-0.01991
X-9	9.38957	8.97420	1.04628	0.01280

Step #7

Variable entering	7 (season)
F-level	1.6323
Standard Error of Y	11414.3563
Degree of freedom	8617
Constant	1485.22030

Variable	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-3	143.90589	68.42427	2.10314	0.02324
X-4	-30.52081	6.88898	-4.43038	-0.05581
X-5	1848.64552	397.11413	4.65520	0.06166
X-6	1153.98655	313.53511	3.68057	0.04927
X-7	-171.82556	134.48777	-1.27763	-0.01686
X-8	-410.79506	265.75599	-1.54576	-0.01777
X-9	13.45858	9.52226	1.41338	0.01835

Step #8

Variable entering	2 (wind speed)
F-level	1.7372
Standard error of Y	11413.8680
Degree of freedom	8616
Constant	1107.71827

Variable	Coefficient	Std. Error of Coefficient	T-Value	Beta Coefficient
X-2	37.67861	28.58691	1.31804	0.01586
X-3	140.71430	68.46418	2.05530	0.02273
X-4	-30.25364	6.89166	-4.38989	-0.05532
X-5	1782.18939	400.28536	4.45230	0.05945
X-6	1066.07577	320.53785	3.32590	0.04551
X-7	-189.65662	135.16077	-1.40319	-0.01860
X-8	-475.89880	270.29616	-1.76066	-0.02058
X-9	17.08310	9.91099	1.72365	0.22329