S.T.E.P.

Selective Traffic Enforcement Program

GREENSBORO POLICE DEPARTMENT

GREENSBORO, NORTH CAROLINA

Greensboro Police Department

SELECTIVE TRAFFIC ENFORCEMENT PROGRAM

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GREENSBORO TRAFFIC EXPERIMENT

A TECHNICAL REPORT

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SUMMARY AND CONCLUSIONS

The City of Greensboro has experienced an increase in traffic accidents over the past several years. As a result, the Greensboro Police Department has engaged in a Selective Traffic Enforcement Program (S.T.E.P.) funded by the North Carolina Governor's Highway Safety Program to determine what enforcement techniques and policies are needed to reduce traffic accidents. Several experiments were conducted from December 1, 1976, through March 31, 1977, which are presented in Sections I through IV.

These experiments tested hypotheses concerning, (1) specific assignment of individual patrol officers, (2) varying degrees of radar usage, (3) different assignments of personnel as a Traffic Unit, (4) differences of roving and stationary patrol, (5) saturation patrol in a predetermined area, and (6) differences in patroling in marked and unmarked police vehicles. Information collected during these experiments also serve to supplement the S.T.E.P. Manual (data base) published on December 1, 1976.

Section V is an analysis of histograms of accidents presented in Sections I through IV comparing modes of one experimental group with three control groups. Section VI presents correlations of traffic arrests and accidents using the Pearson product-moment correlation coefficient, with a multiple regression analysis and scattergram.

Section VII begins the statistical analysis of the experiments, starting with graphs of percentages of increase/decrease by month, by division, for the past 15 months. Two sets of chi-square tests are also presented. The first set compares all accidents in the City during the experimental months with expected frequencies that were computed from 1976 and 1977 data. The second set of chi-square tests compares the experimental group with control groups.

Section VIII is a presentation of t-tests performed to verify findings of the chi-square tests. The values of these t-tests were significantly different from the chi-square tests because variances and standard deviations were estimated from the sample data.

Since values of the different tests were so different, Z-scores were obtained (Section IX) in a like manner as the t-tests except the four month period was considered the population from which variances and standard deviations were computed. Z-scores obtained were similar to the chi-square values computed in Section VII.

Section X presents the experimental and evaluation design of the experiments. Z-scores were obtained to evaluate the effectiveness of the experiments. Section XI continues this evaluation with a short demographic analysis of the two experimental groups and, additional z-scores to test the hypothesis of unit assignments.

Section XII is a synopsis of some of the more important findings and conclusions of the experiments. Only the more important findings are presented in this section to reduce its volume.

The experiments were successful in that they provided the means by which hypotheses were tested and evaluated. This is a technical report that presents pertinent information to the Department concerning traffic arrests and accidents during the test period. This report also serves as a technical documentation of the field experiments and it contains the necessary information for verification and/or replication of experiments by an evaluative agency or another police department.

The following conclusions were either implied or stated throughout this report and are listed here as a synopsis:

(1) City-wide traffic accidents increased each month during the test period except for the month of February as compared with the same period of last year. All things being equal, the year of 1977 will show an increase in traffic accidents for the city as compared to the previous year.

(2) There was a high increase in the number of traffic accidents on those days when snow accumulated in the city. This suggests that citizens are not knowledgeable of driving techniques

to use during snow and that they are inexperienced drivers in such weather conditions. The Department cannot provide experience for drivers, but can do much toward education.

(3) For most days during the test period, the city experienced 10 to 24 accidents per day (mean = 19; mode = 15-19) with an average number of arrests of 46 per day (mode = 40-49). The normality of the number of traffic accidents did not significantly vary during the test period; histograms of accidents resembled a normal curve. The selective traffic enforcement program has not reduced accidents enough to be visible when graphed or plotted in a histogram; graphs show no skewness. If S.T.E.P. has reduced accidents, the number has been so negligible that the reduction is unnoticeable.

(4) There is much unexplained variance in the number of traffic accidents by division by month. This variance was not controlled by a saturation patrol regardless of the type of police vehicles utilized.

(5) Private property accidents increased each month of the test period. The average increase in private property acidents was 23.08 for December/January, and 5.97 for February/March, which indicates more private property accidents occur during increased retail shopping periods, many that are hit-and-run

accidents. Of all hit-and-run accidents, nearly 50 percent occur on private property. Even if private property accidents were not investigated or reported in the city's accident statistics, the problem would still exist for the citizenry and for the hit-and-run unit. Therefore, consideration of causal factors of accidents on private property may be needed, especially during increased retail shopping periods in a comprehensive program to reduce traffic accidents. If prevention of many of these accidents is possible, both the community and the Department would benefit economically.

(6) The "normal rate of traffic enforcement" is between 5 to 9 arrests per day per division. City-wide, there was an average of 22.4 traffic arrests made each day or 5.6 arrests per division. Generally, an average of one of every four patrolmen made one arrest per day (excluding traffic unit officers).

(7) Data suggests that officers can detect traffic law violations as easily and make arrests more frequently when operating marked police vehicles. By and large, citizens in the city realize that officers "working traffic" operate in unmarked police vehicles and are, therefore, unsuspecting of marked police units.

(8) Fewer accidents did not occur per day during the period that traffic officers were given more specific assignments (as the area of patrol was reduced to more specific locations). There-

fore, personnel assignments need not be too specific (see report for details) to reduce accidents in a division or throughout the city, although accidents may decrease in the one patrol area.

(9) Reduced usage of radar equipment did not reduce the number of traffic accidents. The data base documented the need of enforcement of "accident causing violations" as opposed to other violations (i.e., equipment violations or speeding). Data suggests that enforcement of both types is needed.

(10) There were no differences in the number of accidents when patrolmen used a roving type patrol or when they used a stationary patrol. However, when officers used a stationary patrol, they remained visible to the public -- not "hidden".

(11) There were no differences in the mean number of accidents when officers of the traffic unit were patroling a close proximity to one another or when they were divided (or scattered) throughout the experimental division.

(12) According to sample data, in 65 percent of reported accidents, some enforcement action is taken by the investigating officer; and 35 percent of reported accidents, no enforcement action is taken.

(13) Crosstabulations of arrests and accidents show a mode of 40-60 traffic arrests and a mode of 10-20 accidents. There were

26 days during the test period when arrests were in excess of 60 per day, but accidents did not fall below 10 per day. This suggests that the increase in enforcement on those days had little effect on the number of traffic accidents. These cross-tabulations suggest that, generally, as modes of enforcement increase, modes of accidents do not decrease as might be expected. This suggests that accidents cannot be fully controlled by enforcement; to what degree this control is possible is unknown.

(14) The mean number of all traffic arrests for the test period was 46. The mean number of accidents was 19. The standard deviation and corresponding variance was large for both, but especially so for arrests. This indicates an inconsistency in accidents and enforcement. Especially for arrests, there are some days when enforcement is high and some days when enforcement is low.

(15) Correlations between arrests and accidents show weak positive correlations and account for a small portion of the variance in the number of traffic accidents, indicating that traffic arrests, per se, has little effect on the number of accidents.

(16) The product--moment correlation coefficient between traffic arrests and accidents for the test period was .21. This is a weak positive correlation accounting for approximately 4 percent of the variance in traffic accidents.

(17) Correlations of arrests and accidents by division by month ranged from -.39 to .52; explained variations of accidents range from 15 to 27 percent. This data suggests that the number of arrests is not strongly associated with accidents, positively or negatively. An increase or decrease in the number of traffic arrests will not significantly effect the number of traffic accidents.

(18) Chi-square values comparing test months with the same months of the previous year to obtain expected frequencies showed a more significant difference for the December/January period in unmarked police vehicles than the February/March period, patroling in marked police vehicles. The differences were significant at the .10 level in December, .05 in January, and .70 for February and March.

(19) Chi-square values of the experimental group compared with patrol groups revealed more significance for the December/January period in unmarked vehicles than for the February/March period in marked vehicles. Of the eight chi-square tests made for December/January, only one was not significant above the .05 level. Of the eight tests for February/March, none were significant at or above the .05 level.

(20) A t-test for dependent scores was performed comparing the experimental group with control groups. These tests revealed no significant reduction in the experimental group compared with control groups, except with Division IV in January. Dif-

ferences between the chi-square and the t-test were explained by the estimated standard deviation of the t-test.

(21) Z-tests were performed comparing the experimental group with control groups by month which showed the experimental group for December having fewer accidents that control groups I and II and the experimental group for January having fewer accidents than control group IV at the .05 level. Of the six Z-tests performed for December/January, three exceeded the .05 level of significance. None of the six Z-tests for February/March exceeded this level.

(22) Z-tests were performed comparing experimental groups with control groups for: (1) A saturation patrol/normal patrol; (2) saturation patrol in unmarked police vehicles/normal patrol; (3) saturation patrol in marked vehicles/normal patrol; (4) patrol in unmarked/marked police vehicles. None of these tests reached a level of significance at .05. There were no significant differences shown in either direction of the curve between the group means tested.

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GREENSBORO TRAFFIC EXPERIMENT: A TECHNICAL REPORT

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GREENSBORO, NORTH CAROLINA

Many cities in the United States are experiencing a problem of increased traffic accidents; the same is true for Greensboro. During the past five years, Greensboro has experienced 36,456 traffic accidents with 104 fatalities and 4,230 personal injuries. There are no indications that these figures would tend to decrease during the next few years unless the Greensboro Police Department develops new policies and procedures. To complicate the matter, this Department has a limited number of resources (i.e., officers and equipment) to deal with this problem. Therefore, the Department needs to develop effective selective traffic enforcement policies. In an effort to combat this problem, the Greensboro Police Department has engaged in a Selective Traffic Enforcement Program (S.T.E.P.) sponsored by the North Carolina Governor's Highway Safety Program.

As a result of S.T.E.P., several experiments have been conducted in an effort to determine the most effective means of selective enforcement. The objectives of the experiment are to determine what types of enforcement can be best utilized by this Department. The overall goal is to reduce traffic accidents. This document is a technical report of experiments conducted during the months of December, 1976,

through March, 1977. Pertinent data referring to traffic accidents and enforcement are given in this report which includes several tables, charts, statistical formulas, and statistical computation sheets. These items will be fully explained since some personnel may not be familiar with these elements of an experiment. Several suggestions will be made to administrators and supervisors throughout this report on how to use this technical data. Conclusions and resulting recommendations will be briefly summarized at the end of this report according to the findings of the experiment.

Traffic accident and enforcement information was compiled and analyzed to form a data base which was published in December, 1976. This data base was used to assign officers to specific locations at specific times to enforcement traffic laws, especially those thought to cause traffic accidents when violated. While studying selective traffic enforcement, several questions rose, such as:

Will a saturation type patrol, using 260 extra man-hours, be effective in reducing traffic accidents?

Will there be any measureable difference in the number of traffic accidents between patroling in a marked police vehicle and in an unmarked police vehicle?

Will there be any measureable difference in the number of traffic accidents between moderate usage of radar equipment and a reduced usage of radar equipment?

Is there any correlation between the number of traffic accidents and the type of assignment of patrol personnel?

Is there any relationship between the number of arrests and traffic accidents? These questions were converted into hypotheses and an experimental design was made to test these hypotheses.

Experimental Design

Greensboro is divided into four patrol divisions. One division was designated as an experimental group while three patrol divisions were utilized as control groups. An experiment was conducted during each calendar month from December, 1976, through March, 1977. During December, 1976, an experiment was conducted in Division III, testing a saturation type patrol using unmarked police vehicles, roving type patrol, and reduced usage of radar equipment. The experiment was repeated during January, 1977, in Division I. In February, 1977, another experiment was conducted in Division III, testing the saturation type patrol using marked police vehicles, and varying degrees of radar usage. This experiment was repeated in Division I during March, 1977.

This design allowed for one experimental group during each calendar month and three control groups. At the same time, it was recognized that a halo effect may be present in a patrol division once an experiment had been conducted. Therefore, Divisions I and III were designated as experimental groups and Divisions II and IV re-

mained as control groups throughout the four month period. This experimental design allowed for maximum analysis and evaluation since the experimental groups could be compared pre- and post-experiment, compared with control groups, and the two experimental groups could be compared with each other during different tests.

CHAPTER I

TRAFFIC ENFORCEMENT EXPERIMENT

Section I - December Experiment

In December, 1976, Division III was chosen as the experimental group to receive a saturation patrol using 260 extra man-hours. Police officers working in the saturation patrol drove unmarked police vehicles equipped with TDS and radar units to determine the speed of motor vehicles. During the month experiment, usage of this radar equipment was regulated to see if different amounts of radar usage would effect the number of traffic accidents. Officers also used a roving type patrol; they were directed to "keep moving," or keep roving, and not to park on or near the street to observe traffic. The roving patrol had a two-fold purpose, (1) to prevent excessive use of radar equipment (police vehicles must be parked or stationary to operate radar equipment) and (2) to provide maximum patrol of the geographic area assigned to the officer which would, in turn, provide more visability to the public.

Table 1.1 is a comparative summary of all traffic accidents in the City, including public street and private property accidents. This table compares each Division for December, 1976, with the month of December, 1975, giving the increased number of accidents with the increased percentages. Graph 1.1 is a representation of this table.

TABLE 1.1

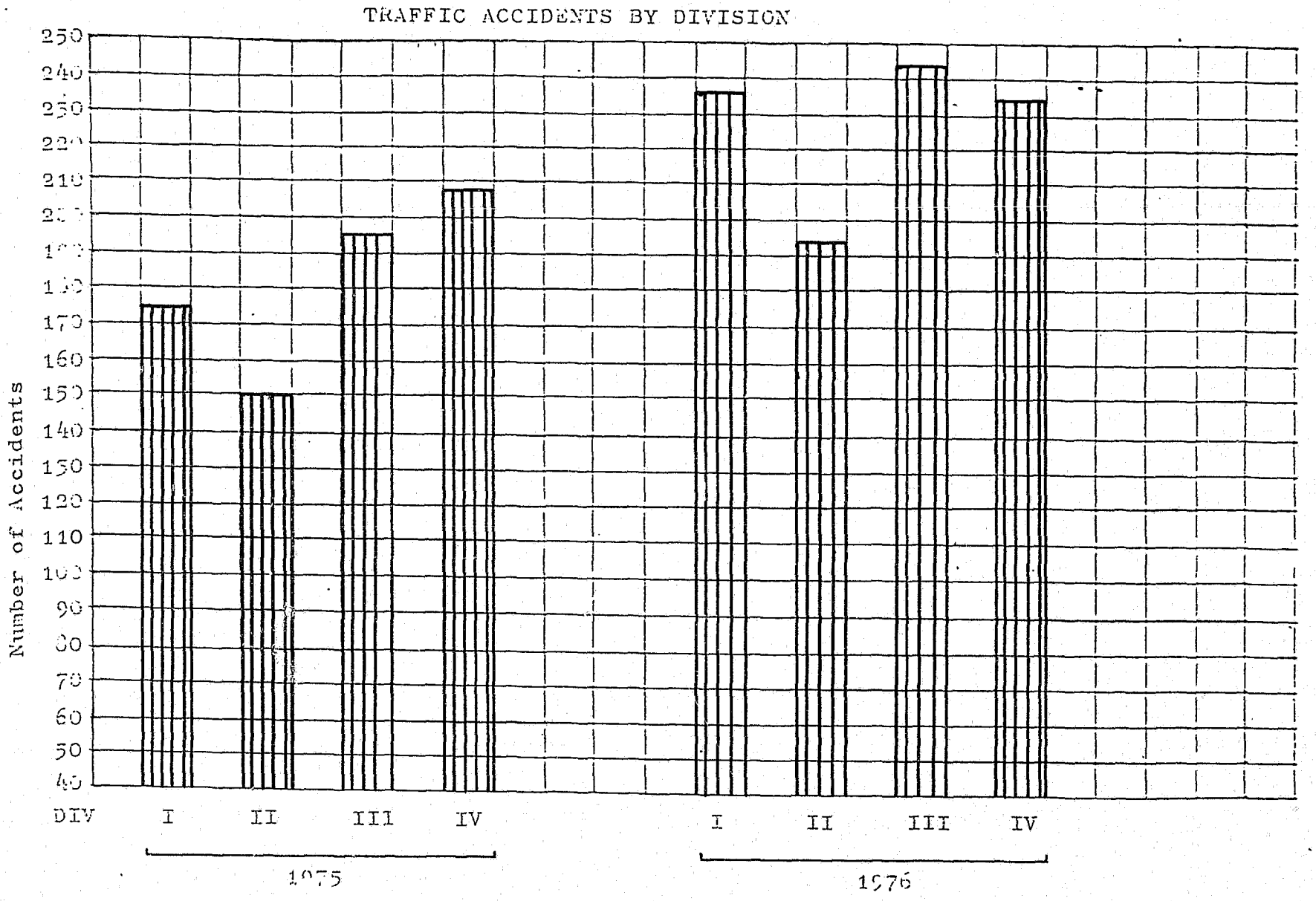
ALL CITY ACCIDENTS FOR DECEMBER, 1976, COMPARED WITH DECEMBER, 1975

	I	II	III	IV	TOTAL
1976	236	192	242	235	905
1975	174	150	195	208	727
Inc./Dec.	59	42	47	27	178
%Inc./Dec.	33.91	28.0	24.10	12.98	24.48

As can be seen, there were significant increases in traffic accidents in all Divisions, ranging from 12.98 percent to 33.91 percent. Overall, City accidents increased by 24.48 percent.

Many factors may have caused this increase in accidents such as an increase in traffic volume. However, one factor that should not have influenced this increase is the time of year, even though December was a holiday season with more people shopping and more off days for public workers; accidents in December, 1976, are compared with the number of accidents in December, 1975, therefore, removing this variable.

Table 1.2 lists private property accidents by Division for December, 1975, and for December, 1976, along with the number and percentage of increase/decrease in 1976 from 1975 (see Graph 1.2). Outstanding in this table is the 117.65 percent increase in private property accidents for Division III.



Comparison of December 1975 with December 1976

****All traffic accidents in the city are shown on this graph

GRAPH 1.1

TABLE 1.2

PRIVATE PROPERTY ACCIDENTS FOR DECEMBER, 1976, COMPARED WITH DECEMBER 1

	I	II	III	IV	TOTAL
1976	52	23	74	46	195
1975	54	21	34	45	154
Inc./Dec.	-2	2	40	1	41
%Inc./Dec.	-3.70	9.52	117.65	2.22	26.62

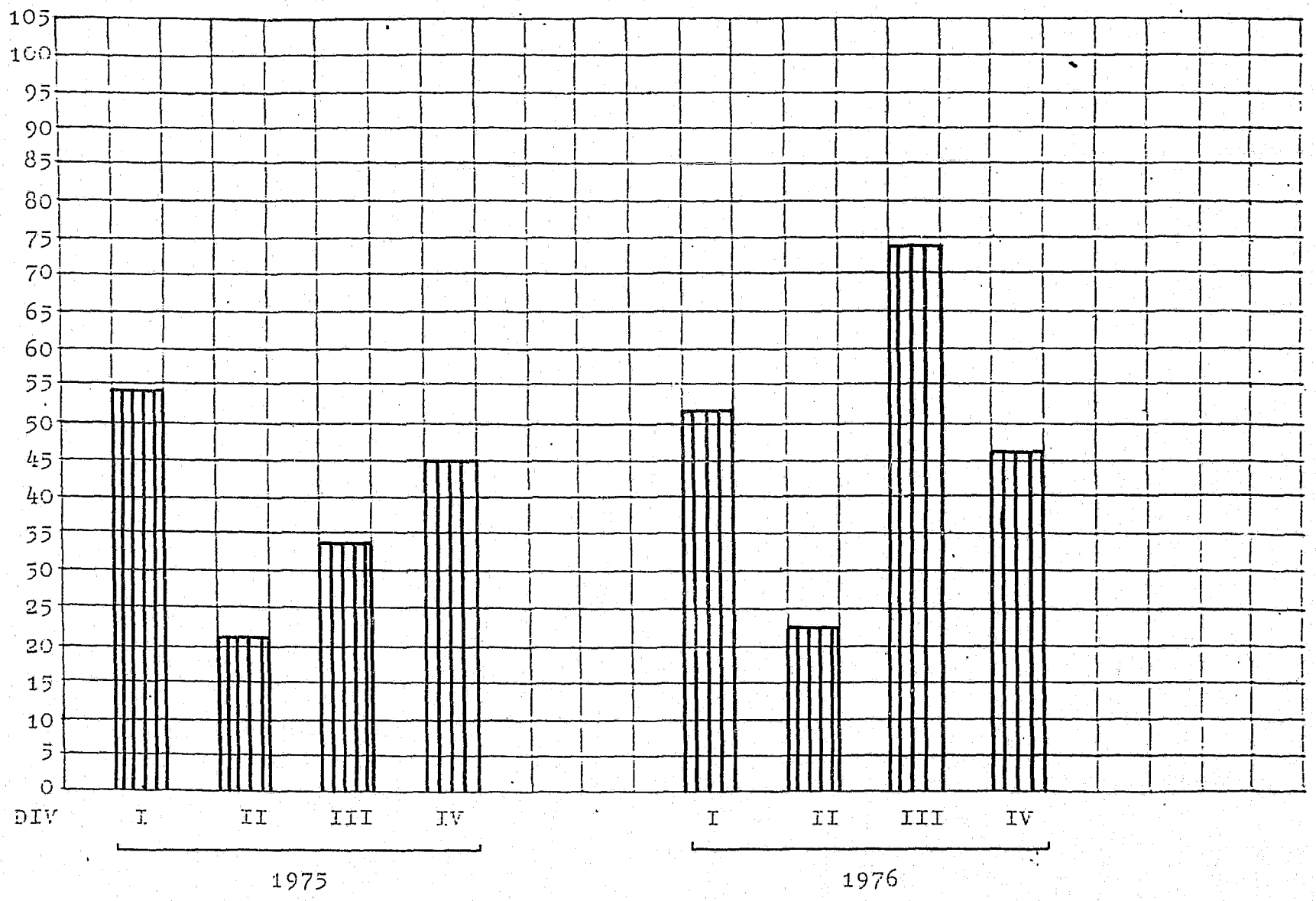
Private property accidents in this Division increased from 34 accidents in 1975 to 74 accidents in 1976, an increase of 40 traffic accidents. Approximately 34 percent of these 74 accidents occurred at Four Seasons Mall. Over one-third of these accidents occurring at the Mall were hit-and-run accidents.

Table 1.3 and Graph 1.3 summarize traffic accidents occurring on public streets for each Division. Public street accidents are computed by deducting private property accidents from all accidents

TABLE 1.3

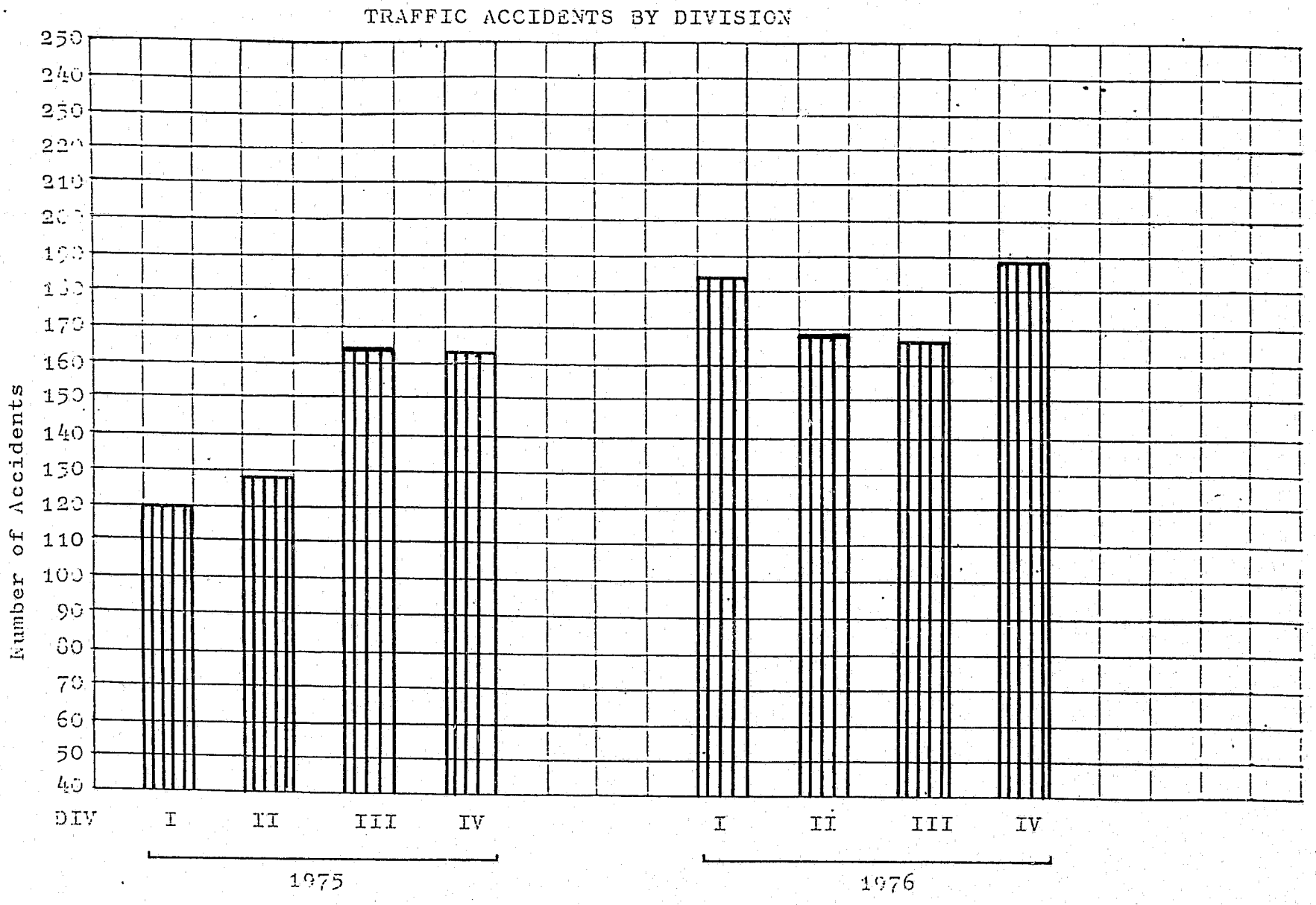
PUBLIC STREET ACCIDENTS FOR DECEMBER, 1976, COMPARED WITH DECEMBER, 1975

	I	II	III	IV	TOTAL
1976	184	169	168	189	710
1975	120	129	163	162	574
Inc./Dec.	64	40	5	27	136
%Inc./Dec.	53.33	31.01	3.07	16.67	23.69



****Only private property accidents are shown on this graph

GRAPH 1.2



Comparison of December 1975 with December 1976

****Only traffic accidents occuring on public streets are shown on this graph, computed by deducting private property accidents from all accidents occuring in the city

GRAPH 1.3

occurring within the City. The highest increase in accidents was experienced in Division I followed by Divisions II, IV, and III, respectively.

Divisions I, II, and IV were the control groups in the experiment; no selective enforcement occurred in these Divisions, only normal traffic enforcement by regular patrol personnel. Public street accidents increased from 16.67 percent (low) to 53.33 percent (high) and the three Divisions averaged a 33.67 percent increase. Public street accidents for the City increased 23.69 percent. Division III, the experimental (or test) group had an increase of 3.07 percent. Compared with the untested areas at a 33.67 percent (average) increase, it can be seen that Division III was 30.60 percent below the average of the untested areas. Compared with the overall City increase in accidents at 23.69 percent, Division III was 20.62 percent below the City increase.

Historically, Division III has more traffic accidents than any Division; Division II has the fewest number of traffic accidents. In 1975, there were 2,437 traffic accidents in Division III - 30 percent of all the City's accidents. Division II had 1,383 accidents or 17 percent. These percentages were generally consistent each month of 1975. In December, 1975, there were 163 street accidents in Division III and 129 in Division II - 34 more accidents (26.36 percent more) on public streets in Division III than in Division II. In December, 1976, after implementation of the Selective Traffic Enforcement Program, Division III had one (1) accident less than Division II.

The implementation of the Selective Traffic Enforcement Program in Division III was begun after compiling the data base which identified traffic accident trends and high accident locations. Traffic enforcement tactics and techniques were formulated using this data base. There was one general meeting concerning this implementation with S.T.E.P. personnel and the Patrol and Division Commanders; it was announced that a test would be conducted in Division III. There was another meeting with S.T.E.P. personnel and the Division III Commander and three of the five Sergeants from Division III where testing procedures were outlined. No other formal meetings or training sessions (etc.) were held by S.T.E.P. personnel.

Personnel in the Traffic Enforcement Section were primarily utilized in the test - five patrolmen and one supervisor, all using unmarked police vehicles equipped with T.D.S. and radar. Because some patrolmen were off and some in court, there were usually three to four patrolmen actually working the field. These officers worked Monday through Friday, 1200 hours to 2000 hours - the highest frequency days and times as established in the data base.

From 12/1/76, through 12/8/76, two men were assigned to High Point Road; one man on Holden Road; and two men on roving patrol within the Division. During this period, the officers used their own discretion in their patrol techniques and in specific patrol locations as long as they remained on the street assigned to them.

During the period of 12/9/76, through 12/15/76, three patrolmen were assigned to High Point Road (since more accidents were occurring there) and two patrolmen were on roving patrol throughout Division III. Again, officers used their own discretion in patrol techniques and specific locations with the exception that strong emphasis was placed on reducing speeding violation arrests (using radar) and increasing "accident causing violation" arrests (identified in the data base). Furthermore, officers were encouraged to "keep moving" in their patrol and not to use stationary patrol.

During 12/16/76, through 12/31/76, three patrolmen remained on High Point Road, one remained on roving patrol, and one assigned on Spring Garden Street between Holden Road and Aycock Street. However, the officers on High Point Road were assigned specific areas; one officer patroling from Hilltop Road to Meadowview Street; one officer patroling from Holden Road to Patterson Street; one officer patroling from Florida Street to Freeman Mill Road. More emphasis was placed against stationary patrol and officers were directly instructed not to use this technique. Also, officers were instructed to use radar/T.D.S. equipment less, although they were not ordered to discard this tool entirely.

In addition to the traffic enforcement personnel, extra-duty personnel were utilized on Fridays, 2000 hours to 2400 hours and on Saturdays, 1000 hours to 1800 hours. In employing these extra-duty officers, five patrolmen and one supervisor were

working in the field each Friday and Saturday during the above hours throughout the test period. Similar assignments were made with these officers as were for the traffic officers as described above. The one main exception is that these extra-duty officers did not use any radar/T.D.S. device unless they were regular traffic enforcement officers.

During the first period (described above), 12/1/76, through 12/8/76, 9.38 accidents per day occurred in Division III; from 12/9/76, through 12/15/76, 8.71 accidents occurred per day; from 12/16/76, through 7.5 accidents occurred per day. It was, therefore, hypothesized that fewer accidents occurred per day during the period that officers were given more specific assignments in their enforcement and as radar equipment was used less. An additional test was conducted to test this hypothesis since it was thought that many intervening variables may have caused these results, such as:

.....inconsistency in the number of days for each period;

.....increased proficiency of patrolmen in selective enforcement;

.....public awareness of increased enforcement as the month progressed.

Because of the extraordinarily small increase in traffic accidents on public streets in Division III, 3.07 percent, it is considered by S.T.E.P. personnel that a significant number of traffic accidents were prevented in that division during the test period that might have occurred without the implementation of the Selective Traffic Enforcement Program. This consideration was based upon the past

history of Division III and upon the City increase (23.62 percent) and untested Divisions average increase (33.67 percent) in public street accidents.

Table 1.4 lists summary statistics of arrests and accidents by Division for December, 1976, including the mean, standard deviation, maximum, minimum, and range for arrests and accidents.

TABLE 1.4

SUMMARY STATISTICS OF ARRESTS AND ACCIDENTS
BY DIVISION FOR DECEMBER, 1976

Division	Mean	Std. Dev.	Maximum	Minimum	Range
DIARR12	7.645	4.103	20	1	19
DIACC12	5.935	3.214	13	0	13
D2ARR12	6.935	3.660	15	2	13
D2ACC12	5.451	2.838	12	0	12
D3ARR12	17.129	10.648	41	2	39
D3ACC12	5.419	3.722	18	2	16
D4ARR12	8.645	5.868	23	1	22
D4ACC12	6.032	2.994	14	2	12

(DIARR12 = Division I, Arrest, for December (12);
DIACC12 = Division I, Accidents, for December (12); ect.)

The evidence of a saturation type patrol can be seen from this table since the average number of traffic arrests in Division III was 17.129 with the standard deviation of 10.648. The maximum number of arrests per day was 41 traffic arrests and the minimum was 2. Traffic ar-

rests for the control groups ranged from 6.935 to 8.645 arrests per day. It can be seen from the minimum colume of Table 1.4 that there are days in all divisions when traffic enforcement is extremely low.

The average number of traffic accidents in rank order are: 5.4 (Division III), 5.5 (Division II), 5.9 (Division I), and 6.0 (Division IV). It can be seen that Division III had the least number of traffic accidents and Division IV the most. However, the deviation of all divisions is very slight even though variance of traffic arrest was much greater.

Table 1.5 shows the mean number of public street accidents per day for December, 1976, compared with December, 1975.

TABLE 1.5

MEAN NUMBER OF PUBLIC STREET ACCIDENTS PER DAY FOR DECEMBER, 1976, COMPARED WITH DECEMBER, 1975

Division	1975	1976	Difference
I	3.870	5.935	+ 2.065
II	4.161	5.451	+ 1.290
III	5.258	5.419	+ .161
IV	5.226	6.032	+ .806

From this table, the mean number of traffic accidents can be compared for each division as well as the difference in the mean

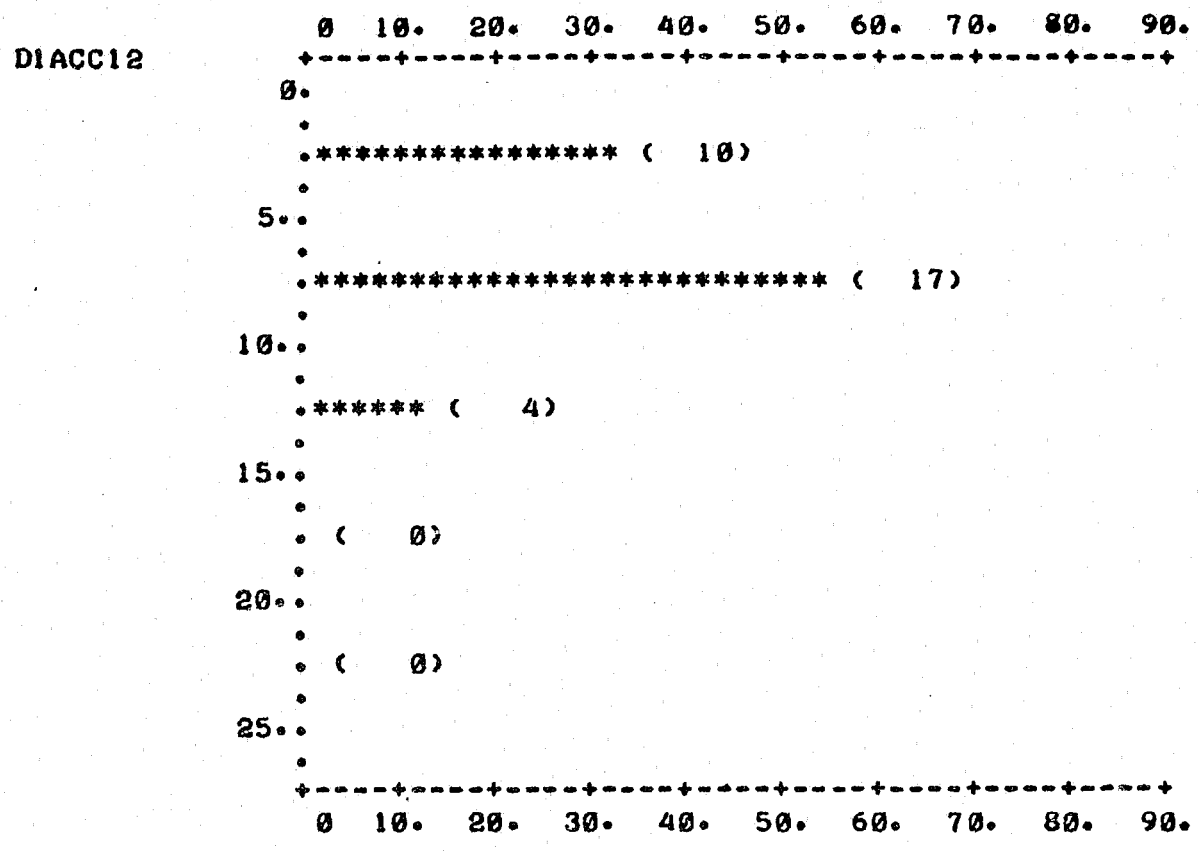
number of accidents of this year from last year. The rank order of the mean difference, from lowest to highest, is as follows:

Div. III (.161), Div. IV (.806), Div. II (1.29), Div. I (2.065)

It can be noticed that the ranking order changes, when looking at the mean for 1976 and when looking at the mean difference between 1976 and 1975. The comparison of the mean differene gives a point of reference and is a more informative comparison than a simple comparison of the mean number of traffic accidents in 1976. It may be noticed that all divisions increased in traffic accidents in total numbers, in means, and in mean differences.

Graph 1.4 shows four histograms of accidents by divisions for December, 1976. The histograms are divided into five intervals, from 0 through 25. The frequency percentages are graphed in the intervals and the frequency counts appear at the ends of the bars. It can be seen from the histogram from Division I for December that between 0 and 4 accidents occurred ten days out of the month which accounted for approximately 31 percent of the month. Between 5 and 9 accidents occurred 17 days out of the month which accounted for approximately 55 percent of the days of December, 1976. Likewise, there were 17 days during the month when Division II experienced between 5 and 9 traffic accidents per day. These histograms show that Division III experienced 10 or more accidents per day, more days than any other division; for more than 16 percent of the days in December, Division III experienced more than 10 accidents per day.

HISTOGRAM FOR D1ACC12



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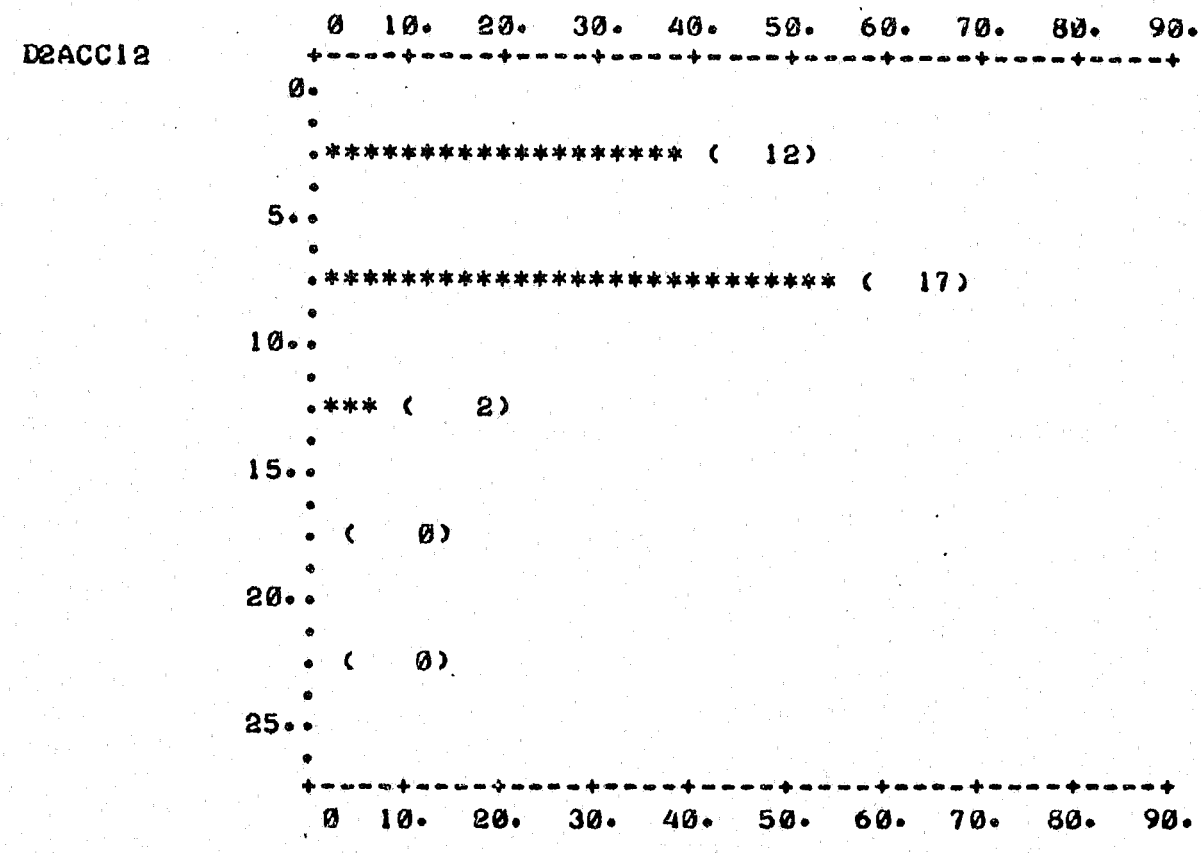

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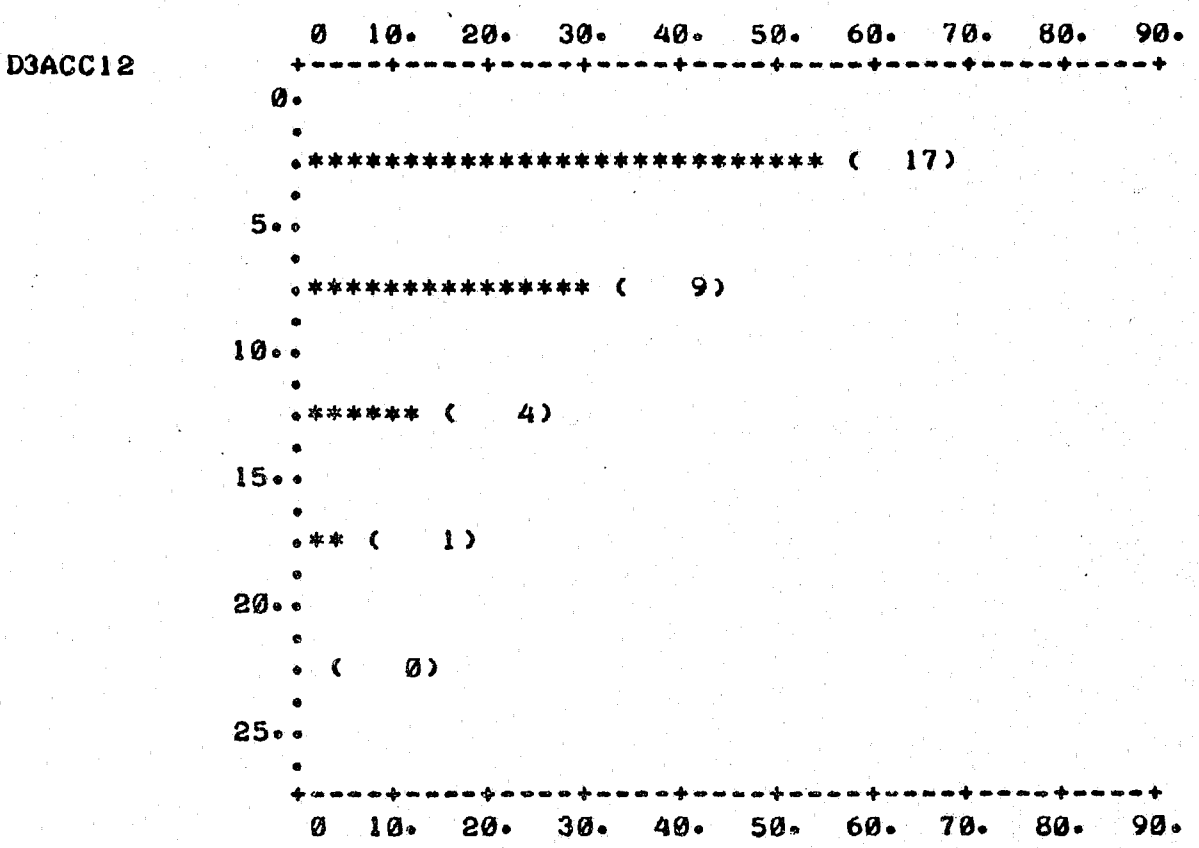

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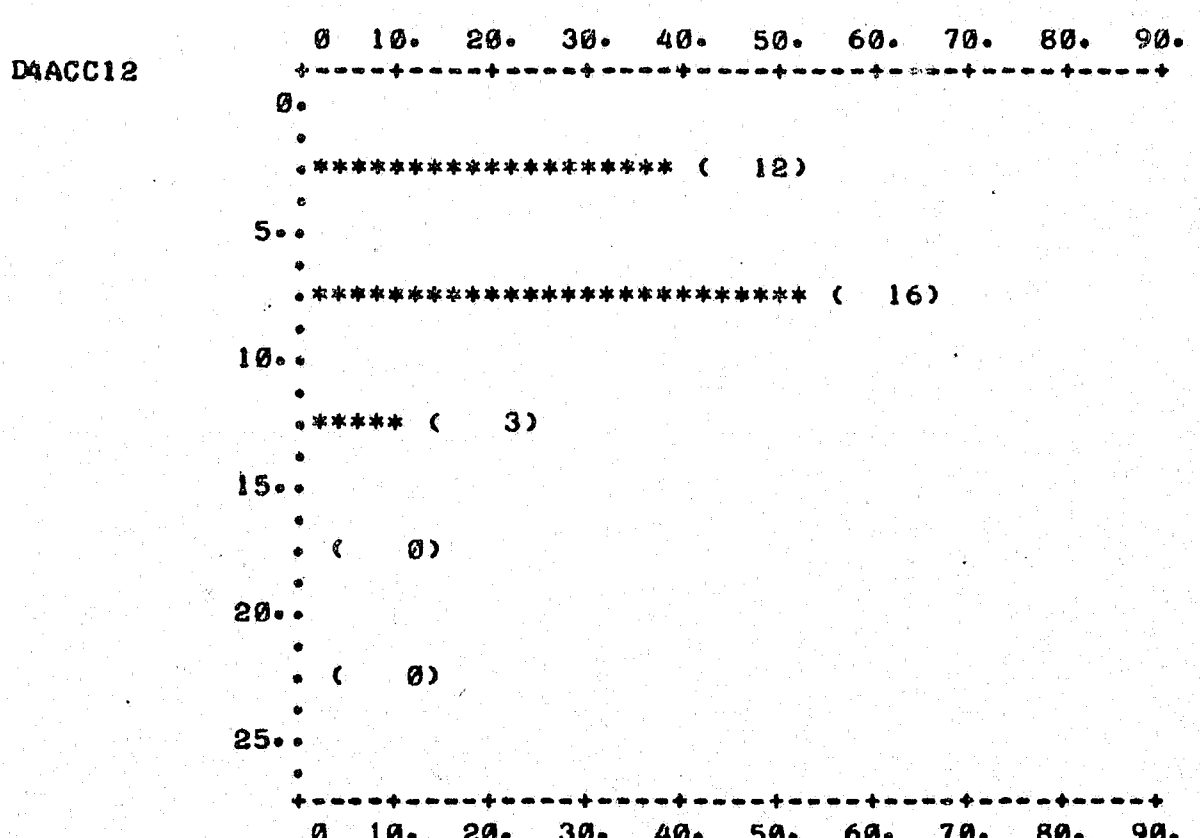


TABLE 1.6

ABSTRACT OF HISTOGRAMS OF ACCIDENTS BY DIVISION FOR DECEMBER, 1976, SHOWING FREQUENCIES WITHIN FIVE ACCIDENT INTERVALS

Accident Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	10	12	*17	12
5-9	*17	*17	9	*16
10-14	4	2	4	3
15-19			1	
20-24				

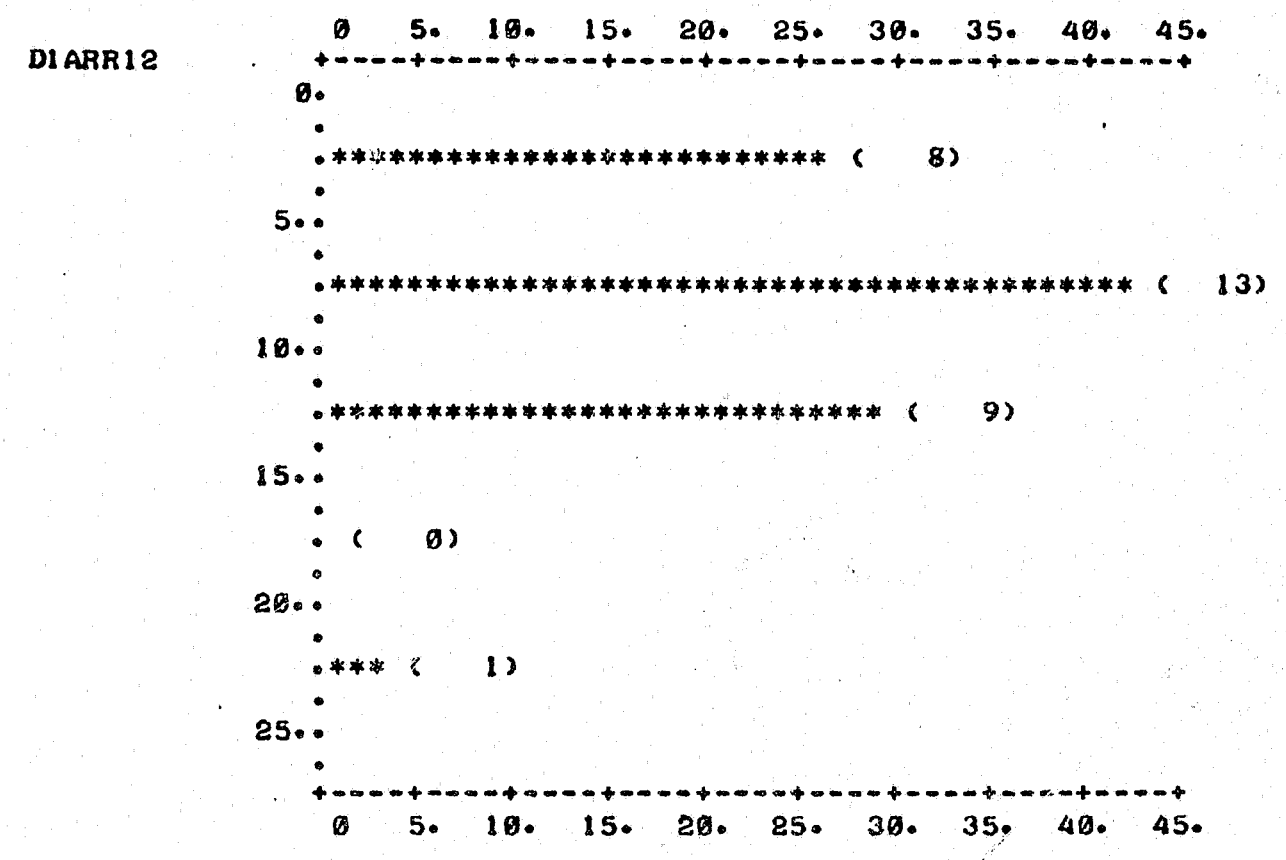
* = Mode

It is easily seen from this table that Division III had more days with fewer accidents than the remaining three divisions. These modes correlate well with the means given in Table 1.4.

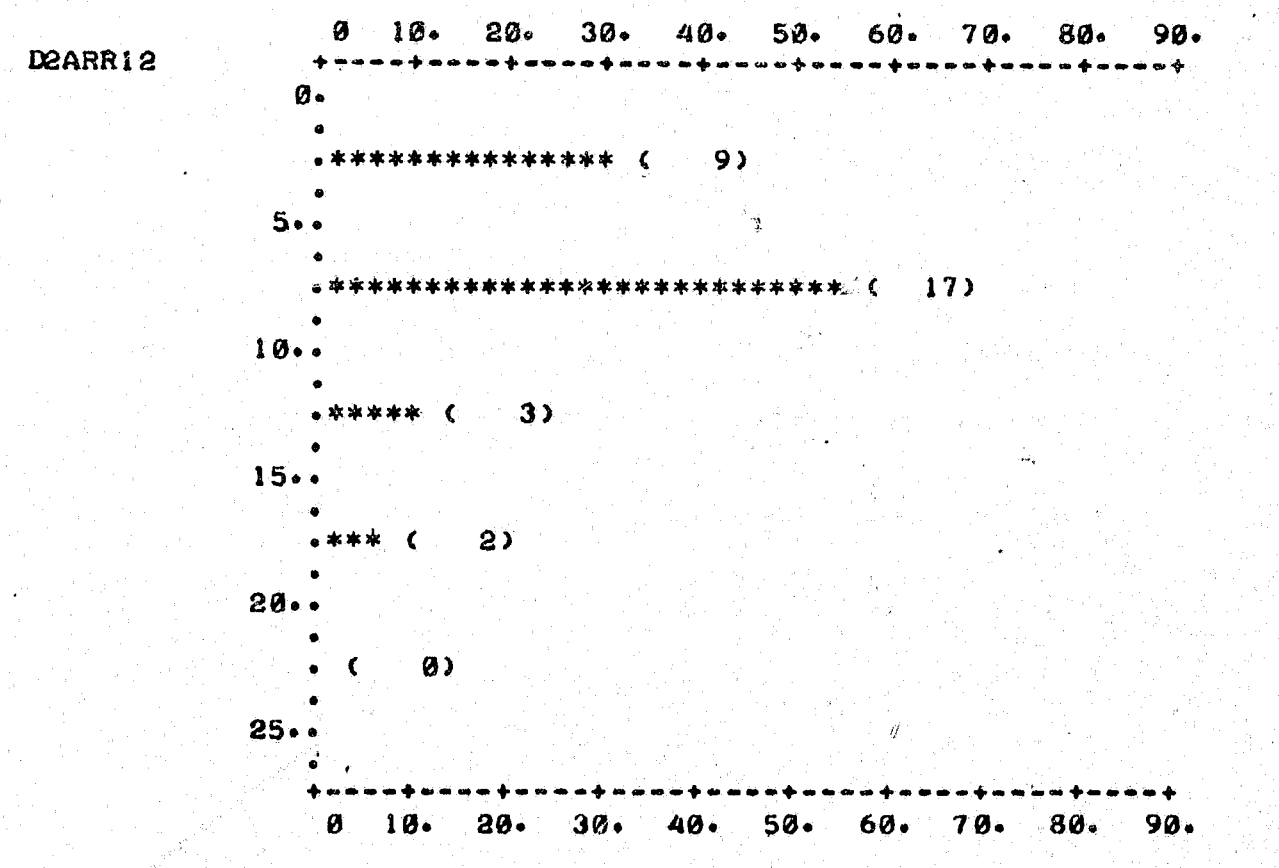
Graph 1.5 is a histogram of arrests by division for December, 1976. The design of this histogram is the same as histograms for accidents where counts appear at the end of the bars and frequency percentages are graphed. Arrests are divided into five intervals, but it should be noticed that the intervals for Division III range from 0 through 50 where the remaining divisions range from 0 through 25. Divisional commanders and supervisors should take special notice to the histograms for accidents and arrests and compare their divisions with other divisions.

Table 1.7 is an abstract of histograms of arrest by division for

HISTOGRAM FOR D1ARR12



HISTOGRAM FOR D2ARR12



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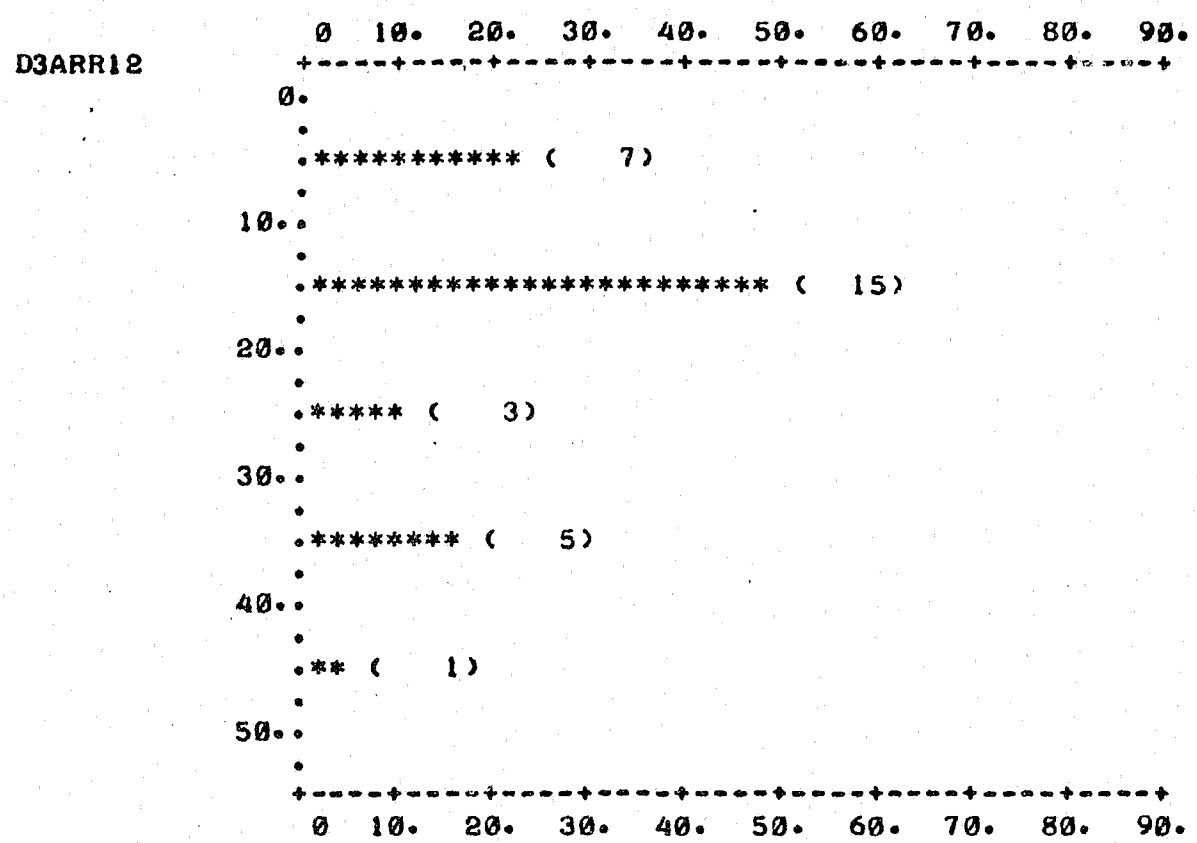

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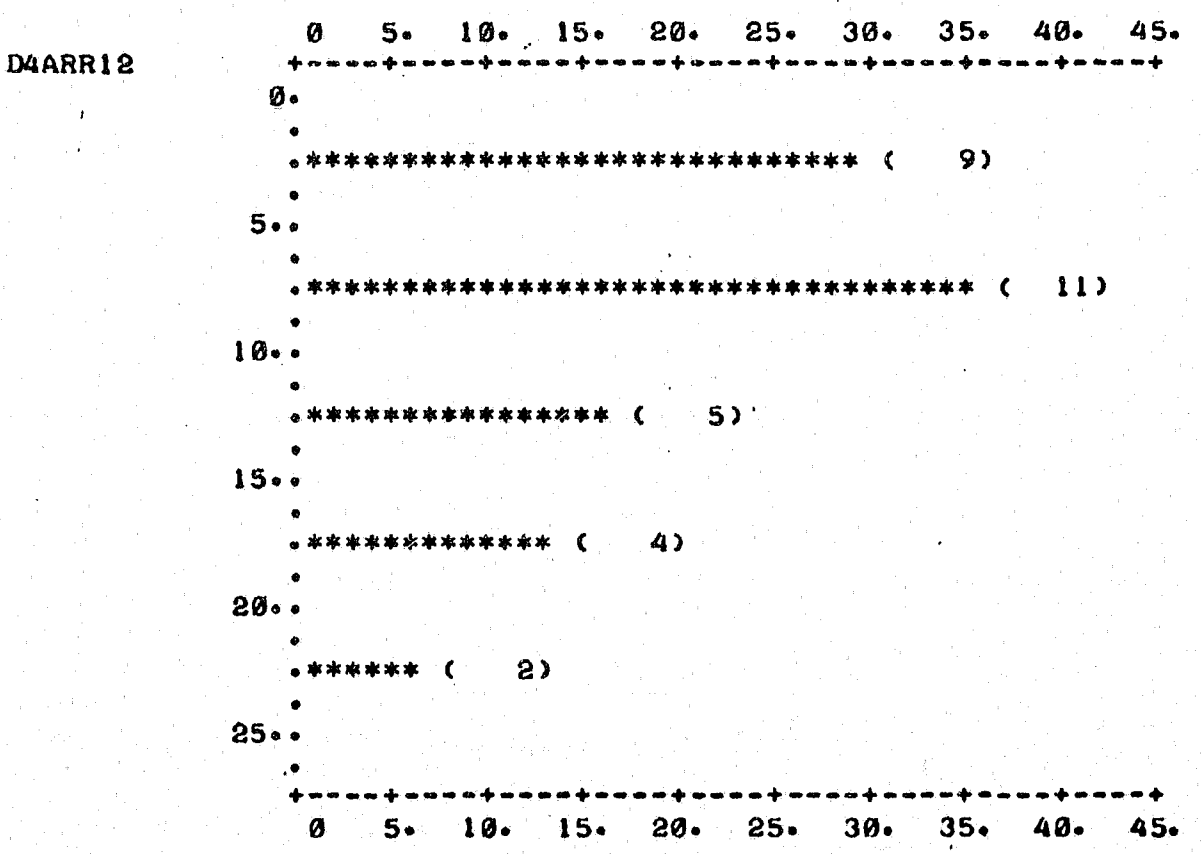


December, showing the frequencies within five arrest intervals and modes are indicated by an asterisk.

TABLE 1.7

ABSTRACT OF HISTOGRAMS OF ARREST BY DIVISION FOR DECEMBER, 1976, SHOWING FREQUENCIES WITHIN FIVE ARREST INTERVALS

Arrest Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	8	9	2	9
5-9	*13	*17	5	*11
10-14	9	3	*9	5
15-19		2	6	4
20-24	1		3	2
25			6	

* = Mode

It is easily seen from this table that for most days, traffic arrests fall within the five to nine range and seldom exceed 14 arrests per day. It can also be seen that a saturation type patrol, as experienced in Division III, significantly increases the number of arrests per day. There were only two days during the month that Division III experienced between 0 and 4 traffic arrests per day and at the other extreme, 6 days during the month when arrests exceeded 25 per day. This histogram and Table 5.5 document the saturation patrol in Division III and establishes the frequency of a "normal" patrol.

Graph 1.6 is a crosstabulation of arrests with accidents for all divisions for December, 1976, These crosstabulations combine both traffic arrests and traffic accidents per day.

Table 1.8 is an abstract of crosstabulations of arrests and accidents by division for December, showing relative modes. As Graph 1.6 shows all the days of the month, Table 1.8 only shows the modes. It can be seen that the interval for the experimental group is lower than the control groups for accidents and higher in arrests.

TABLE 1.8

ABSTRACT OF CROSSTABULATIONS OF ARRESTS AND ACCIDENTS BY DIVISION FOR DECEMBER, 1976, SHOWING RELATIVE MODES

Horizontal = Arrest, Vertical = Accidents

20

15

10

I/II/IV

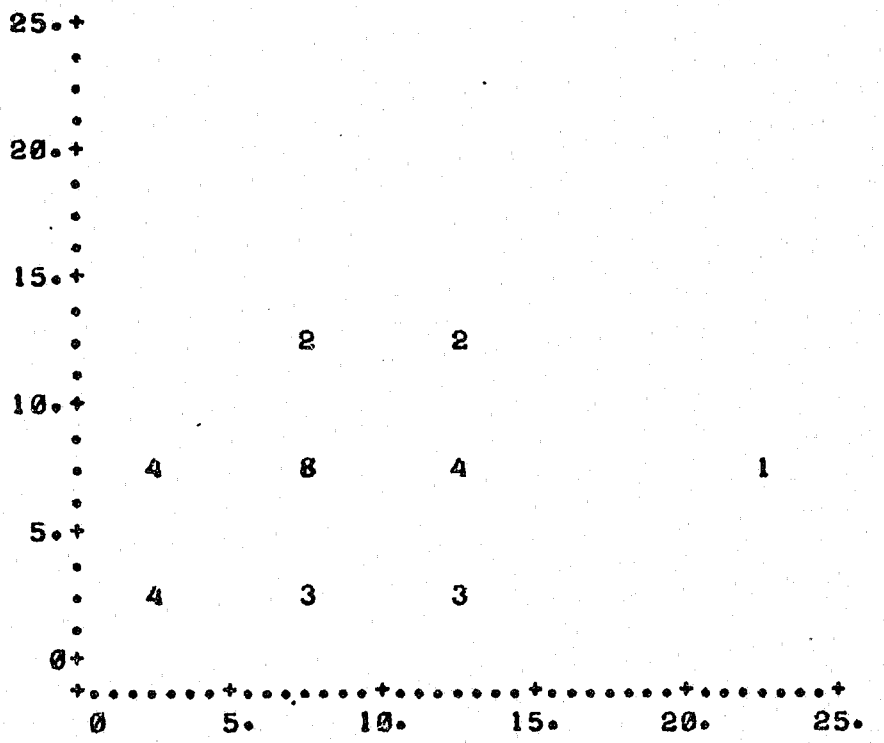
5

III

0 5 10 15 20 25

Ideally, this would be the case where enforcement would increase (move to right on the chart) and the level of accidents would

CROSSTABULATION HORIZONTAL=D1ARR12 , VERTICAL=D1ACC12



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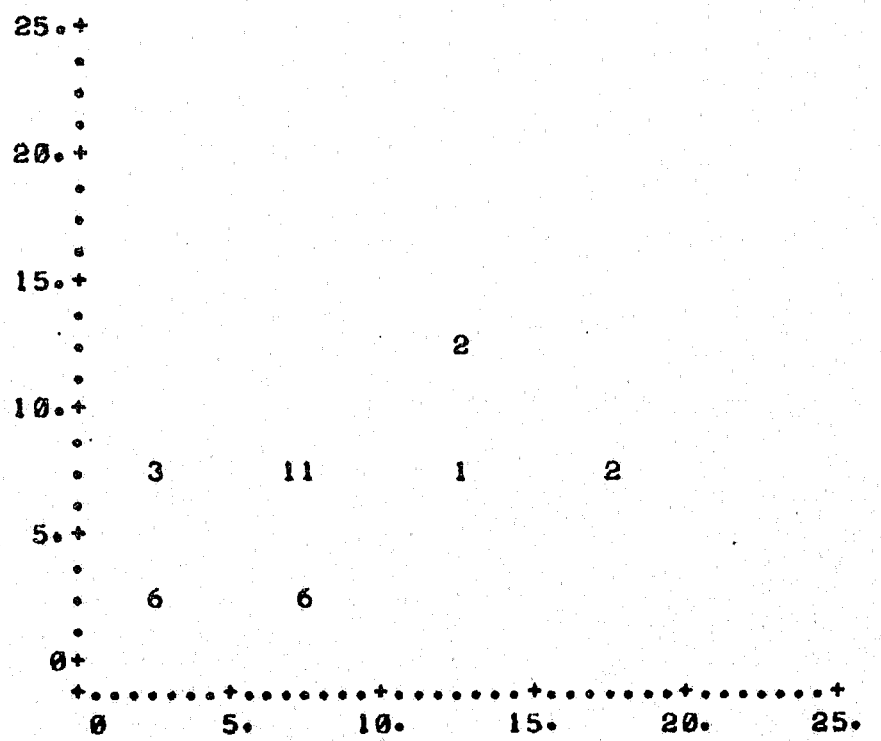

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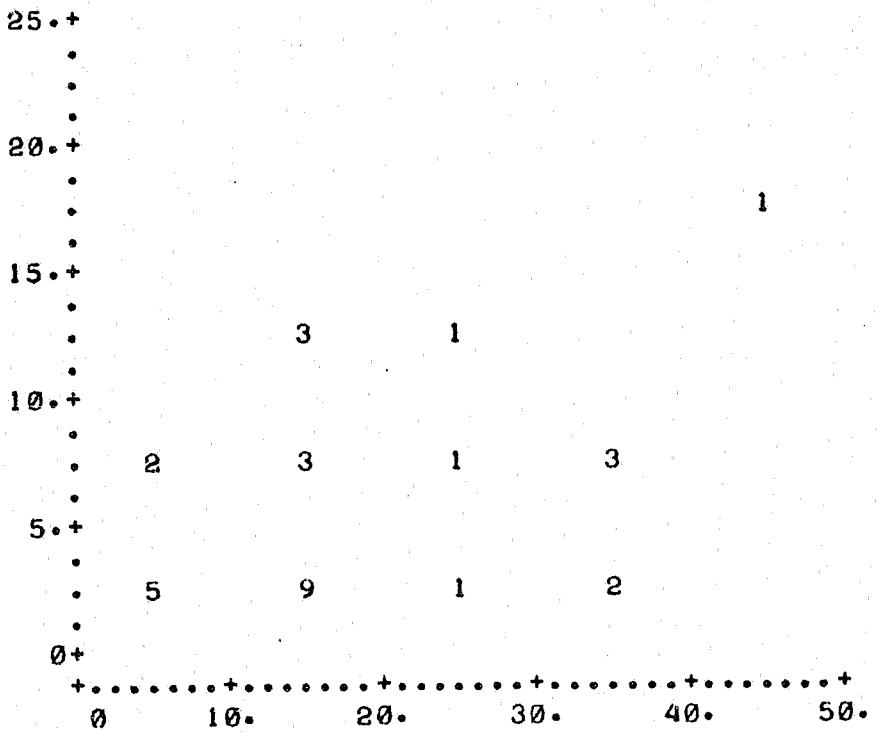

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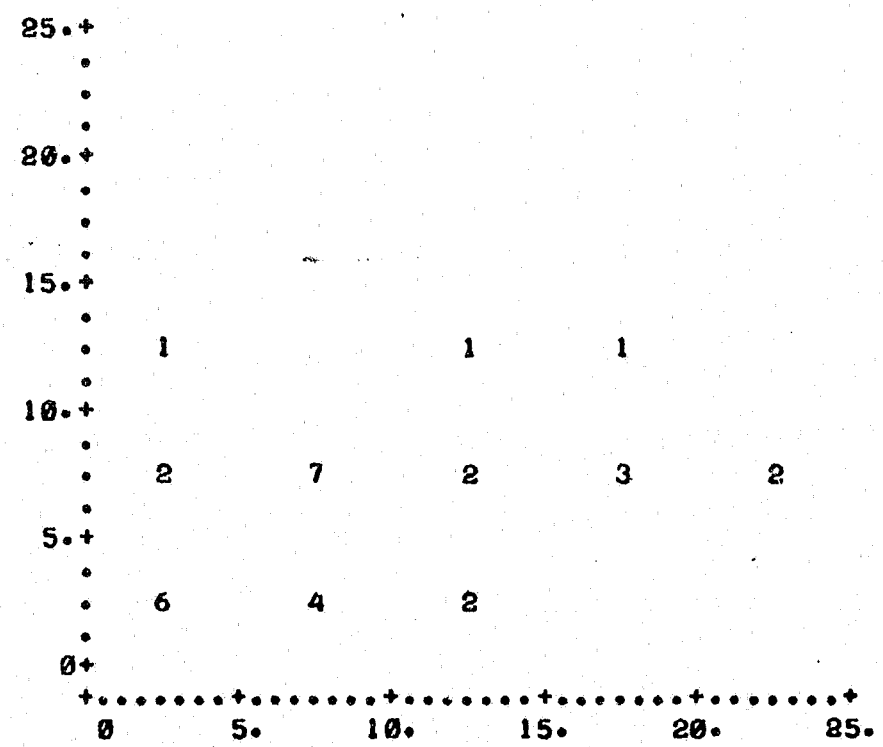


decrease (move toward the bottom of the chart). Although this is the case in our experimental group for December, an examination of previous material, such as the mean and histograms for accidents, show that the difference is very slight for the experimental and control groups.

Section II - January Experiment

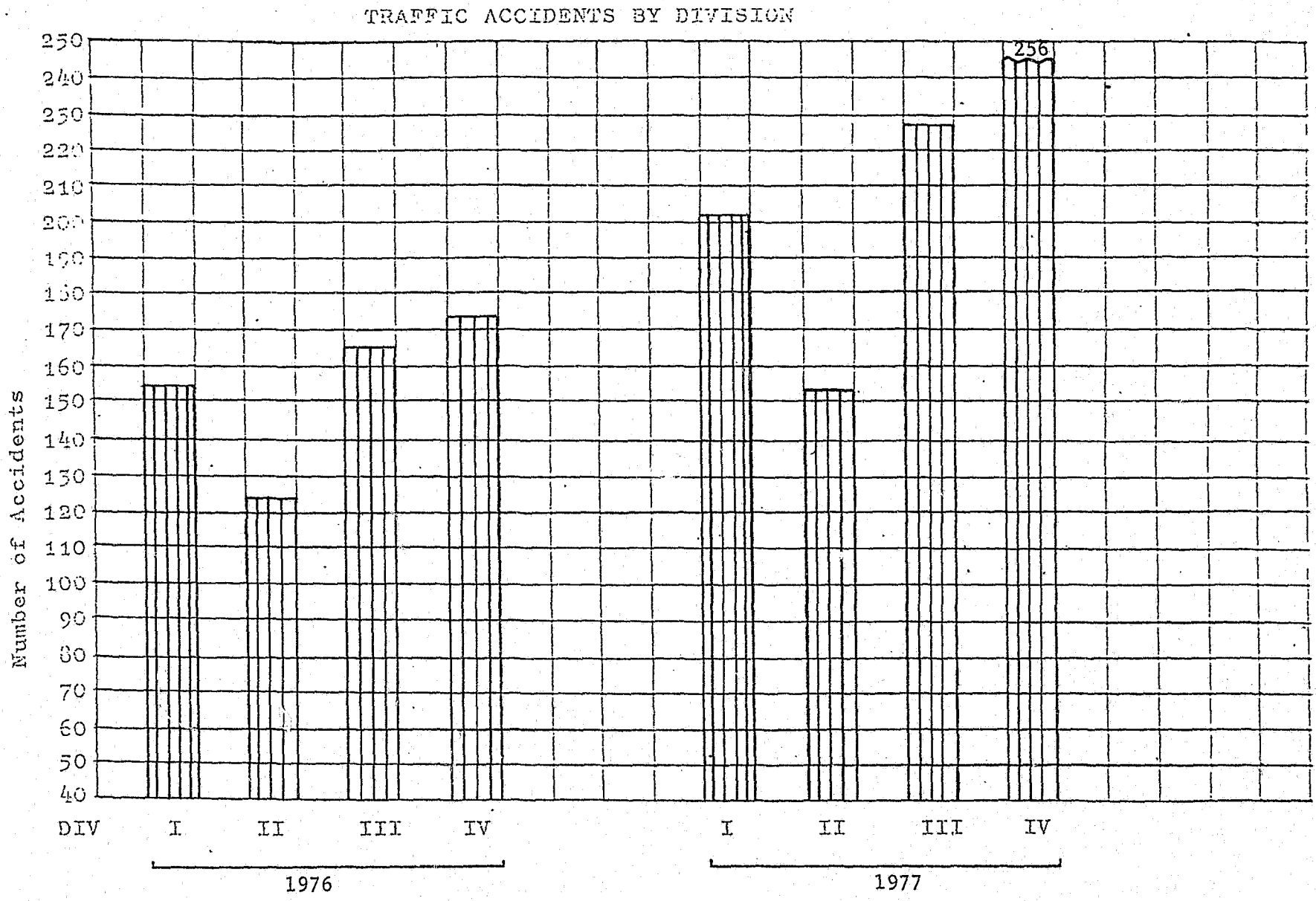
Division I was selected as the experimental group for January, 1977. The experiment was a replication of the experiment conducted in Division III during December, using a saturation, roving type patrol operating unmarked police vehicles. The purpose of this replication was to corroborate the findings in the first experiment.

Table 2.1 is a comparative summary of all traffic accidents within the city, including public street and private property accidents, comparing January, 1977, with January, 1976.

TABLE 2.1

ALL CITY ACCIDENT FOR JANUARY, 1977, COMPARED WITH JANUARY, 1976

	I	II	III	IV	TOTAL
1977	201	152	228	256	836
1976	154	124	166	173	617
Inc./Dec.	47	28	62	83	220
%Inc./Dec.	30.52	22.58	37.35	47.98	35.66



Comparison of January 1976 with January 1977

****All traffic accidents in the city are shown on this graph

Graph 2.1

Graph 2.1 illustrates this table. All Divisions had an increase in traffic accidents ranging from 22.58 to 47.98 percent. City-wide, accidents increased 35.66 percent in January, 1977, as compared with January of last year.

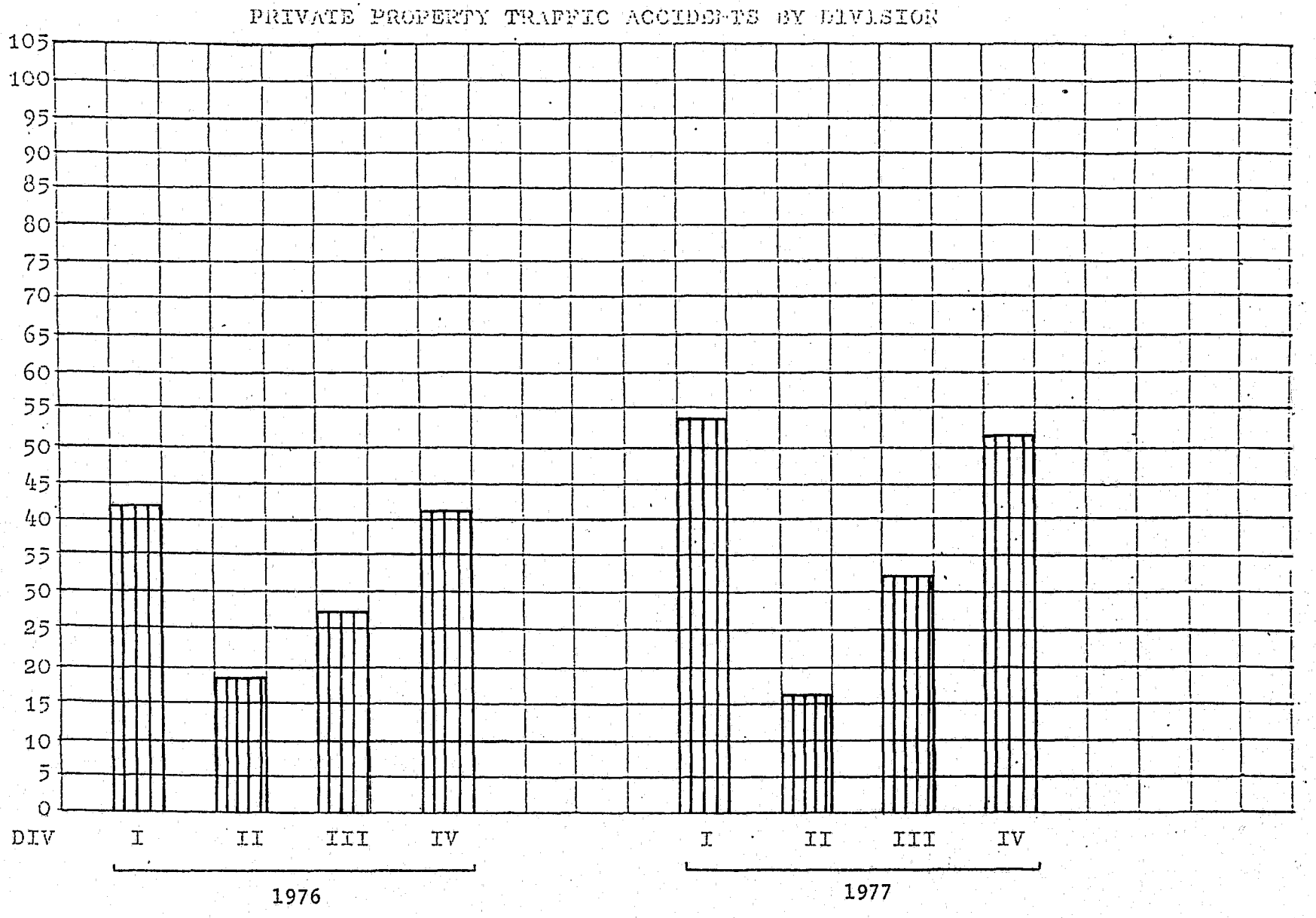
Table 2.2 lists private property accidents by division for January, 1976 (see Graph 2.1). Division II had a decrease in private property accidents while the remaining divisions increased. City wide, private property accidents increased 19.53 percent. It is interesting to notice from this table that while the percentages of increase may seem high (i.e., Division I increased nearly 29 percent), the number

TABLE 2.2

PRIVATE PROPERTY ACCIDENTS FOR JANUARY, 1977, COMPARED WITH JANUARY, 1976

	I	II	III	IV	TOTAL
1977	54	16	32	51	153
1976	42	18	27	41	128
Inc./Dec.	12	-2	5	10	25
%Inc./Dec.	28.57	-11.11	18.52	24.39	19.53

of accidents of that increase are comparatively low (Division I increased by only 12 accidents for the month). This is because the total number of private property accidents is relatively low. For example, Division I had 54 private property accidents from a total of 201 accidents during the month of January. City-wide, private property accidents compromised approximately 18 percent of all traffic



Comparison of January 1976 with January 1977

****Only private property accidents are shown on this graph

GRAPH 2.2

accidents in January, 1977. Considering the reason for such high percentages, special attention should be given to Division III because of the dramatic increase differences during test periods that are not present in other Divisions.

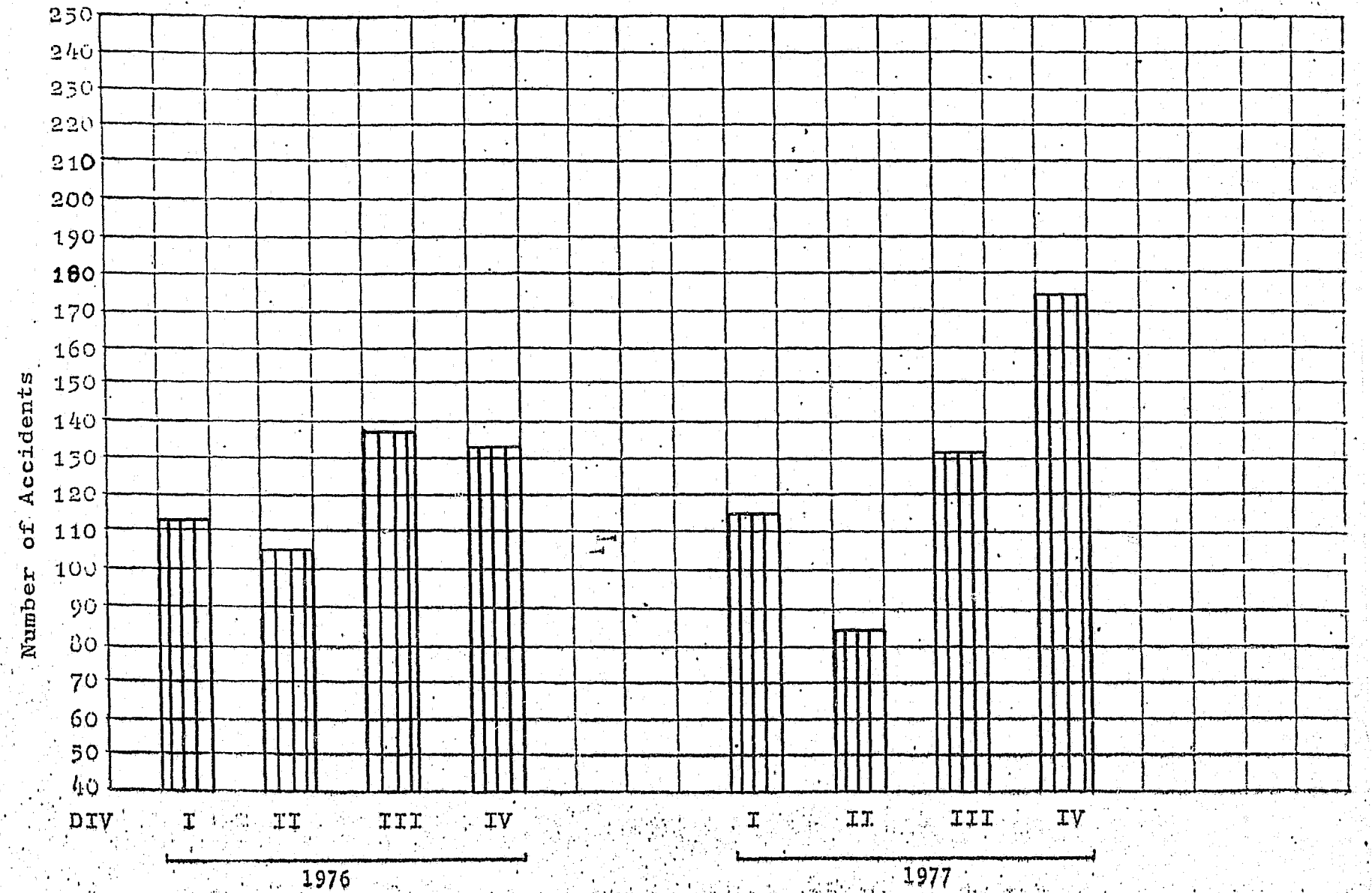
Last month (December, 1976) private property accidents increased by 40 accidents in Division III. This was a 117.65 percent in- increase over December, 1975. This month (January, 1977) private property accidents increased by 5 accidents or by 18.52 percent in Division III over January, 1976. Considering only this two month period, the differences between the 117.65 percent increase and the 18.52 percent increase would seem to be due to the large number of retail businesses in Division III, especially the Four Seasons Mall, and the Christmas shopping period. Consideration of causative factors of accidents on private property may be needed, especially during increased retail shopping periods, in a comprehensive program to reduce traffic accidents.

TABLE 2.3

PUBLIC STREET ACCIDENTS FOR JANUARY, 1977, COMPARED WITH JANUARY, 1976

	I	II	III	IV	TOTAL
1977	114	84	131	175	504
1976	112	106	139	132	489
Inc./Dec.	2	-22	-8	43	15
%Inc./Dec.	1.79	-20.75	-5.76	32.58	3.07

TRAFFIC ACCIDENTS BY DIVISION



****Only traffic accidents occuring on public streets are shown on this graph, computed by deducting private property accidents from all accidents occuring in the city

GRAPH 2.3

Divisions II and III decreased in the number of public street accidents while Divisions I and IV increased. City-wide, public street accidents increased by 3.07 percent, after corrections were made for snow accumulation on the streets causing an excessive number of traffic accidents. Division I, the experimental group, increased by 1.79 percent.

A major confounding variable in this experiment was snow accumulation during the month. In January, 1977, the city experienced 8.1 inches of accumulated snow. Snow accumulated on the streets on the 3rd, 6th, 7th, 9th, and 24th days of the month in addition to heavy sleet and ice accumulation on the 14th day. For most of these days, the snow and ice remained on the roadways at least one day following the snow before it melted or was removed. During the comparative month of January, 1976, there was only a "trace" of snow (.09 of an inch or less) which did not accumulate on the roadways.

Being the case, the comparison was made with one month having over 8 inches of snow with a month having no measureable amount of snow. This makes it extremely difficult to determine true results of the test since all divisions experienced many accidents due to snow and ice on the streets.

To account for this intervening variable, a correction factor was made by subtracting all accidents occurring on snow days, dividing the remainder by 25 to obtain a mean, multiplying the mean by 6, and

adding this number to the total number of accidents occurring on non-snow days. For example, in Division I, the computation was:

$$201 - 68 = 133 \div 25 = 5.32 \times 6 = 32 + 133 = 165.$$

The same procedure was followed for private property accidents that were deducted from all accidents to obtain the number of public street accidents. Table 2.3 reflects these correction factors.

The implementation of the Selective Enforcement Program in Division I was begun after the first test was completed in Division III. The test in Division I utilized the techniques and enforcement tactics in those areas of the Division seen to be high frequency accident locations as identified in the data base. As the first phase of the implementation, a meeting was held with S.T.E.P. personnel and the Division I Commander, executive officer, and five sergeants where basic techniques and expectations were discussed. No other formal meetings or taining sessions were held by S.T.E.P. personnel.

As in December, personnel in the Traffic Enforcement Section were were primarily utilized in the test - five patrolmen and one supervisor, all using unmarked patrol vehicles equipped with T.D.S. and radar. Because some patrolmen were off and some in court, there were usually three to four patrolmen actually working in the field. These

officers worked Monday through Friday, 1200 hours 2000 hours, the highest frequency days and times as established in the data base.

In addition to the traffic enforcement personnel, extra-duty personnel were utilized on Fridays, 2000 hours to 2400 hours, and on Saturdays, 1000 hours to 1800 hours. In employing these extra-duty officers, five patrolmen and one supervisor were working in the field each Friday and Saturday during the above hours throughout the test period. Similar assignments were made with these officers as were for the traffic officers. The one main exception is that these extra-duty officers did not use any radar/T.D.S. device unless they were regular traffic enforcement officers.

As an enforcement unit, traffic enforcement personnel were given three different assignments. From 1/1/77, through 1/10/77, one officer was assigned on Cone Boulevard, from Elm Street to U.S. 29; two officers were assigned on Summit Avenue, one from Church Street to Bessemer Avenue and one from Bessemer Avenue to Phillips Avenue; one officer was assigned on Wendover Avenue from Summit Avenue to Lindsay Street - Lindsay Street to Bessemer Avenue - Bessemer Avenue to Summit Avenue - Summit Avenue to Wendover Avenue; and one officer was assigned on Bessemer Avenue, Elm Street to U.S. 29. Officers were instructed not to use stationary patrol and were instructed to make very limited use of T.D.S./radar equipment if used at all.

From 1/11/77, through 1/20/77, one officer was assigned on Cone Boulevard; one on Bessemer Avenue; one on Wendover Avenue; and two officers were assigned on Summit Avenue. Officers were encouraged to use roving type patrol and to limit usage of T.D.S./radar. Officers used their own discretion in patrol techniques and specific locations or patrol except as described above.

From 1/21/77, through 1/31/77, one officer was assigned on Bessemer Avenue; one on Wendover Avenue; one on Cone Boulevard; one on Summit Avenue; and one on Market Street. Officers were to use their own discretion in their patrol techniques and in specific locations as long as they remain on the street assigned to them.

These assignments were made, as close as possible, like the three assignments made in Division III during the first test period, but in reverse order. In brief, the assignments were as follows:

(1) One officer on each of the five streets identified in the data base as high-frequency accident locations with officers using their discretion in patrol techniques.

(2) More specific street assignments with more officers on those streets where more accidents occur and encouraging roving type patrol and a reduction in the use of T.D.S./radar.

(3) Most specific street assignments concentrating officers in a smaller area where more accidents occur, and officer's

discretion is almost eliminated as to the type of patrol (using roving patrol only) and as to T.D.S/radar equipment (very limited use if used at all).

These assignments were used in this order (1, 2, 3) during the first test period in Division III. These assignments were made in reverse order in Division I (3, 2, 1) which required some presumption as to the more specific street assignments where accidents occur more often (which in Division I, of course, had not occurred). These presumptions were carefully made and based on as much evidence as could be obtained as to past accident trends for Division I. This was necessary to prove or disprove the hypothesis raised, that fewer accidents occur per day during the period that officers were given more specific assignments in their enforcement and as radar equipment was used less.

It was not an original objective of these first two tests to prove/disprove this hypothesis. However, as the weeks progressed during December, 1976, (the first test period) it was deemed necessary to give officers more specific assignments in an effort to reduce accidents. A pin map of Division III was studied daily and as "troubled" areas began to appear, officers were so directed. At the end of the test period, it was noticed that accidents per day steadily decreased during the three assignment periods. This raised a hypothesis that fewer accidents occur during the period that officers were given more specific assignments in their en-

forcement and as radar equipment was used less; but as noted, there are many intervening variables that may have caused these results, such as:

.....inconsistency in the number of days for each period;

.....increased proficiency of patrolmen in selective enforcement;

.....public awareness of increased enforcement as the month progressed.

During the second test period, an effort was made to test the hypothesis; the three assignments were made in reverse order. If the hypothesis was true and if the presumptions on street assignments in Division I were valid, it stands that accidents would steadily increase during the three assignment periods since the assignments were made in reverse order.

During the first period, 1/1/77, through 1/10/77, 7.2 accidents per day occurred in Division I; from 1/11/77, through 1/20/77, 6.6 accidents occurred per day; from 1/21/77, through 1/31/77, 5.73 accidents occurred per day. Table 2.4 compares assignments 1 through 3 with Division III and Division I.

TABLE 2.4

ASSIGNMENT COMPARISON WITH DIVISION III TO DIVISION I

Assignments	Division III	Division I
1	9.38 (first week)	5.73 (third week)
2	8.71 (second week)	6.6 (second week)
3	7.5 (third week)	7.2 (first week)

This table shows Division III and Division I had a decrease each period. Since we would expect accidents to increase in Division I from the hypothesis, because the most specific assignments were made during the first week and the least specific assignments during the third week, it stands that the hypothesis is not true and some variable other than assignments given to officers tend to decrease accidents per day as the month progresses.

Because the inconsistency in the number of days for each assignment period is corrected in the second test, this variable was eliminated. And because increase proficiency of patrolmen in selective enforcement will reach a stopping point, most likely a point before a 60-day period, it is probable that this variable can be eliminated. This leaves the last and most probable variable that growing public awareness of enforcement tends to reduce accidents per day as the months progress. This raises another question which will require additional testing:

At what point will this growing public awareness of increased enforcement stop reducing accidents? How many weeks will accidents show a reduction in the number of accidents per day until the number of accidents level off?

In summary of our two test periods concerning this hypothesis of personnel assignment, it can be said that fewer accidents did not occur per day during the period that officers were given more specific assignments in the enforcement and as radar equipment

was used less. Of course, this does not say that patrolmen should be given no direction in enforcement, remembering that all assignments were directed in the high-frequency accident locations as identified in the data base. It also does not preclude directing patrolmen to "trouble" areas as they appear on the pin map. It does say, however, that removing all discretion from officers as to the type of patroling techniques they use (roving/sationary patrol; T.D.S/radar/visual observation/distrance/time/area of patrol) and overly restricting patrol areas is ineffective in reducing the number of traffic accidents.

Table 2.4 gives summary statistics of arrests and accidents by Division for January, calculated without snow days.

TABLE 2.4

SUMMARY STATISTICS OF ARREST AND ACCIDENTS BY DIVISION FOR JANUARY 1977

Division	Mean	Std. Dev.	Maximum	Minimum	Range
D1ARR1	16.280	11.971	49	2	47
D1ACC1	3.680	2.495	10	0	10
D2ARR1	6.120	4.076	18	2	16
D2ACC1	2.760	2.107	7	0	7
D3ARR1	8.760	4.294	21	2	19
D3ACC1	4.240	3.711	18	1	17
D4ARR1	9.880	4.216	22	3	19
D4ACC1	5.640	3.264	16	1	15

(D1ARR1 = Division I Arrest for January (1);
D1ACC1 = Division I, Accidents for January (1); etc..)

Again, this table documents the saturation type patrol in the experimental group, which is Division I. As shown, Division I had an average of 16.3 traffic arrests per day with a maximum of 49 and a minimum of 2 per day. Accidents in Division I averaged 3.68 with a maximum of 10 and a minimum of 0. Traffic arrests for the control groups range from 6.1 to 9.9, and accidents ranged from an average of 2.8 to 5.6.

Table 2.5 compares the mean number of public street accidents per day by division.

TABLE 2.5

MEAN NUMBER OF PUBLIC STREET ACCIDENTS PER DAY FOR JANUARY, 1977, COMPARED WITH JANUARY, 1976

Division	1975	1976	Difference
I	3.613	3.680	+ .067
II	3.419	2.760	- .659
III	4.484	4.240	- .244
IV	4.258	5.640	+ 1.382

The mean number of public street accidents for 1976 in rank order, from lowest to highest, is as follows:

Div. II (2.8), Div. I (3.7), Div. III (4.2), Div. IV (5.6)

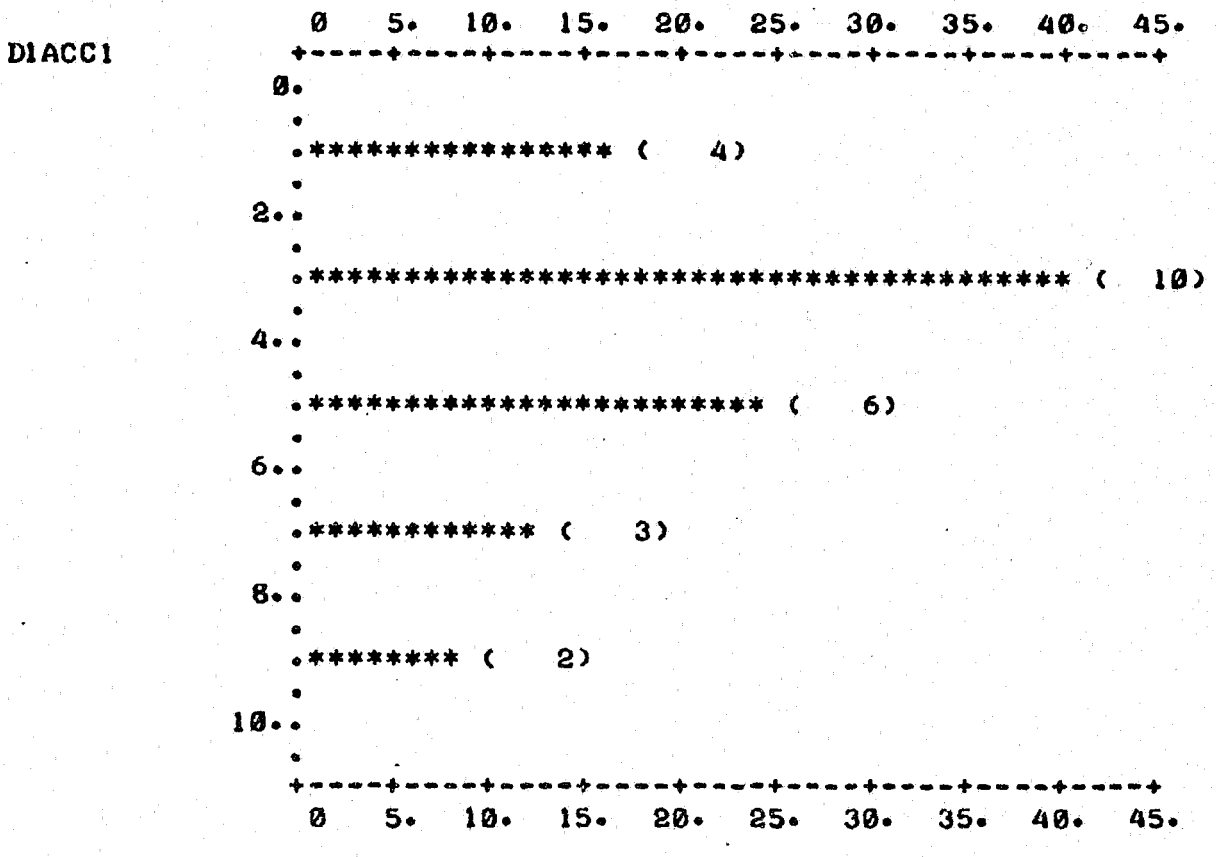
This is the same order, of course, as could be obtained from data in Table 2.3. However, the ranking order changes as the mean difference is ranked by division, which is:

Div. II (-.659), Div. III (-244), Div. I (+.067), Div. IV (+1.382)

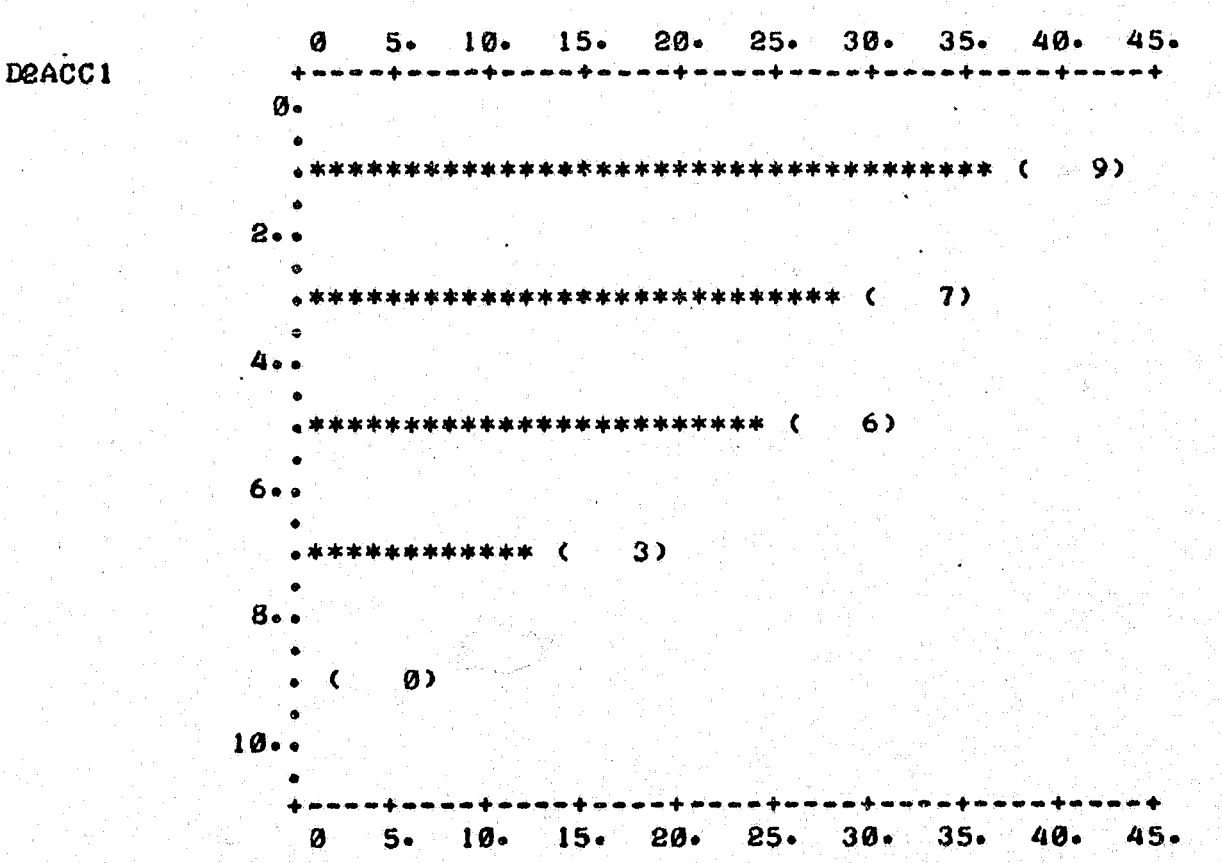
It can be seen from the ranking that Divisions I and III have exchanged places when the mean differences are ranked, since Division III experienced a decrease in the mean number of accidents and Division I experienced an increase. It can be remembered that during December, the experimental group ranked lowest with the mean difference and in January ranked third of four divisions. It is also to be remembered that the exact same experiment was conducted in Division I during January as was conducted in Division III during December. The purpose of the replication was to verify findings and not rely solely on a 30-day experiment.

Graph 2.4 shows histograms of accidents for all divisions during January, 1977. Because of the variations in the number of traffic accidents in divisions, the interval frequencies are different for Divisions I and II than for Divisions III and IV. In all cases, there are five accident intervals and the frequency percentages are graphed. It is easily seen from this graph that more accidents occur per day in Divisions III and IV than in Divisions I and II.

HISTOGRAM FOR D1ACC1



HISTOGRAM FOR D2ACC1



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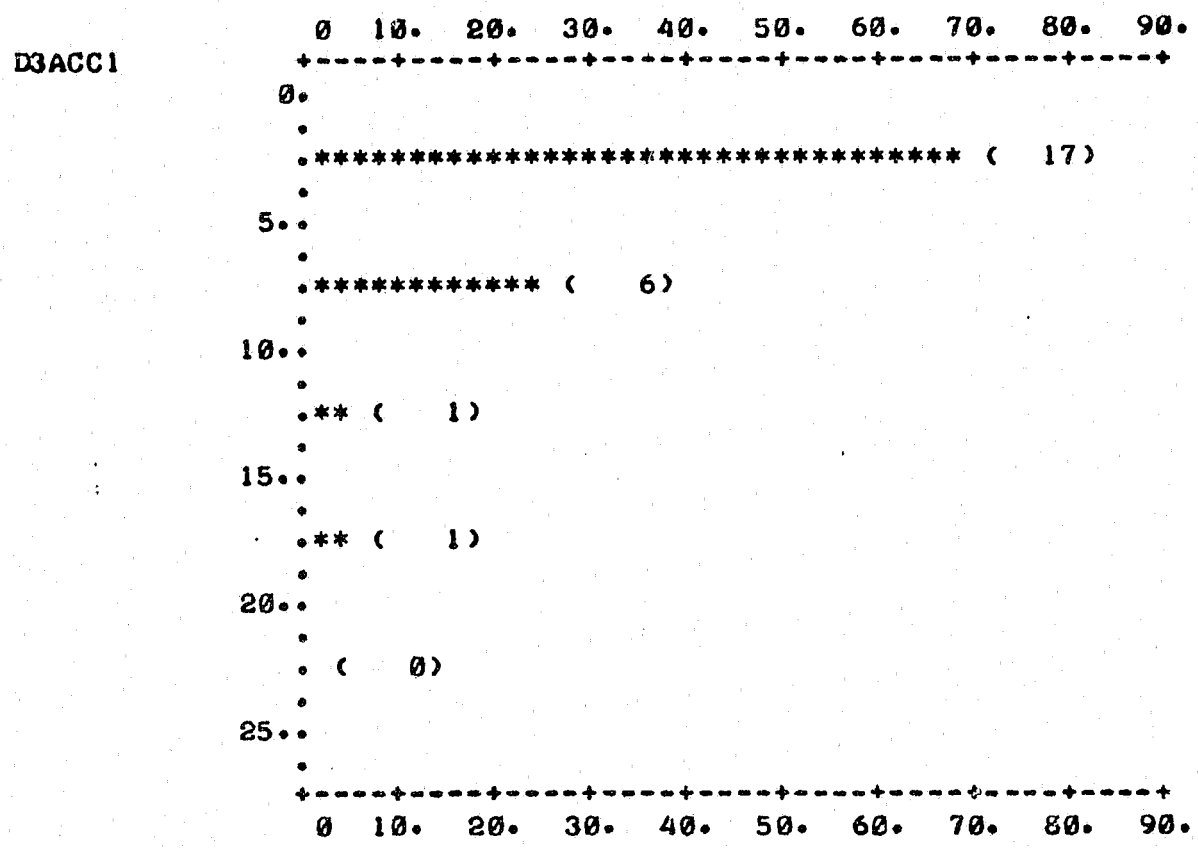

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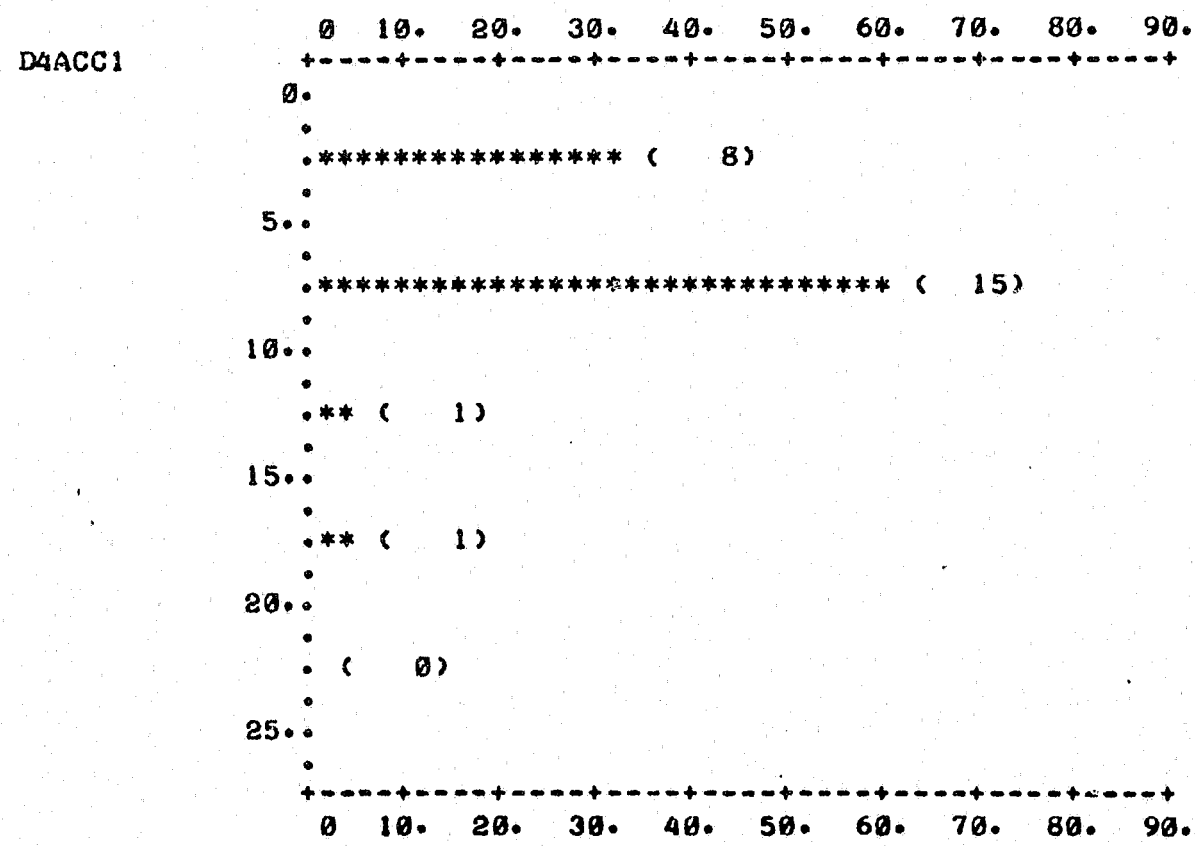


Table 2.6 is an abstract of histograms of accidents by division for January showing frequencies within the five accident intervals and modes are marked with an asterisk. Modes for Divisions I, II, and III are in the same accident interval with very little variance between them while the mode for Division IV is in a higher interval. It is also noteworthy that Divisions III and IV experienced a large number of traffic accidents during two days of the month.

TABLE 2.6

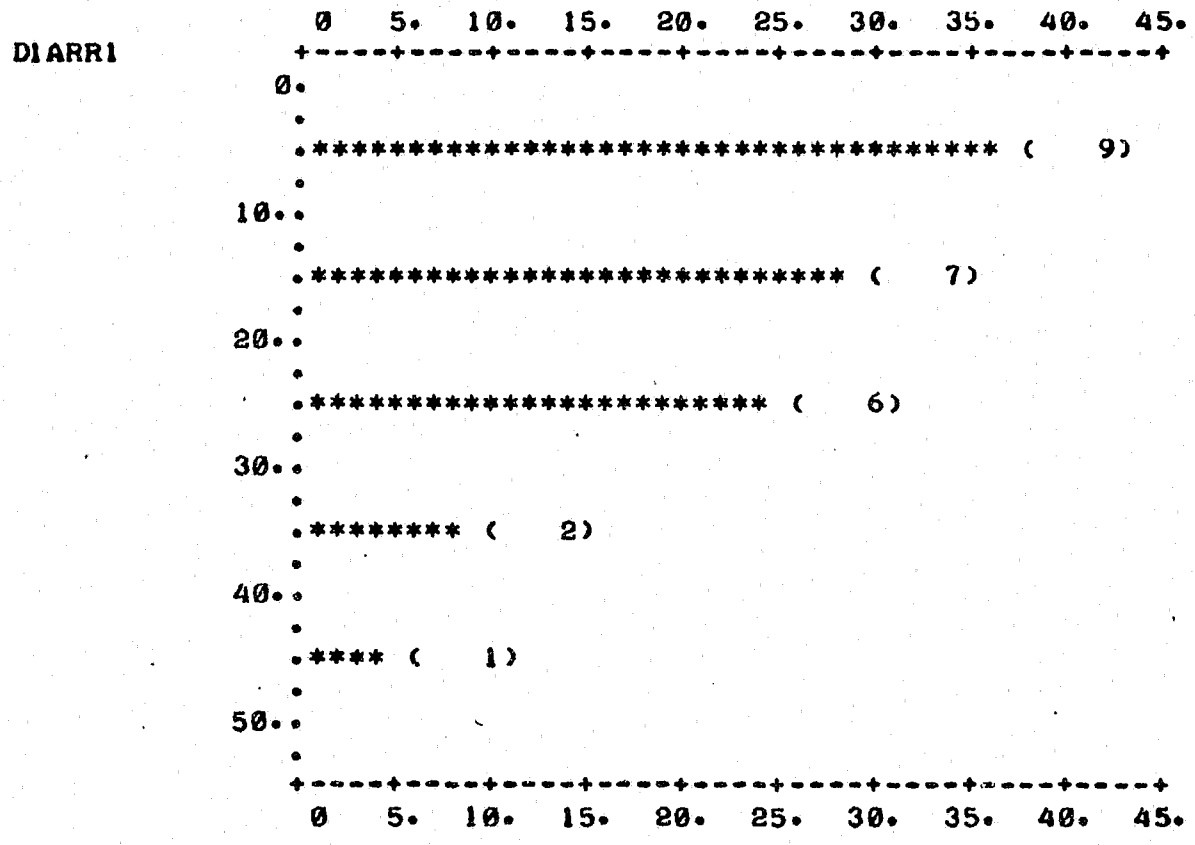
ABSTRACT OF HISTOGRAMS OF ACCIDENTS BY DIVISION FOR JANUARY, 1977, SHOWING FREQUENCIES WITHIN FIVE ACCIDENT INTERVALS

Accident Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	*18	*19	*17	8
5-9	6	6	6	*15
10-14	1		1	1
15-19			1	1
20-24				

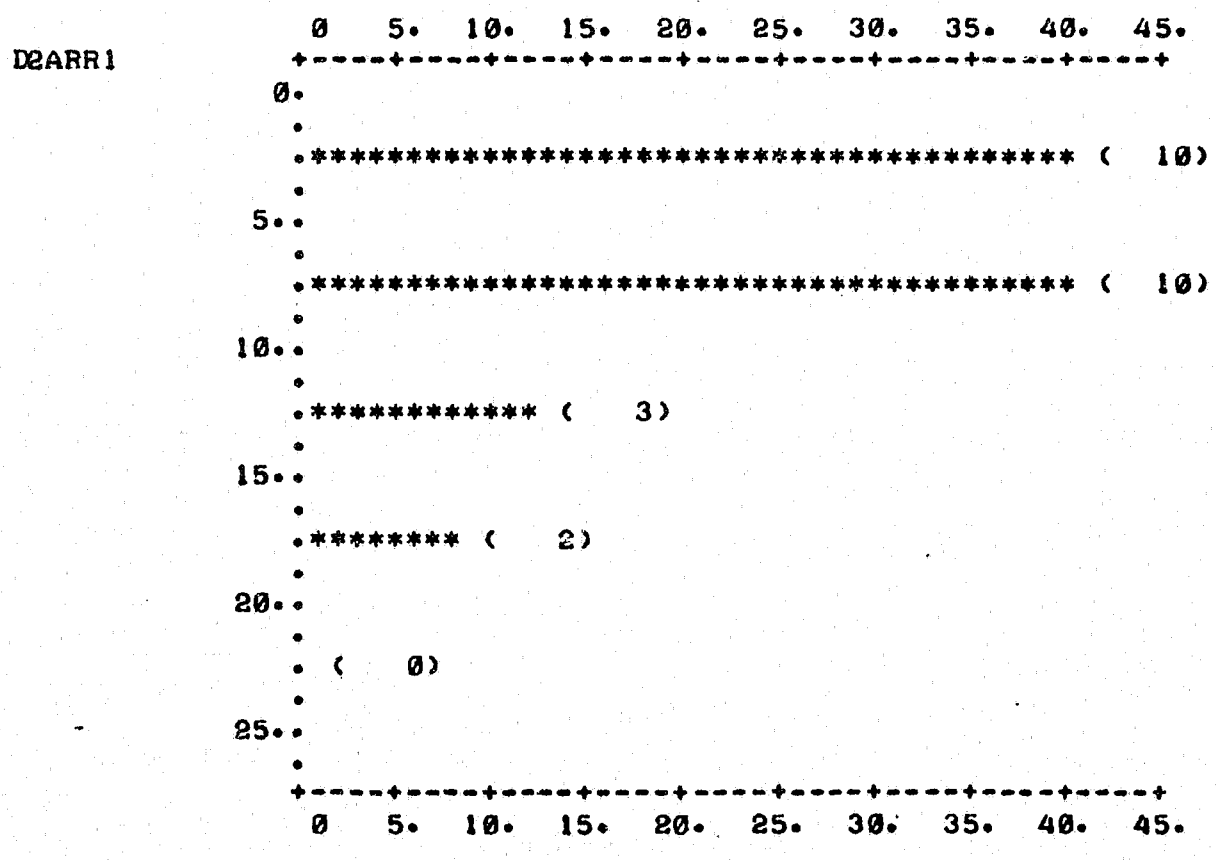
* = Mode

Graph 2.5 shows histograms of arrests by division for January and Table 5.11 is an abstract of these histograms.

HISTOGRAM FOR D1ARR1



HISTOGRAM FOR D2ARR1



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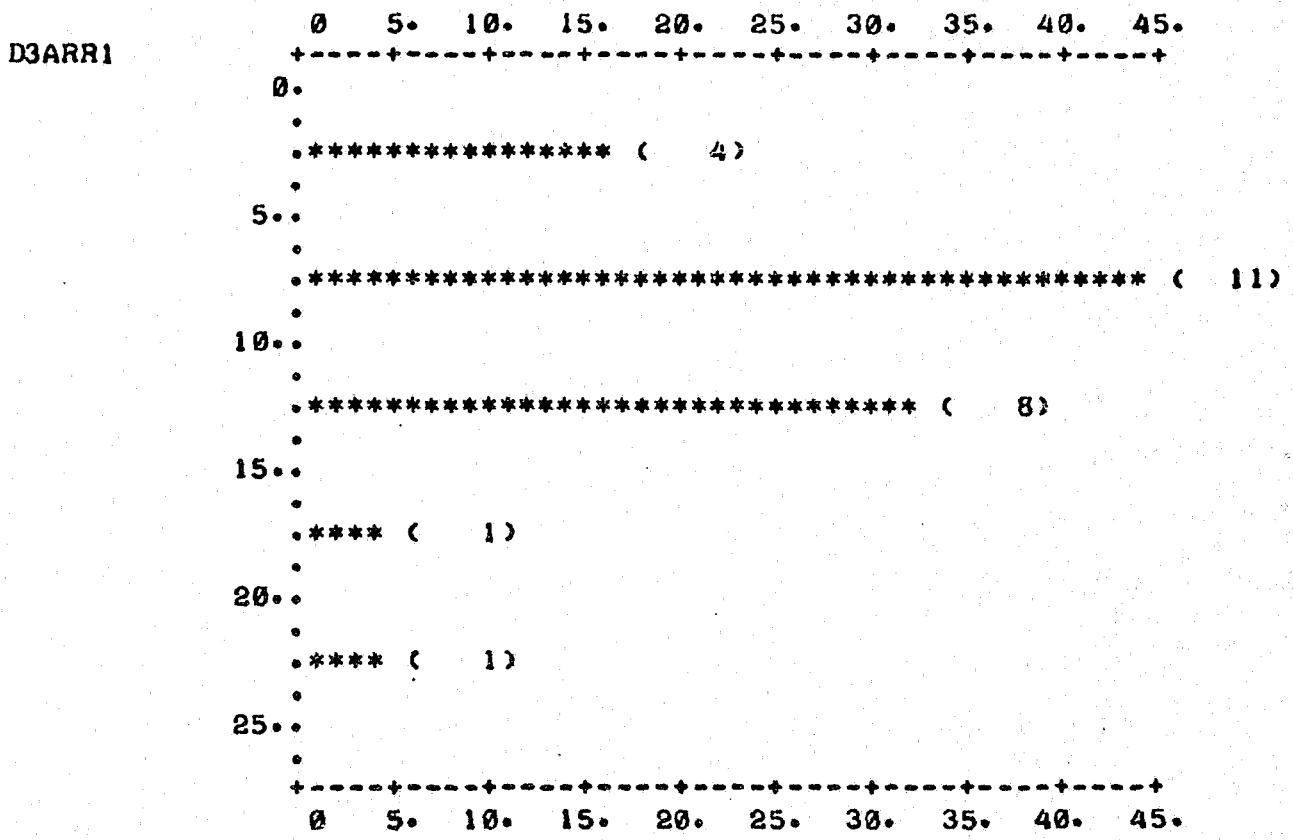

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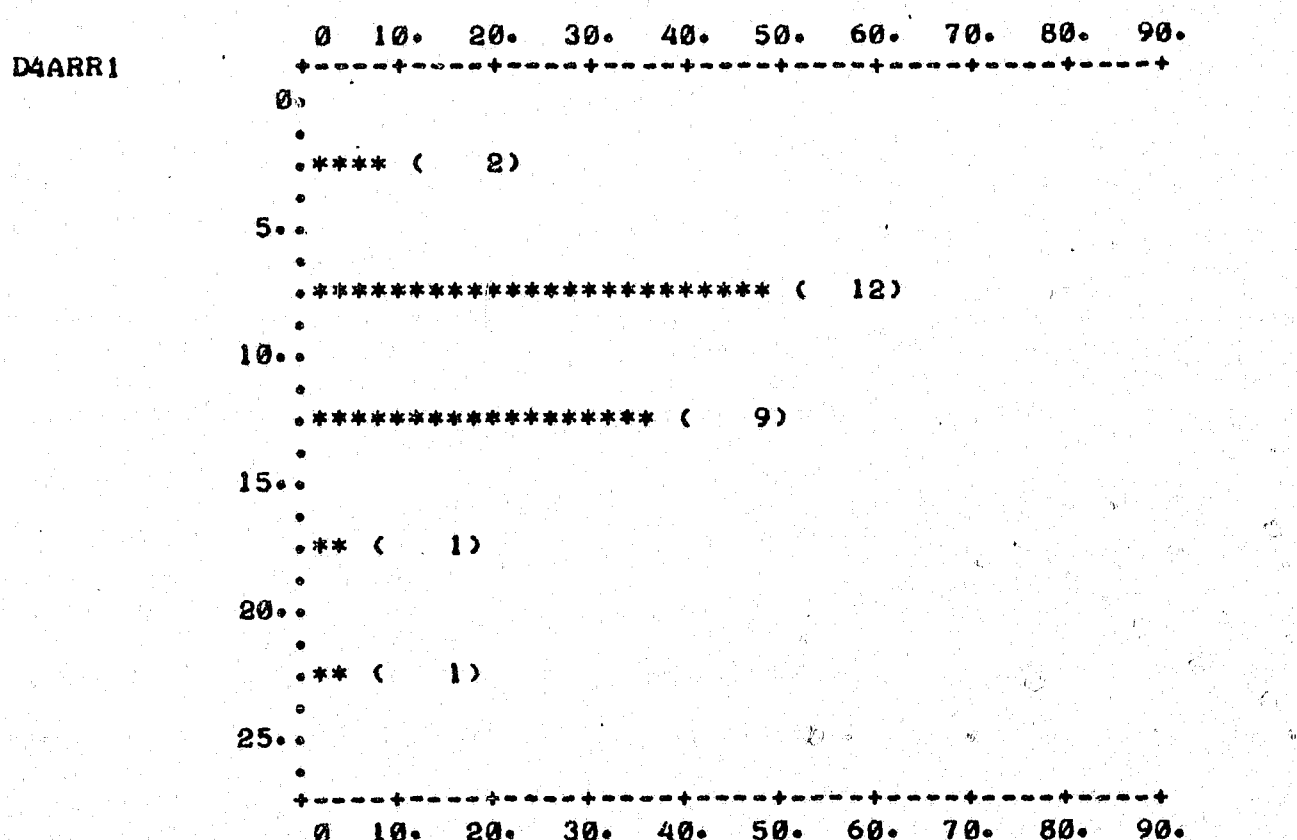

The graph and table again documents the saturation type patrol in the experimental group with the number of traffic arrests being significantly higher in Division I. The mode of traffic enforcement remains at the same interval for the control groups during January as it was for December, which reinforces the conception of a normal enforcement rate.

TABLE 2.7

ABSTRACT OF HISTOGRAMS OF ARRESTS BY DIVISION FOR JANUARY, 1977, SHOWING FREQUENCIES WITHIN FIVE ARREST INTERVALS

Arrest Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	4	10	4	2
5-9	5	*10	*11	*12
10-14	2	3	8	9
15-19	*5	2	1	1
20-24	5		1	1
25	4			

* = Mode

Graph 2.6 are crosstabulations of arrests and accidents by division for January and Table 2.8 is an abstract of these crosstabulations, showing the relative modes of each division. As can be seen, the relative intervals of traffic accidents are the same for Divisions I, II, and III, although the interval of enforcement increases for Division I. These crosstabulations are suggesting that intervals of accidents will increase and decrease for more than one division

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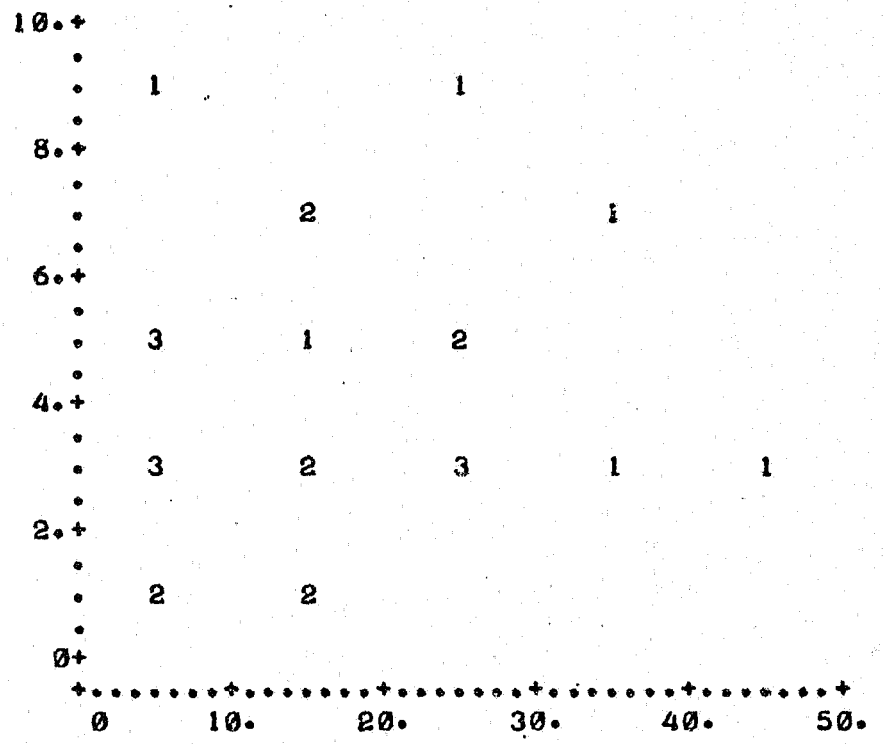

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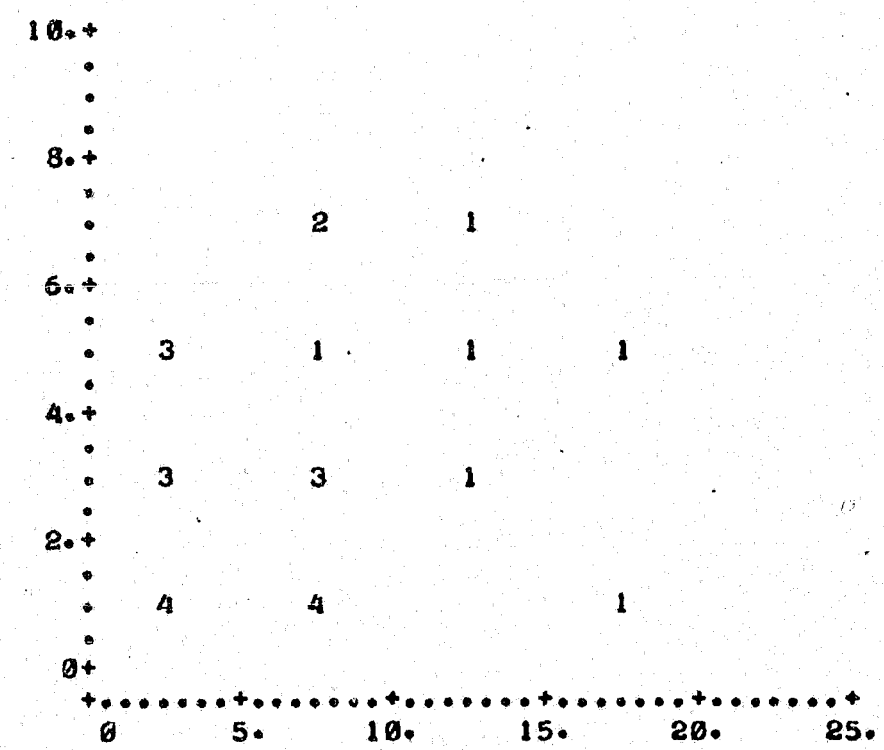
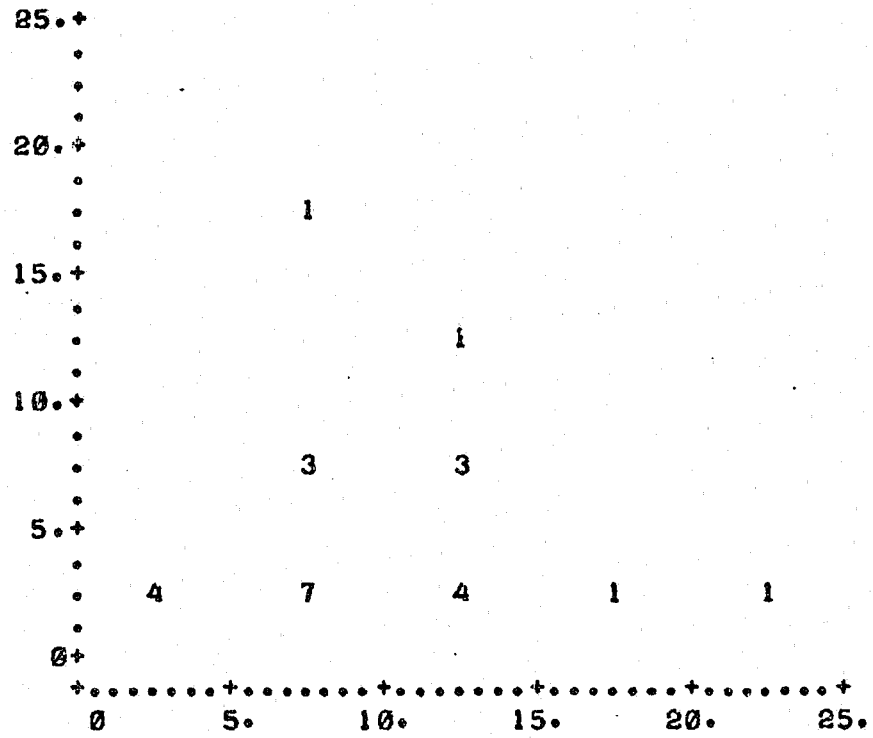
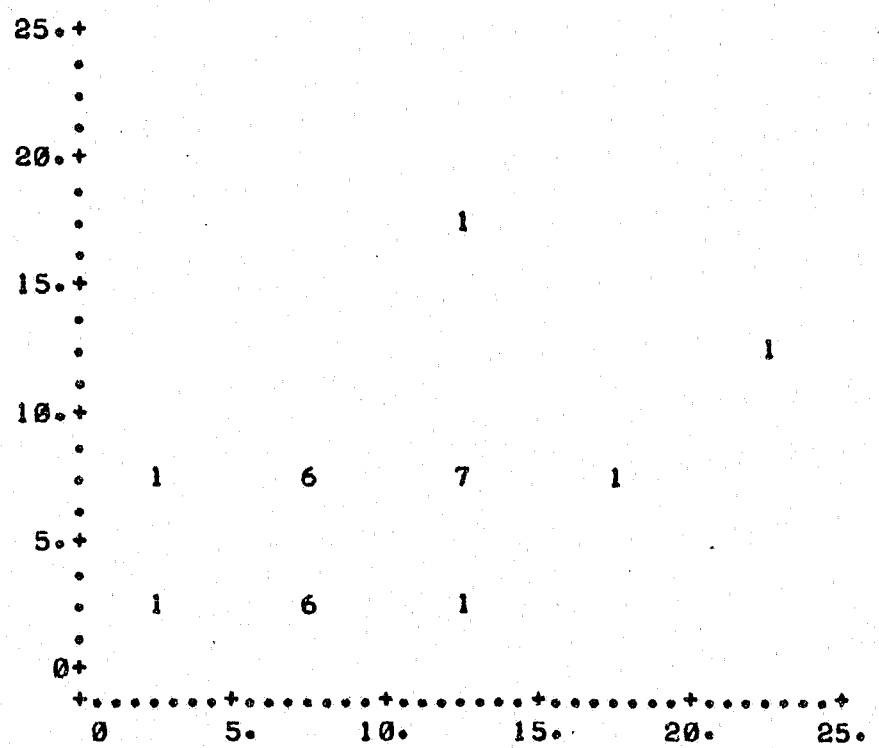


CROSSTABULATION HORIZONTAL=D3ARR1 , VERTICAL=D3ACC1



CROSSTABULATION HORIZONTAL=D4ARR1 , VERTICAL=D4ACC1

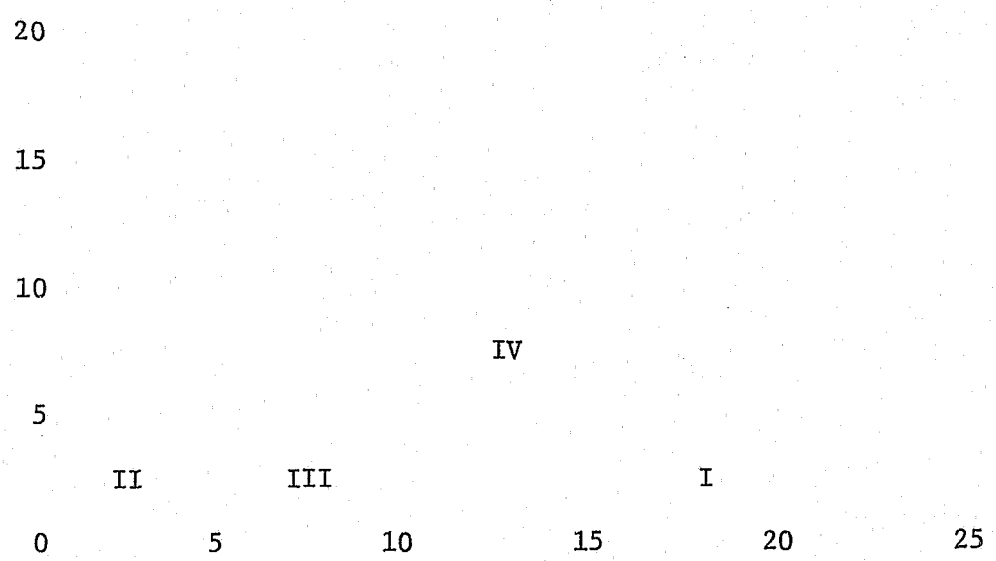


at a time, regardless of the increase of enforcement. The importance of these crosstabulations will be more apparent when correlations between arrest and accidents are considered.

TABLE 2.8

ABSTRACT OF CROSSTABULATION OF ARREST AND ACCIDENTS BY BY DIVISION FOR JANUARY, 1977, SHOWING RELATIVE MODES

Horizontal = Arrest, Vertical = Accidents



Section III - February Experiment

Division III was again selected as the experimental group for the February, 1977, test. The reason Division III was chosen instead of Divisions II or IV was to confine all experiments within two divisions, I and III. This would allow Divisions II and IV to remain as "uncontaminated" control groups throughout the four month period. This was considered important since it might be argued that effects of the experiment might remain in an area even though the experiment was concluded (a halo effect). Therefore, it might be argued that once an area was used as an experimental group, receiving saturation patrol (etc.), that this area could not serve as a reliable or valid control group until such an effect were to deminish. Whether this is true or not is unknown; however, the precaution was made to reduce criticism as to the validity of the experiment.

The experiment in Division III for February was similar to previous experiments using a saturation patrol, but, in this experiment, patrolmen used marked patrol vehicles. These vehicles were regular police blue colored cars with a police insigna (shield) on the side and blue emergency lights and siren mounted on the roof. It was suspected that officers driving these marked police vehicles would be more visible to the motoring public than they would be while driving unmarked police vehicles.

Table 3.1 is a comparative summary of all traffic accidents within

the City, including public street and private property accidents, comparing February, 1977, with February, 1976.

TABLE 3.1

ALL CITY ACCIDENTS FOR FEBRUARY, 1977, COMPARED WITH FEBRUARY, 1976

	I	II	III	IV	TOTAL
1977	153	118	170	199	640
1976	144	126	173	176	619
Inc./Dec.	9	- 8	- 3	23	21
%Inc./Dec.	6.25	-6.35	-1.73	13.07	3.39

Graph 3.1 illustrates this table. Divisions I and IV increased in traffic accidents, while Divisions II and III decreased in traffic accidents. City-wide, accidents increased by 3.39 percent.

This month, as in January, 1977, snow was an intervening variable in the experiment. This month, there was 1.2 inches of accumulated snow in Greensboro while February of 1976 had only .3 inches of snow or sleet. All snow this month accumulated in one day (2/18/77). A correction factor was made in Table 3.1 by deleting the number of accidents that occurred on 2/18/77, and substituting the average number of accidents of the month for 2/18/77 (the average is based on all accidents for February except those occurring on 2/18/77). Another correction factor was made by adding the same number of accidents (the average for the month) as a 29th day for February

because February, 1976, had 29 days in the month. The first correction factor will keep the table from showing more accidents than should be shown (because of the snow), and the latter correction factor will keep the table from showing fewer accidents than should be shown (because of the inconsistent number of days in the comparative month). A corrected table is shown as Table 3.2.

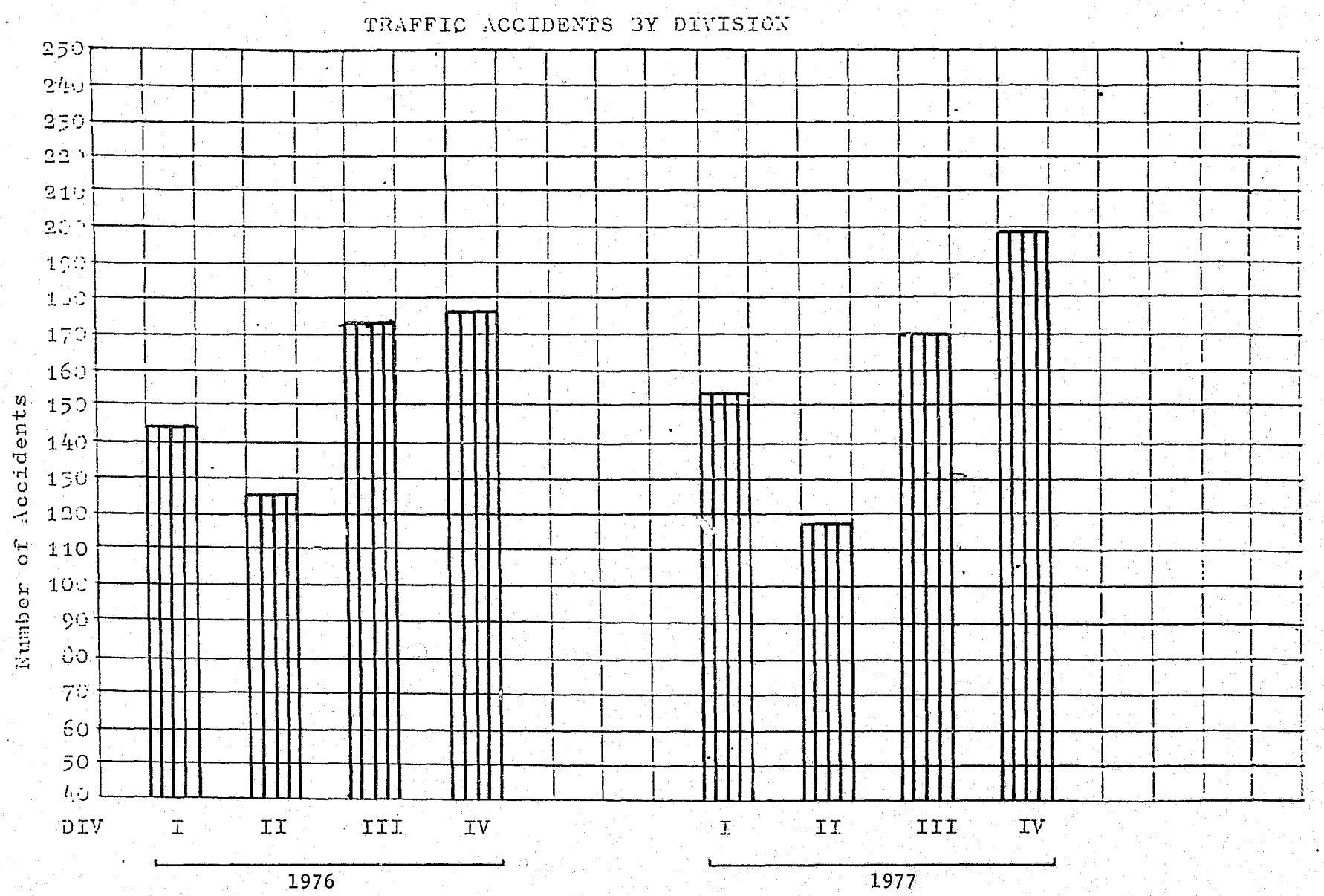
TABLE 3.2

ALL CITY ACCIDENTS FOR FEBRUARY, 1977, COMPARED WITH FEBRUARY, 1976

	I	II	III	IV	TOTAL
1977	145	109	148	170	572
1976	144	126	173	176	619
Inc./Dec.	1	- 17	- 25	- 6	- 47
%Inc./Dec.	.69	-13.49	-14.45	-3.41	-7.59

From this table it can be seen that Divisions II, III, and IV decreased in traffic accidents while accidents increased in Division I. City-wide, accidents decreased 7.59 percent. Division III had the largest decrease in all traffic accidents (-14.45%) and was 5.90 percent below the city-wide decrease of 7.59 percent.

Table 3.3 compares private property accidents for February, 1977, with February, 1976. Graph 3.2 illustrates this table.



****All traffic accidents in the city are shown on this graph

GRAPH 3.1

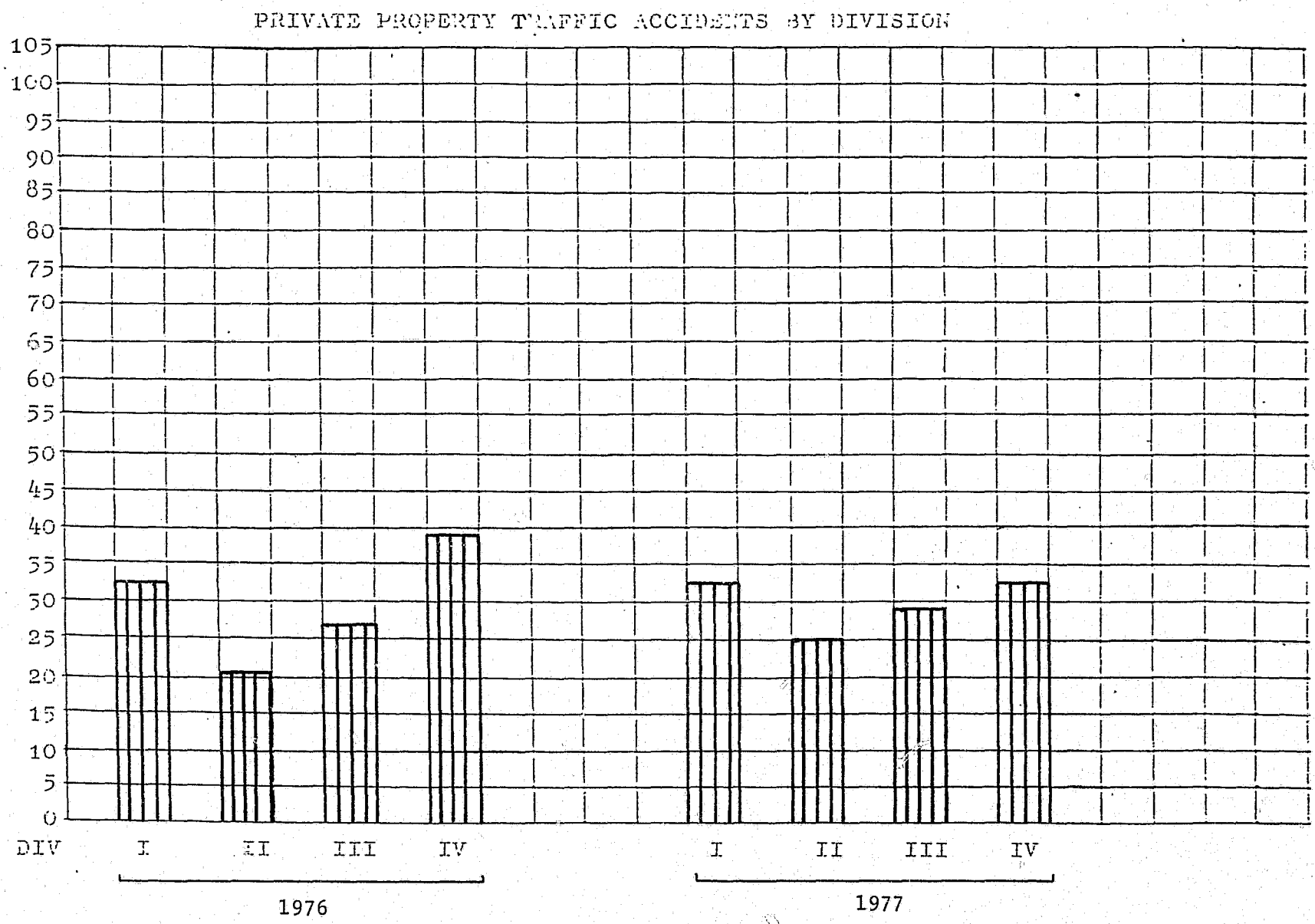
TABLE 3.3

PRIVATE PROPERTY ACCIDENTS FOR FEBRUARY, 1977, COMPARED WITH FEBRUARY, 1976

	I	II	III	IV	TOTAL
1977	33	25	29	40	127
1976	33	21	27	39	120
Inc./Dec.	-0-	4	2	1	7
%Inc./Dec.	-0-	19.05	7.41	2.56	5.83

Because of the small number of accidents, there are no correction factors in this table. Except for Division I with 0 percent increase/decrease, all divisions increased in private property accidents; however, the percentages of increase are not outstanding. City-wide, private property accidents increased by 5.83 percent which is lower than the percentage of increase for December, 1976 (26.62) or January, 1977 (19.53).

Table 3.4 compares public street accidents by Division for February, 1977, with February, 1976 (public street accidents are computed by deducting private property accidents from all accidents, Tables 3.2 and 3.3). Division I had a very insignificant increase for the month; Divisions II, III, and IV had a decrease in public street accidents that ranged from -5.11 percent to -20.00 percent.



****Only private property accidents are shown on this graph

GRAPH 3.2

CONTINUED

1 OF 3

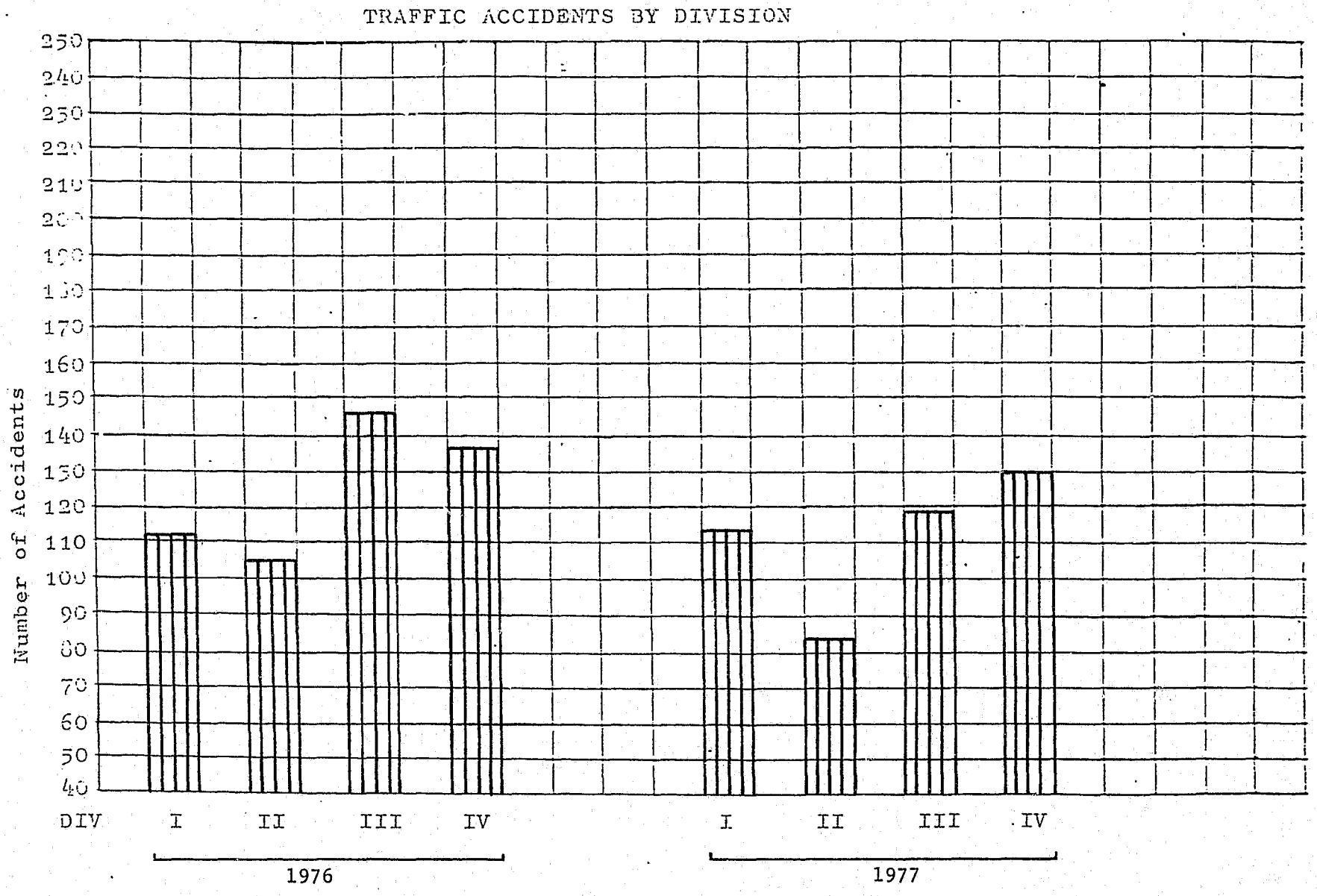
TABLE 3.4

PUBLIC STREET ACCIDENTS FOR FEBRUARY, 1977, COMPARED WITH FEBRUARY, 1976

	I	II	III	IV	TOTAL
1977	112	84	119	130	445
1976	111	105	146	137	449
Inc./Dec.	1	- 21	- 27	- 7	- 54
%Inc./Dec.	.90	-20.00	-18.49	-5.11	-10.82

City-wide, public street accidents decreased -10.82 percent (see Graph 3.3). Division III experienced the greatest reduction in the number of public street accidents with 27 fewer accidents this February over last February. In percentages, Division III had the second largest reduction of accidents and was 7.67 percent below the City average. Division III has not had a reduction in the percentage of traffic accidents in nine consecutive months. In the past thirteen months, Division III has only experienced a reduction during two months, January, 1976 (.71 percent decrease), and April, 1976 (.387 percent decrease). Likewise, city-wide accidents decreased this month for the first time since October, 1976, an occurrence that happened only twice in the previous thirteen months.

The test conducted in Division III began on February 1, 1977, and ended February 28, 1977. Selective traffic enforcement was emphasized to Division III personnel and the traffic enforcement



****Only traffic accidents occuring on public streets are shown on this graph, computed by deducting private property accidents from all accidents occuring in the city

GRAPH 3.3

unit was deployed to that area. There were four to five traffic officers assigned to Division III driving marked police vehicles, equipped with stationary radar units. Since one officer was on sick leave and usually one officer in court or off-duty, three to four traffic officers were actually working in the field. These officers worked Monday through Friday, 1200 hours through 2000 hours - the highest frequency days and times as established in the data base.

Two of these traffic officers patrolled on High Point Road and one on Holden Road during the month. When a fourth officer was available, he was assigned to High Point Road; when a fifth officer was available, he was assigned to Holden Road. The patrol area on High Point Road was divided between the two or three officers working the area. Holden Road was divided between two officers when five patrolmen were working. These officers were allowed to use their discretion in patrol techniques, but were generally encouraged to use stationary patrol (allowing usage of radar equipment) at selected intersections, but to change locations and exercise roving patrol about every fifteen minutes.

In addition to the traffic enforcement personnel, extra-duty personnel were utilized on Fridays, 2000 hours to 2400 hours, and on Saturdays, 1000 hours to 1800 hours. In employing these extra-duty officers, five patrolmen and one superivsor were working in the field each Friday and Saturday during the above hours, throughout the test

period. Similar assignments were made with these officers as were for the traffic officers. The one main exception is that these extra-duty officers did not use any radar device unless they were regular traffic enforcement officers.

The most significant difference between this test and the previous two tests is that patrolmen working in S.T.E.P. were driving marked police vehicles this month. During the December-January test, patrolmen working in S.T.E.P. were driving unmarked police vehicles equipped with T.D.S. and radar units. This month these patrolmen were placed in regular marked police vehicles using radar units only.

It was hypothesized that a greater effect in reducing traffic accidents will be produced by using the marked patrol vehicles verses the unmarked patrol vehicles. It was suggested that the marked patrol units are more visible to the general public than unmarked patrol units and, therefore, may deter more traffic violations, resulting in fewer traffic accidents. Some people were of the opinion that unmarked police vehicles are seen and recognized as much by motorists as are marked patrol vehicles and, therefore, one type vehicle is no better or worse than another.

Greensboro experienced 411 traffic accidents during February (omitting snow days) with the fewest number of accidents in Division IV. Division III, the experimental group, ranked the third highest in the number of traffic accidents. Table 3.5 gives summary statistics of

arrests and accidents by division for February. The saturation patrol is documented in this table as Division III averaged 22.4 arrests per day, using the saturation type patrol in the marked police vehicles. An interesting note is that although officers were driving these marked police vehicles, supposedly more visible to the public, the mean number of arrests for this month exceed either month of December or January. In December, the mean number of arrests was 17.1 and in January, the mean arrest was 16.3 in the experimental group. This suggests that patrol officers can detect traffic violations as easily and make traffic arrests as frequently while operating marked police vehicles as with unmarked police vehicles. The number of arrests in control groups ranged from 6.8 to 10.8 traffic arrests per day. The number of traffic accidents ranged from an average of 2.9 to 4.3 accidents per day.

TABLE 3.5

SUMMARY STATISTICS OF ARRESTS AND ACCIDENTS
BY DIVISION FOR FEBRUARY, 1977

Division	Mean	Std. Dev.	Maximum	Minimum	Range
D1ARR2	8.815	4.000	17	3	14
D1ACC2	3.926	2.147	9	0	9
D1ARR2	6.778	3.766	16	1	15
D2ACC2	2.889	2.044	8	0	8
D3ARR2	22.407	8.807	42	6	36
D3ACC2	4.074	1.567	8	2	6
D4ARR2	10.815	5.650	22	2	20
D4ACC2	4.333	2.760	9	0	9

(D1ARR2 = Division I Arrest for February (2);
D1ACC2 = Division I Accidents for February (2); etc.)

Table 3.6 compares to mean number of public street accidents per day for February, 1977, with February, 1976. The mean number of accidents in rank order from lowest to highest for 1977 are as follows:

Div. II (2.9), Div. I (3.9), Div. III (4.1), Div. IV (4.3)

TABLE 3.6

MEAN NUMBER OF PUBLIC STREET ACCIDENTS PER DAY FOR FEBRUARY, 1977, COMPARED WITH FEBRUARY, 1976

Division	1976	1977	Difference
I	3.828	3.926	+ .098
II	3.621	2.889	- .732
III	5.034	4.074	- .960
IV	4.724	4.333	- .391

It can be seen that this same ranking order was experienced in February as in January, with Division II being the lowest, Division IV the highest. Neither the saturation type patrol nor officers operating in marked police vehicles changed the ranking in February from January. The mean difference in rank order from lowest to highest is as follows:

Div. III (-.960), Div. II (-.732), Div. IV (-.391), Div. I (+.098)

Again, the ranking changes from the mean to the mean difference. The most dramatic change was between Divisions I and III. Division III drops to the lowest and Division I moves to the highest. It can

be noticed that Division III, the experimental group, ranked lowest in December and in February, while the experimental group for January, (Division I) ranked third in the mean difference. This suggests that our experiment may be somewhat more successful in Division III than in Division I, which may be accounted for by the demographic differences between the two divisions. The demographic differences between divisions will be examined in the last section of this report.

Graph 3.4 shows histograms of accidents by division for February and Table 3.7 is an abstract of these histograms with modes marked with an asterisk. The histogram is a visual representation of accidents and the difference between each division may be easily compared.

TABLE 3.7

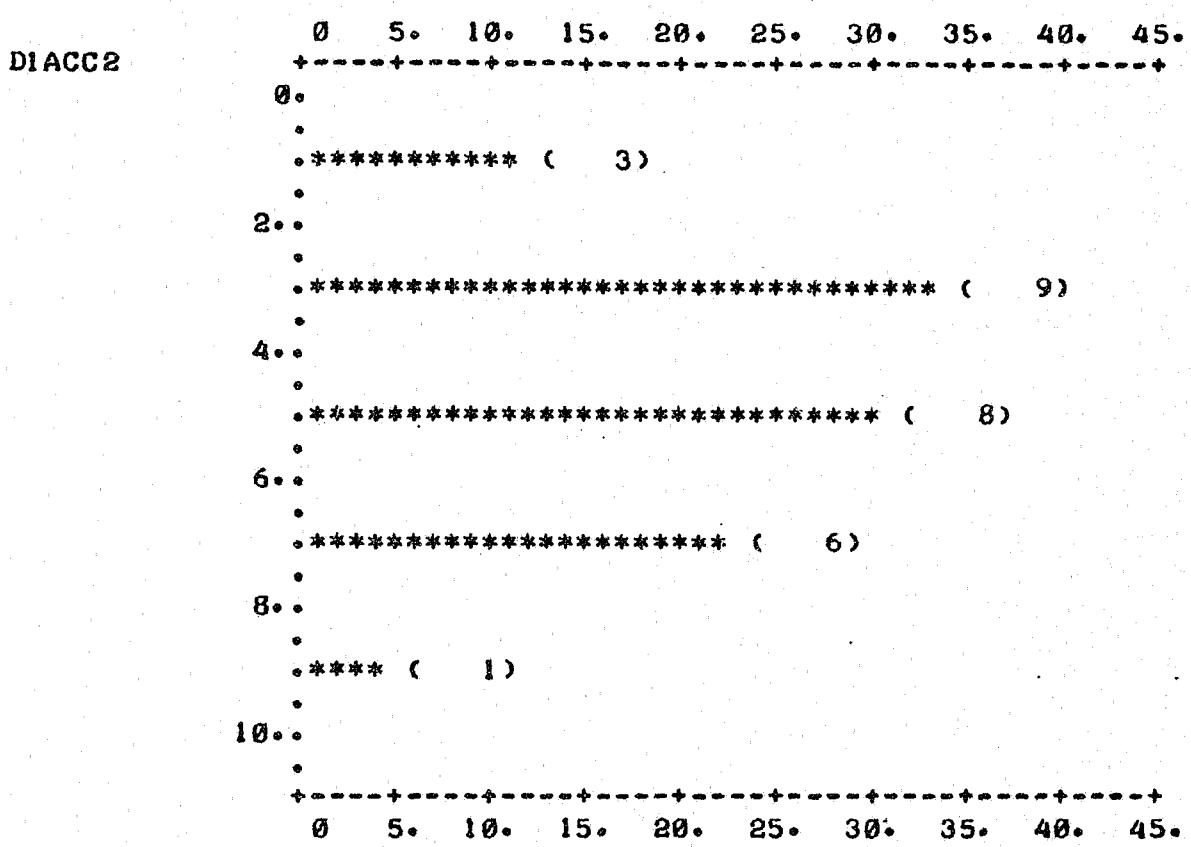
ABSTRACT OF HISTOGRAMS OF ACCIDENTS BY DIVISION FOR FEBRUARY, 1977, SHOWING FREQUENCIES WITHIN FIVE ACCIDENT INTERVALS

Accident Intervals	Div. I	Div. II	Div. III	Div. IV
0-1	3	6		4
2-3	*9	*13	9	*9
4-5	8	5	*13	6
6-7	6	1	4	3
809	1	2	1	5

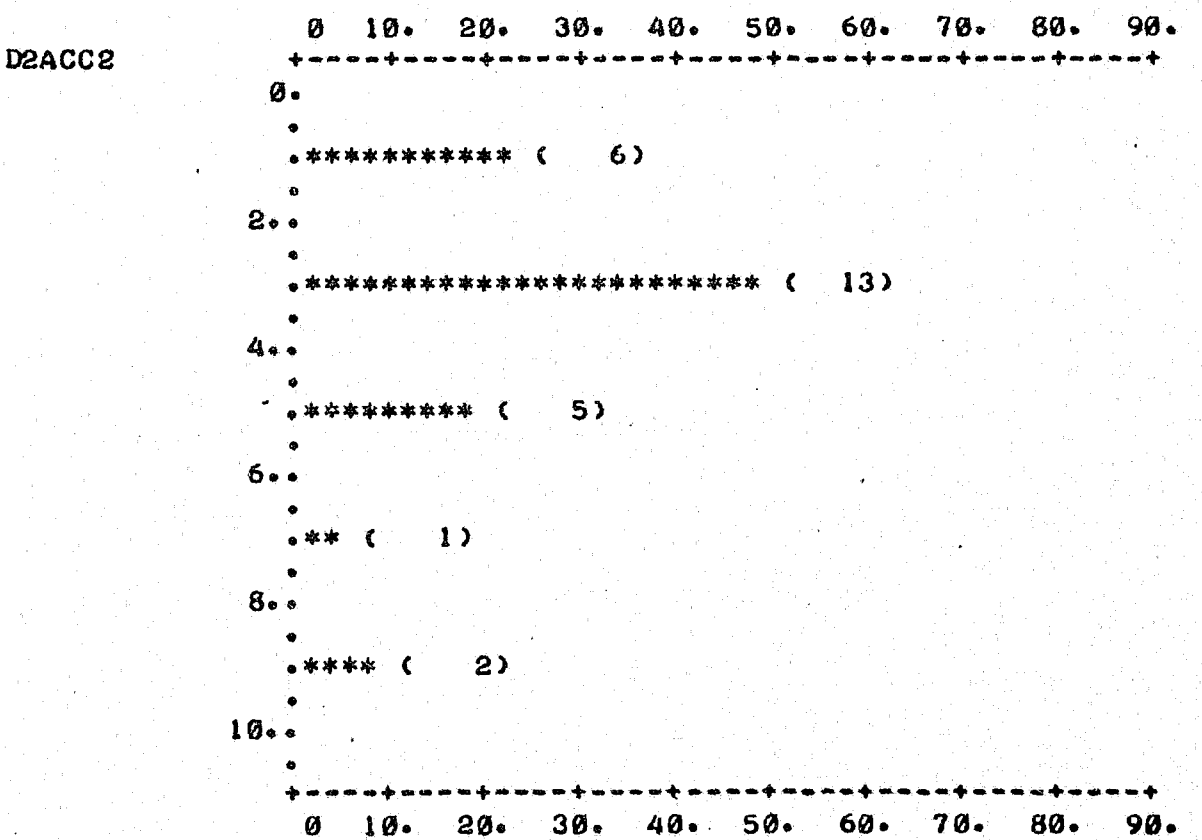
* = Mode

GRAPH 3.4a

HISTOGRAM FOR D1ACC2

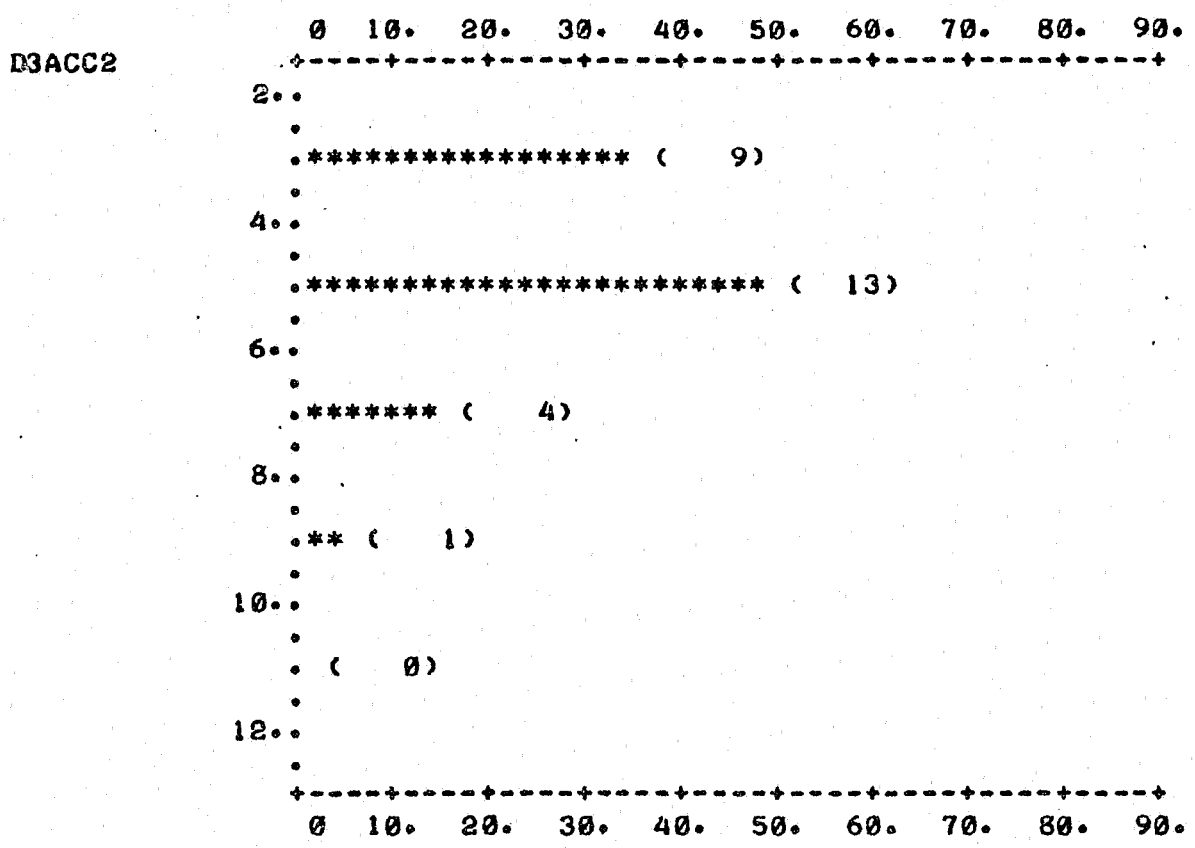


HISTOGRAM FOR D2ACC2

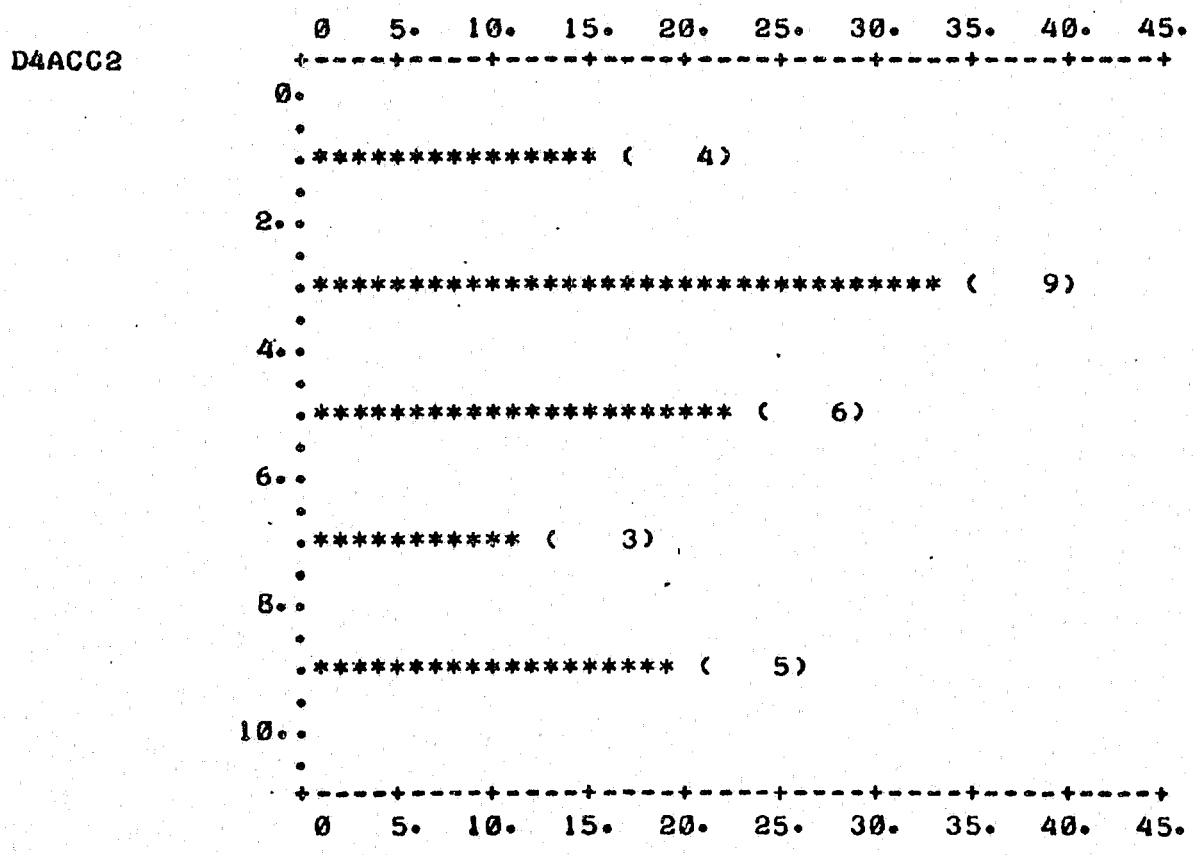


GRAPH 3.4b

HISTOGRAM FOR D3ACC2



HISTOGRAM FOR D4ACC2

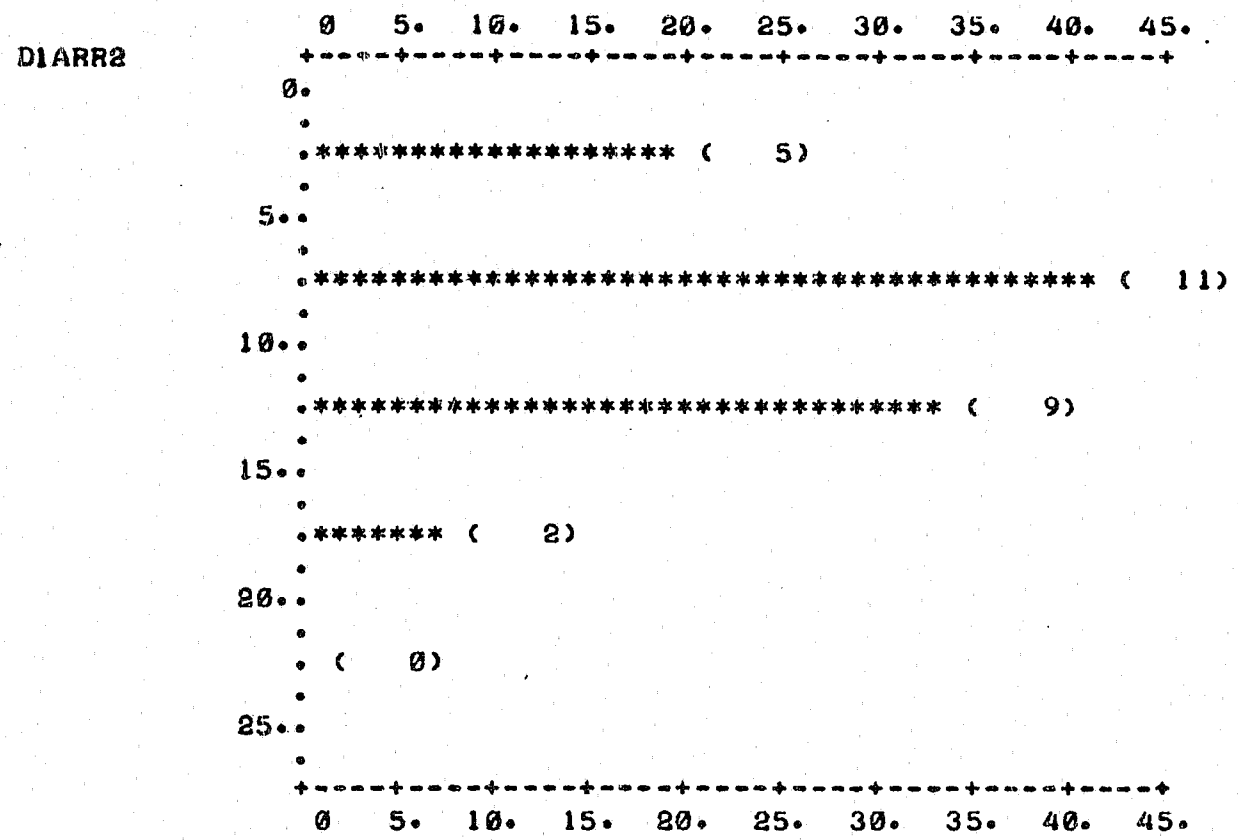


It is shown by this graph and table that the accident interval for Division III, the experimental group, is greater than the control groups, since Division III experienced 13 days with four to five traffic accidents each day. The control groups experienced between two and three accidents most of the days during the month. This is a change from previous experiments. In December, the experimental group was in the lowest interval while control groups were in a higher interval; in January, the experimental group was again in the lowest interval although two of three control groups were in the same interval.

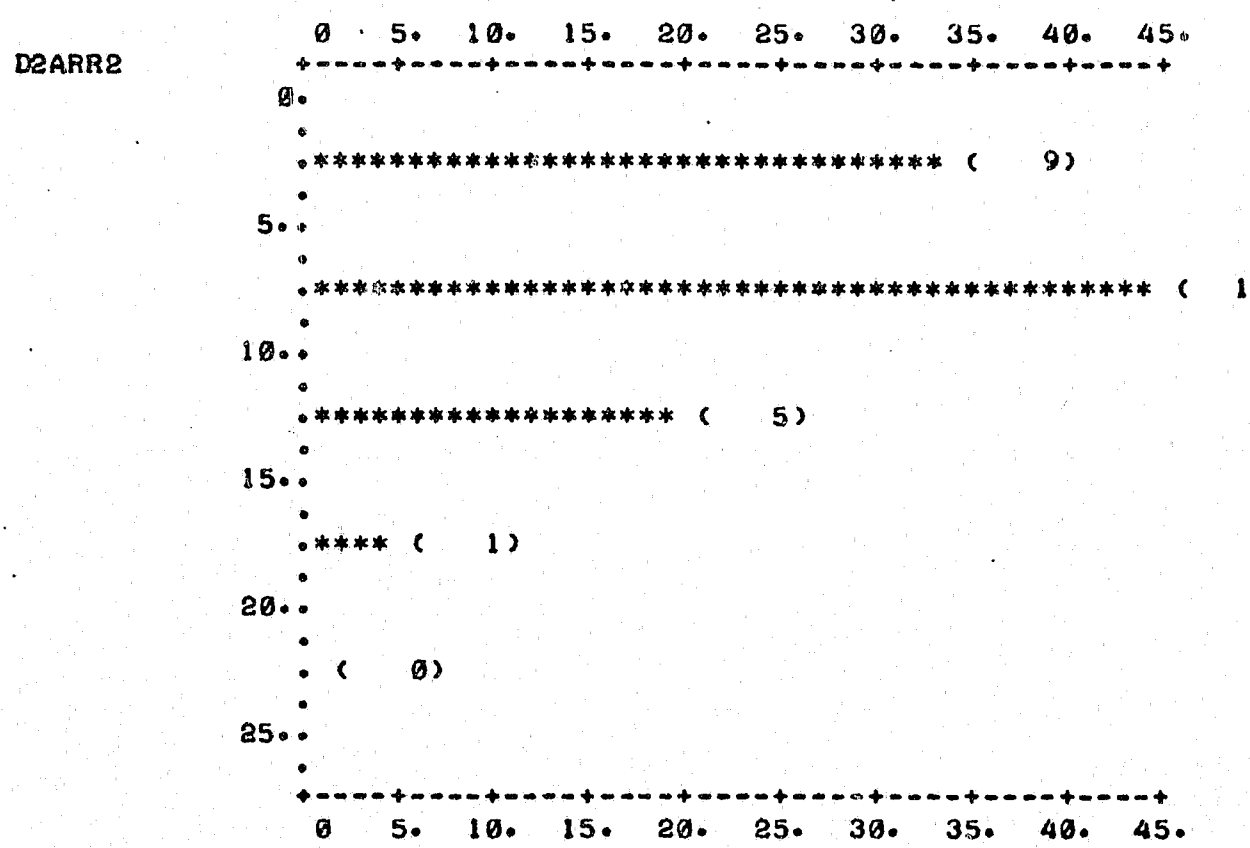
Graph 3.5 shows histograms of arrests by division for February and Table 3.8 is an abstract of these histograms, indicating the modes by an asterisk. The experimental group, Division III, experienced a saturation type patrol with the mode in the highest enforcement interval. The mode for control groups remained at the 5 to 9 arrest interval in February as it did for December and January. This graph shows that more traffic arrests were made in Division III during this experiment than in previous experimental groups, and that the intervals remain constant for control groups that were receiving a normal patrol.

GRAPH 3.5a

HISTOGRAM FOR D1ARR2

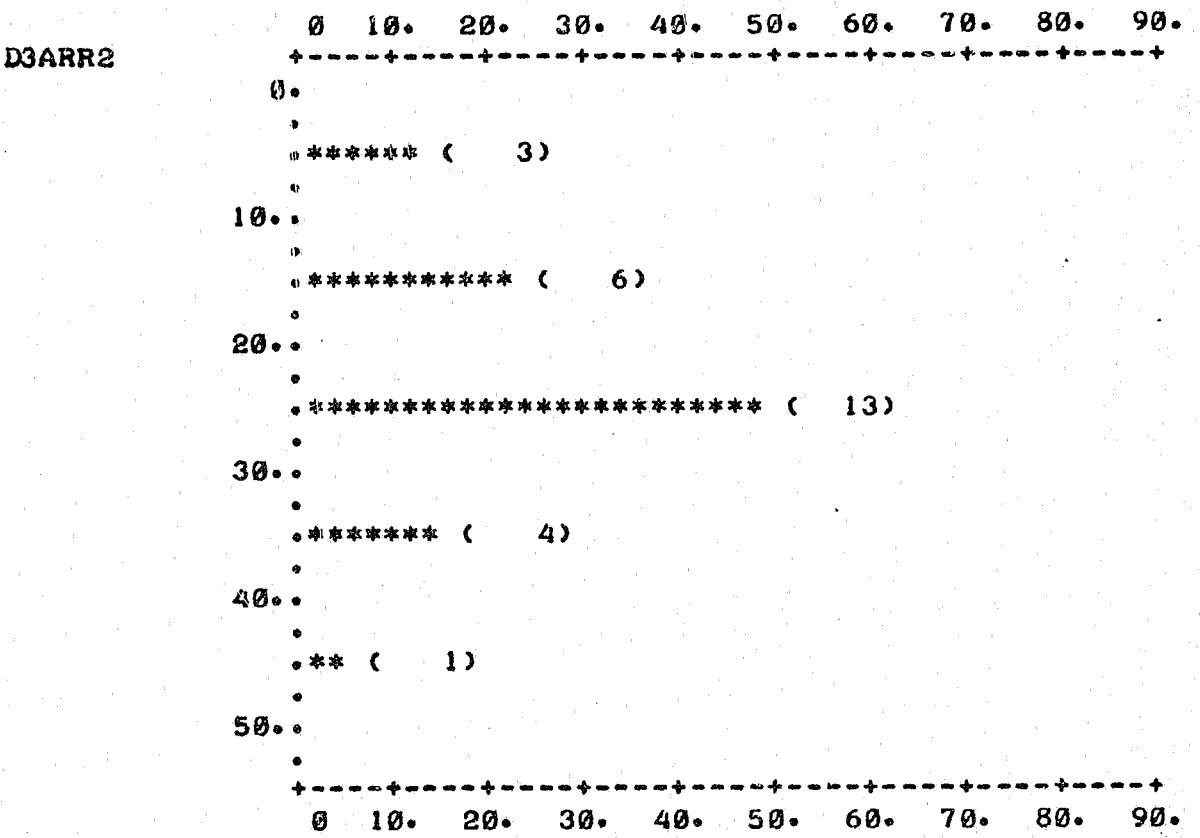


HISTOGRAM FOR D2ARR2



GRAPH 3.5b

HISTOGRAM FOR D3ARR2



HISTOGRAM FOR D4ARR2

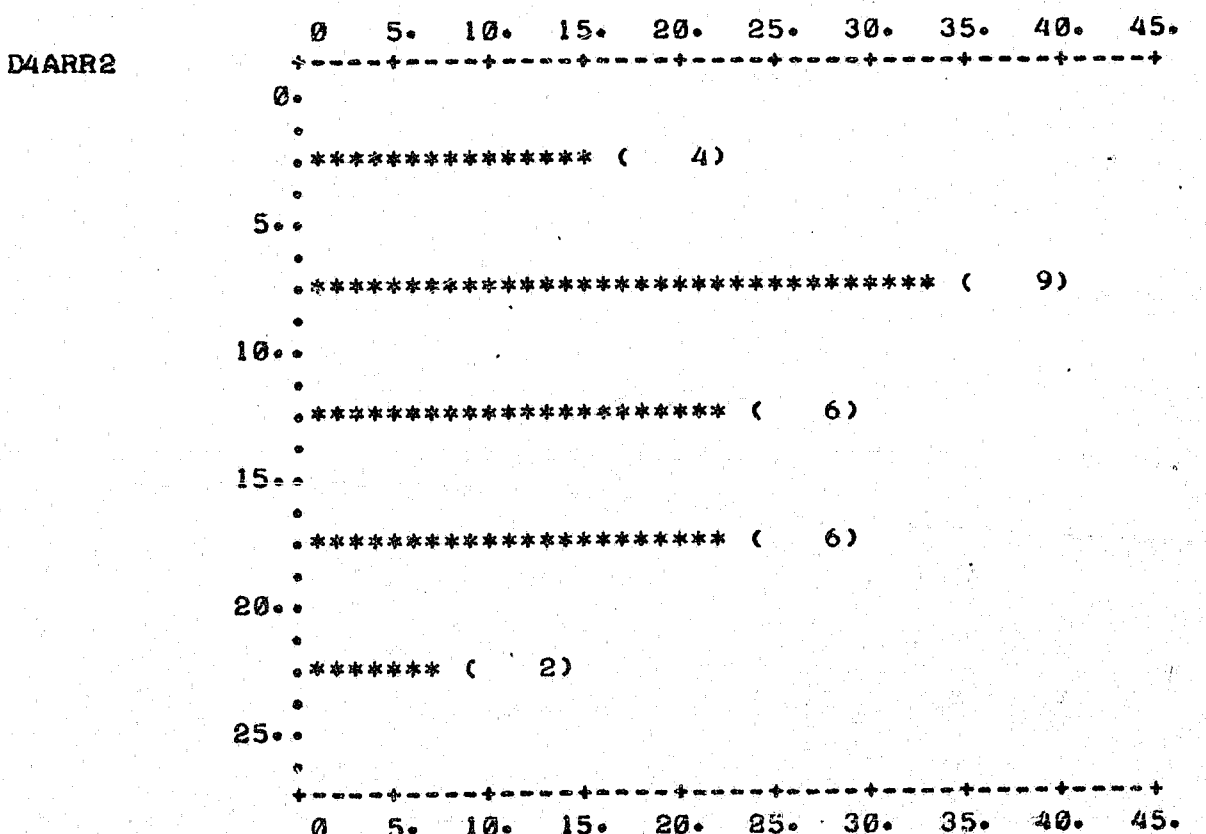


TABLE 3.8

ABSTRACT OF HISTOGRAMS OF ARREST BY DIVISION FOR FEBRUARY, 1977, SHOWING FREQUENCIES WITHIN FIVE ARREST INTERVALS

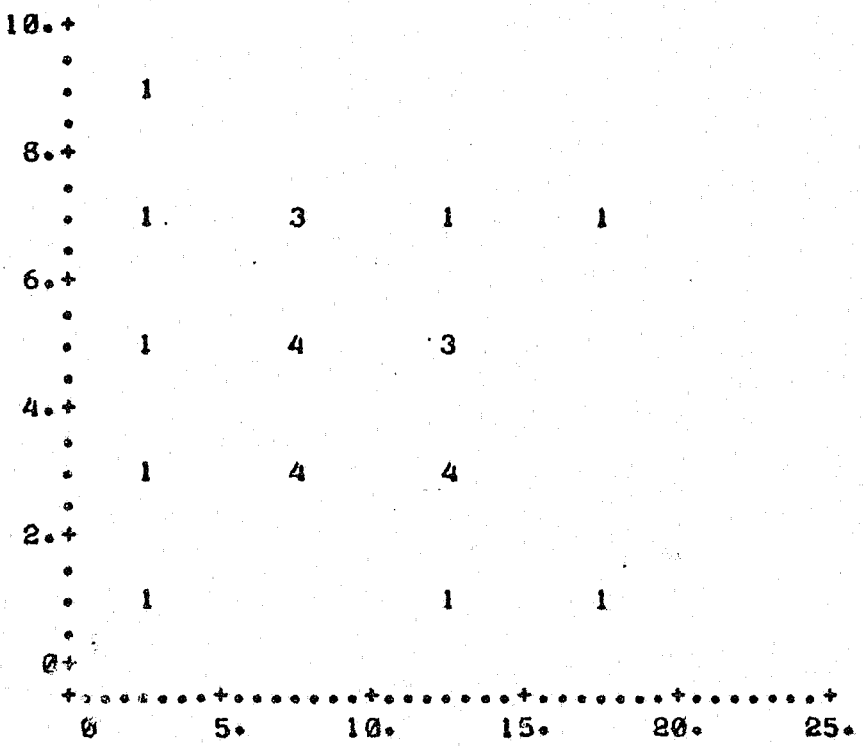
Arrest Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	5	9		4
5-9	*11	*12	3	*9
10-14	9	5	2	6
15-19	2	1	4	6
20-24			8	2
25			*10	

* = Mode

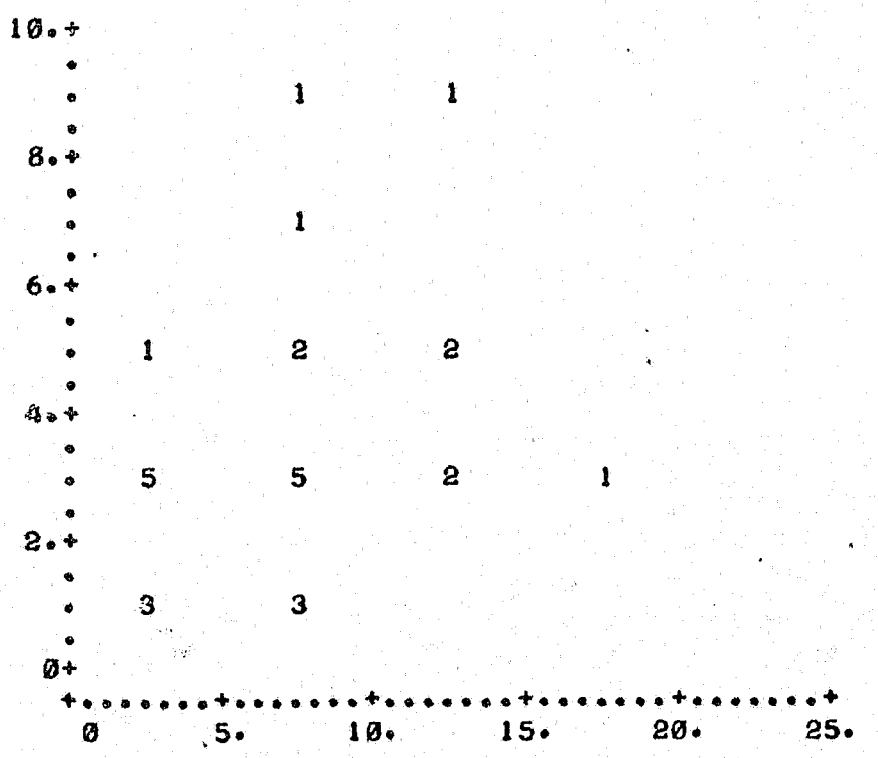
Graph 3.6 shows crosstabulations of arrests and accidents by division for February and Table 3.9 is an abstract of these crosstabulations, showing relative modes of each division. The modes for accident intervals vary more during February than for December and January. The most outstanding variation is with the experimental group, Division III. Instead of being in a lower accident interval, the experimental group is in a higher accident interval, although the enforcement interval is much greater. There were more arrests made in the experimental group this month compared with experimental groups of December and January, which the higher interval of the mode suggest; the mode for accidents was also in a higher interval this month. Again, this crosstabulation suggests that as the enforcement interval increases, the accident interval does not decrease as might be expected.

GRAPH 3.6a

CROSSTABULATION HORIZONTAL=D1ARR2 , VERTICAL=D1ACC2

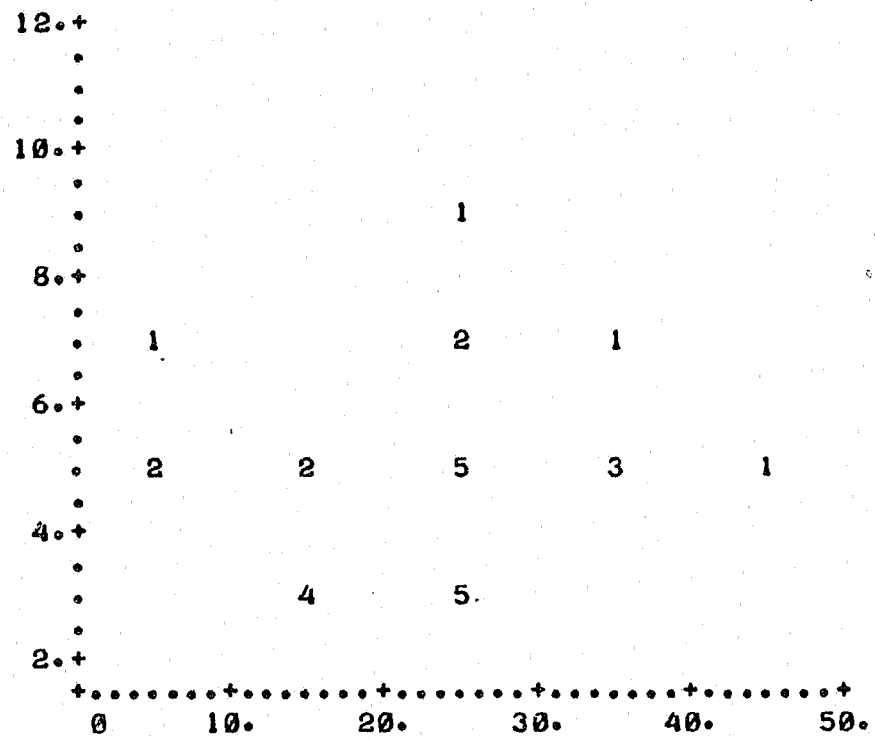


CROSSTABULATION HORIZONTAL=D2ARR2 , VERTICAL=D2ACC2



GRAPH 3.6b

CROSSTABULATION HORIZONTAL=D3ARR2 , VERTICAL=D3ACC2



CROSSTABULATION HORIZONTAL=D4ARR2 , VERTICAL=D4ACC2

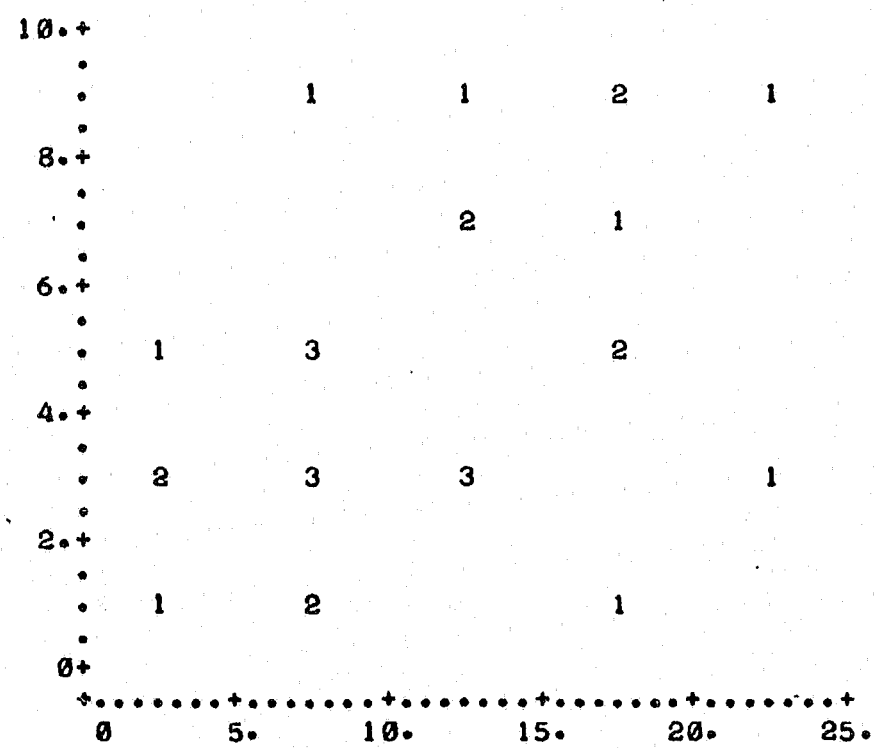
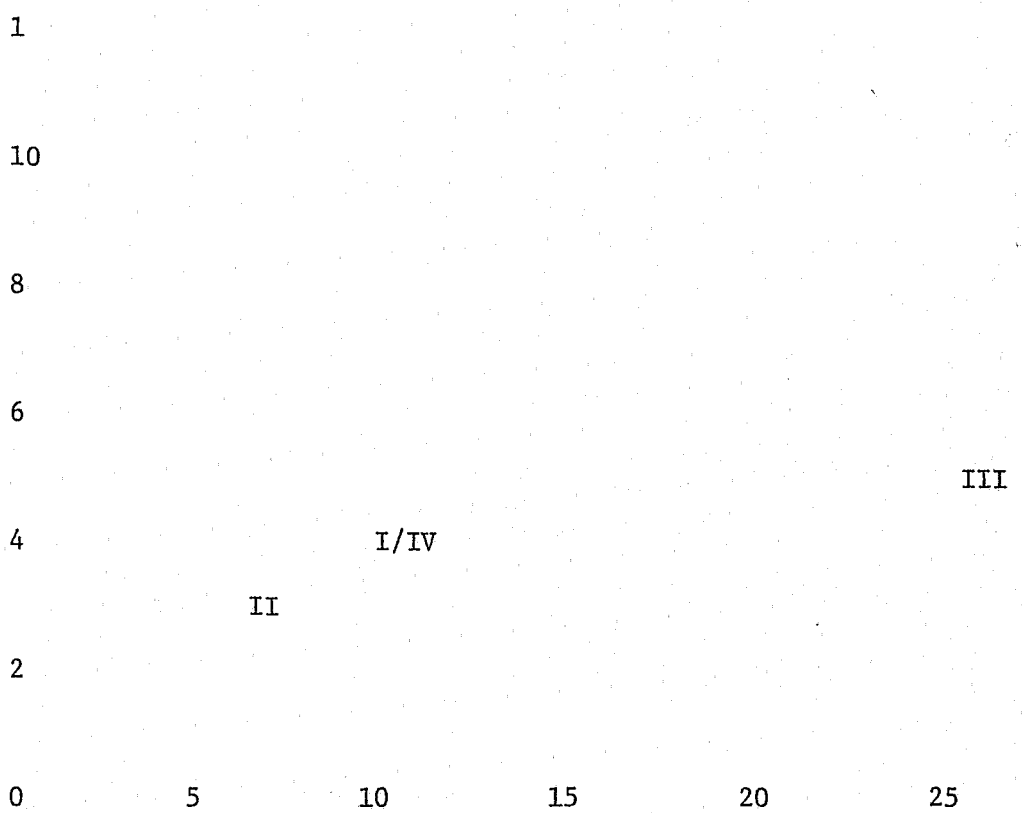


TABLE 3.9

ABSTRACT OF CROSSTABULATION OF ARREST AND ACCIDENTS
BY DIVISION FOR FEBRUARY, 1977, SHOWING RELATIVE MODES

Horizontal = Arrest, Vertical = Accidents



Section IV - March Experiment

Division I was designated as the experimental group for the March, 1977, experiment which is a replication of the February experiment. The experimental division received a saturation patrol with officers driving marked patrol vehicles.

Table 4.1 is a comparative summary of all traffic accidents within the City, including public street and private property accidents, comparing March, 1977, with March, 1976.

TABLE 4.1

ALL CITY ACCIDENTS FOR MARCH, 1977, COMPARED WITH MARCH, 1976

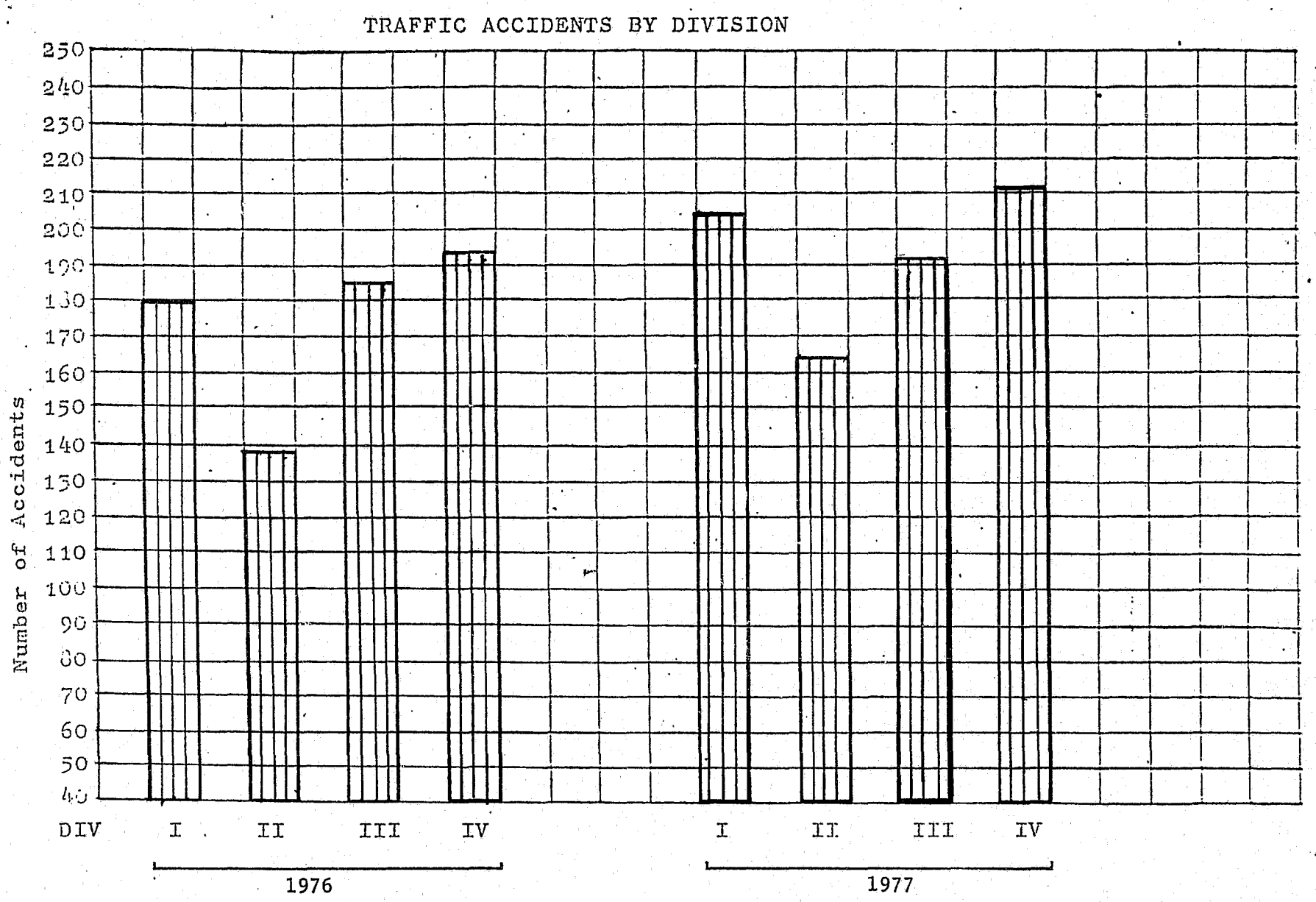
	I	II	III	IV	TOTAL
1977	205	165	191	211	772
1976	180	139	186	194	669
Inc./Dec.	25	26	5	17	73
%Inc./Dec.	13.89	18.71	2.69	8.76	10.44

Graph 4.1 illustrates this table. All divisions had an increase in traffic accidents ranging from 2.69 to 18.7 percent. City-wide ac-accidents increased 10.44 percent in March, 1977, as compared with March of last year.

TABLE 4.2

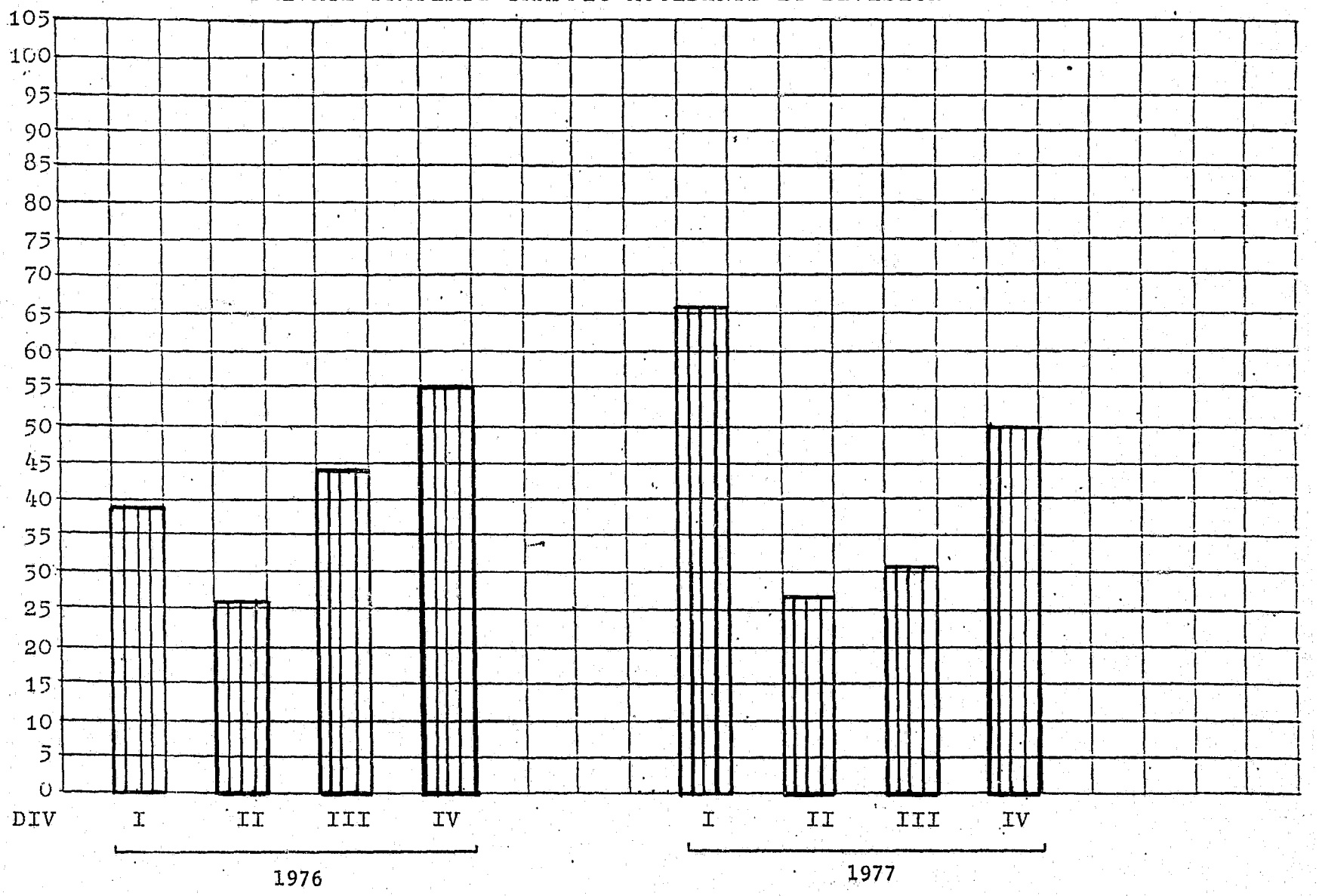
PRIVATE PROPERTY ACCIDENTS FOR MARCH, 1977, COMPARED WITH MARCH, 1976

	I	II	III	IV	TOTAL
1977	66	27	31	50	174
1977	39	26	44	55	164
Inc./Dec.	27	1	- 13	- 5	10
%Inc./Dec.	69.23	3.85	-29.55	-9.09	6.10



****All traffic accidents in the city are shown on this graph

GRAPH 4.1



****Only private property accidents are shown on this graph

GRAPH 4.2

Table 4.2 lists private property accidents by division for March, 1977, compared with March, 1976 (see graph 4.2). Divisions III and IV had a decrease in the number of private property accidents in March, 1977, compared with March, 1976, while Divisions I and II increased in the percentage of private property accidents. As can be seen from Table 4.2, private property accidents in Division I substantially increased relative to the other three divisions with a 69.23 percent in private property accidents.

Table 4.3 compares public street accidents by division for March, 1977, with March, 1976 (public street accidents are computed by deducting private property accidents from all accidents, Tables 4.1 and 4.2).

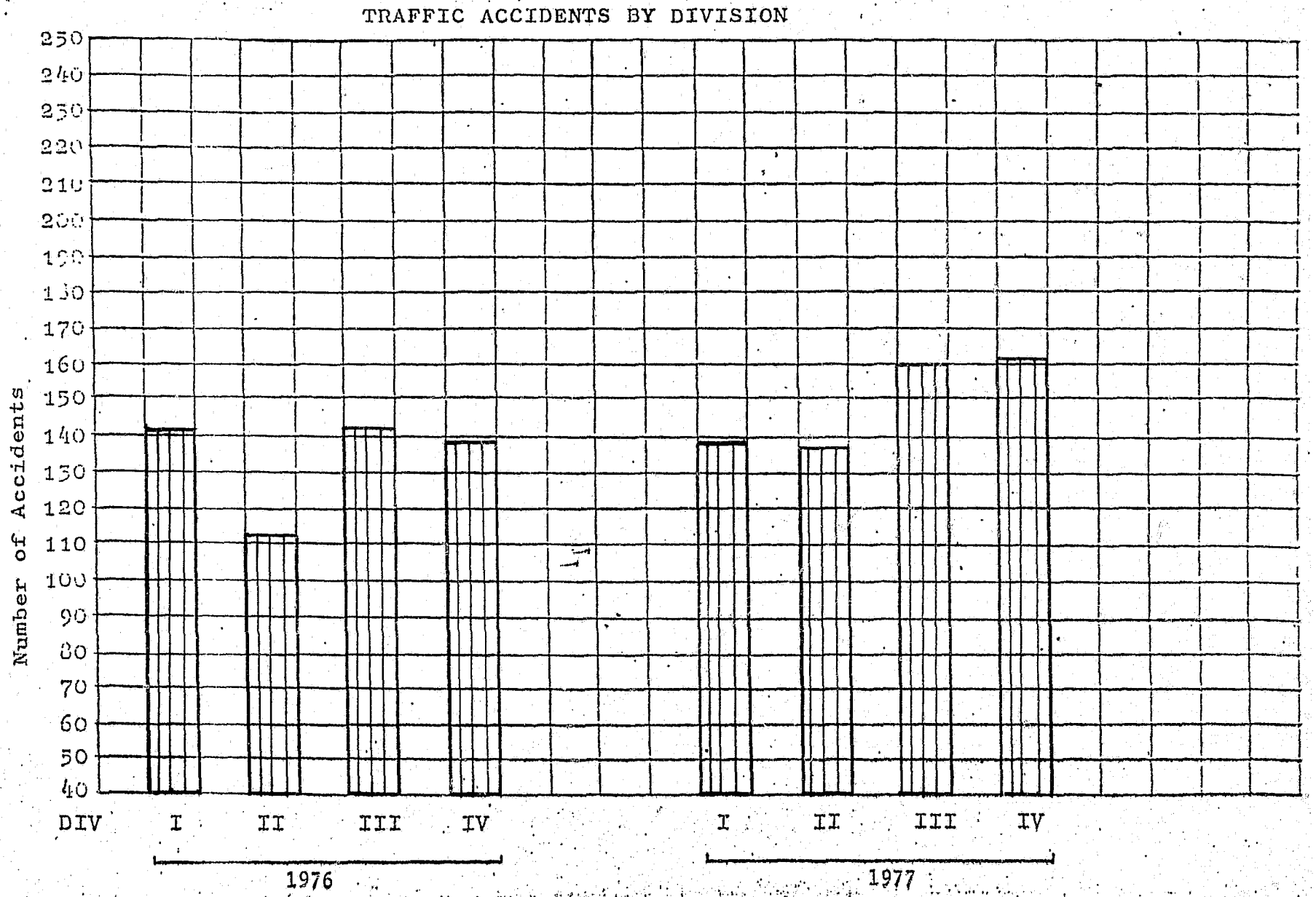
TABLE 4.3

PUBLIC STREET ACCIDENTS FOR MARCH, 1977, COMPARED WITH MARCH, 1976

	I	II	III	IV	TOTAL
1977	139	138	160	161	598
1976	141	113	142	139	535
Inc./Dec.	- 2	25	18	22	63
%Inc./Dec.	-1.42	22.12	12.68	15.83	11.78

Division I, the experimental group, decreased in the number of public street accidents by -1.42 percent. All other divisions showed an increase in traffic accidents ranging from 12.68 percent to 22.12 per-

Graph 4.3



****Only traffic accidents occuring on public streets are shown on this graph, computed by deducting private property accidents from all accidents occuring in the city

cent. City-wide public street accidents increased for the month of March, 1977, compared with March, 1976, by 11.78 percent (see Graph 4.3).

During the last month (February), all divisions showed a decrease in the number of public street accidents (City-wide accidents decreased by more than 10 percent during February). This month (March) only Division I continued this trend of decreasing in the number of public street accidents. As stated, the remaining divisions experienced an increase in public street accidents as compared with March of last year, and with last month.

The test conducted in Division I began on March 1, 1977, and ended March 31, 1977. Selective traffic enforcement was emphasized to Division I personnel and the Traffic Unit was deployed to that area. There were four to five traffic officers assigned to Division I driving marked police vehicles equipped with stationary radar units. Since one officer was usually off, and/or in court, three or four traffic officers were actually working in the field. These officers worked Monday through Friday, 1100 hours through 1900 hours / the highest frequency days and times as established in the data base. It should be noted these hours were changed from the previous three months (1200 hours through 2000 hours) to begin the officers working at 1100 hours. As stated in the data base, the 1100 hour and 1200 hour are approximately the same in the number of traffic accidents occurring. It was found by S.T.E.P.

personnel to be more convenient for traffic officers and more helpful in selective enforcement for officers to begin working at this earlier hour.

Street assignments were made to the officers in the Traffic Unit, working in Division I. One officer was assigned on Summit Avenue to patrol from Phillips Avenue to Bessemer Avenue; one officer patrolled on Summit Avenue from Bessemer to Wendover, on Wendover from Summit to Arnold Street, on Arnold Street from Wendover to Bessemer, and on Bessemer Avenue from Arnold to Summit; one officer patrolled on Market Street concentrating in the area of U.S. 29; an additional officer, when available, patrolled on English Street from Market Street to Phillips Avenue. These officers were allowed to use their discretion in patrolling techniques but were generally encouraged to use stationary patrol, allowing usage of radar equipment (at selective intersections), but to change locations and exercise roving patrol about every 15 minutes.

In addition to the Traffic Enforcement personnel, extra-duty personnel were utilized on Fridays, 2000 hours to 2400 hours, and on Saturdays, 1000 to 1800 hours. In employing these extra-duty officers, five patrolmen, and one supervisor were working in the field each Friday and Saturday during the above hours throughout the test period. Similar assignments were made with these officers as were for the traffic officers. The one main exception is that these extra-duty officers did not use any radar device unless they were regular traffic enforcement officers.

Table 4.4 gives summary statistics by division for March 19, 1977, and shows the mean number of traffic arrests in Division I was 23.7 arrests with a maximum of 57 and a minimum of 4.

TABLE 4.4

SUMMARY STATISTICS OF ARRESTS AND ACCIDENTS BY DIVISION FOR MARCH, 1977

Division	Mean	Std. Dev.	Maximum	Minimum	Range
D1ARR3	23.677	12.194	57	4	53
D1ACC3	4.484	2.111	8	0	8
D2ARR3	9.065	4.139	21	0	21
D2ACC3	4.452	2.234	9	0	9
D3ARR3	10.484	4.567	20	4	16
D3ACC3	5.161	1.864	9	1	8
D4ARR3	10.226	5.841	31	3	28
D4ACC3	5.194	1.922	8	2	6

(D1ARR3 = Division I Arrest for March (3);
D1ACC3 = Division I Accidents for March (3); etc.)

The average number of traffic arrests in control groups ranged from 9.1 in Division II to 10.5 arrests in Division III. It should be noticed that the total number, thus the mean, arrests of the experimental group increased during March. It was noted the mean increased in February from the previous two months although traffic officers were driving marked police vehicles. The mean in-

creased in March over February, while officers continued using marked police vehicles. This indicates that traffic arrests will not decrease with officers operating marked vehicles as suspected by many police officers and administrators.

The average number of traffic accidents ranged from a low of 4.45 in Division II to a high of 5.19 in Division IV. The average number of accidents in the experimental group was 4.48. The difference between the highest and lowest mean is .74, less than one accident. The difference between the experimental group mean and the control group means range from -.29 to .71.

Table 4.5 compares the mean number of public street accidents per day for March, 1977, with March, 1976. The mean number of traffic accidents in 1977 in ranked order, from lowest to highest, is:

Div. II (4.45), Div. I (4.48), Div. III (5.16), Div. IV (5.19)

Division II ranked lowest in the number of traffic accidents while the experimental group, Division I, ranked second lowest The mean difference in traffic accidents as compared with the previous year in ranked order, from lowest to highest, is:

Div. I (-.064), Div. III (+.580), Div. IV (+.71), Div. II (.807)

The rank of order changes from the mean number of traffic accidents to the mean number of traffic accidents to the mean difference in traffic accidents compared with the previous year. Division II, which ranked lowest in the average number of accidents in 1977, ranked highest in the average difference between 1977 and 1976. The experimental group ranked lowest in the mean difference of traffic accidents.

As seen from Table 4.5, the experimental group decreased in the mean difference in traffic accidents while all control groups showed an increase in the mean difference. This slightly suggests that the experiment was successful, but it should be noted that the difference between Division I, the lowest, and Division II, the highest, is less than one traffic accident (the difference is .87).

TABLE 4.5

MEAN NUMBER OF PUBLIC STREET ACCIDENTS PER DAY FOR MARCH, 1977, COMPARED WITH MARCH, 1976

Division	1976	1977	Difference
I	4.548	4.484	- .064
II	3.645	4.452	+ .807
III	4.581	5.161	+ .580
IV	4.484	5.194	+ .710

TABLE 4.6

ABSTRACT OF HISTOGRAMS OF ACCIDENTS BY DIVISION FOR MARCH, 1977, SHOWING FREQUENCIES WITHIN FIVE ACCIDENT INTERVALS

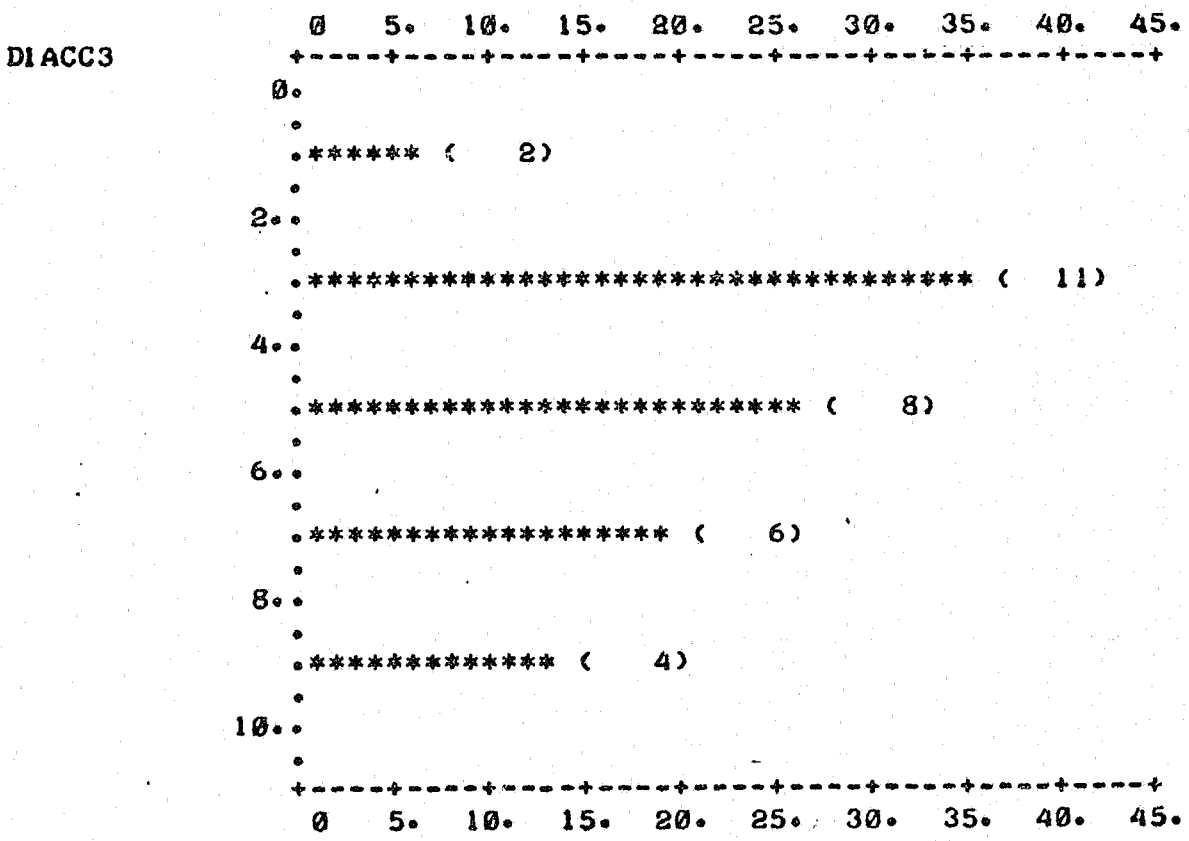
Accident Intervals	Div. I	Div. II	Div. III	Div. IV
0-1	2	2	2	
2-3	*11	*11	2	6
4-5	8	7	*15	10
6-7	6	8	9	*11
8-9	4	3	3	4

* = Mode

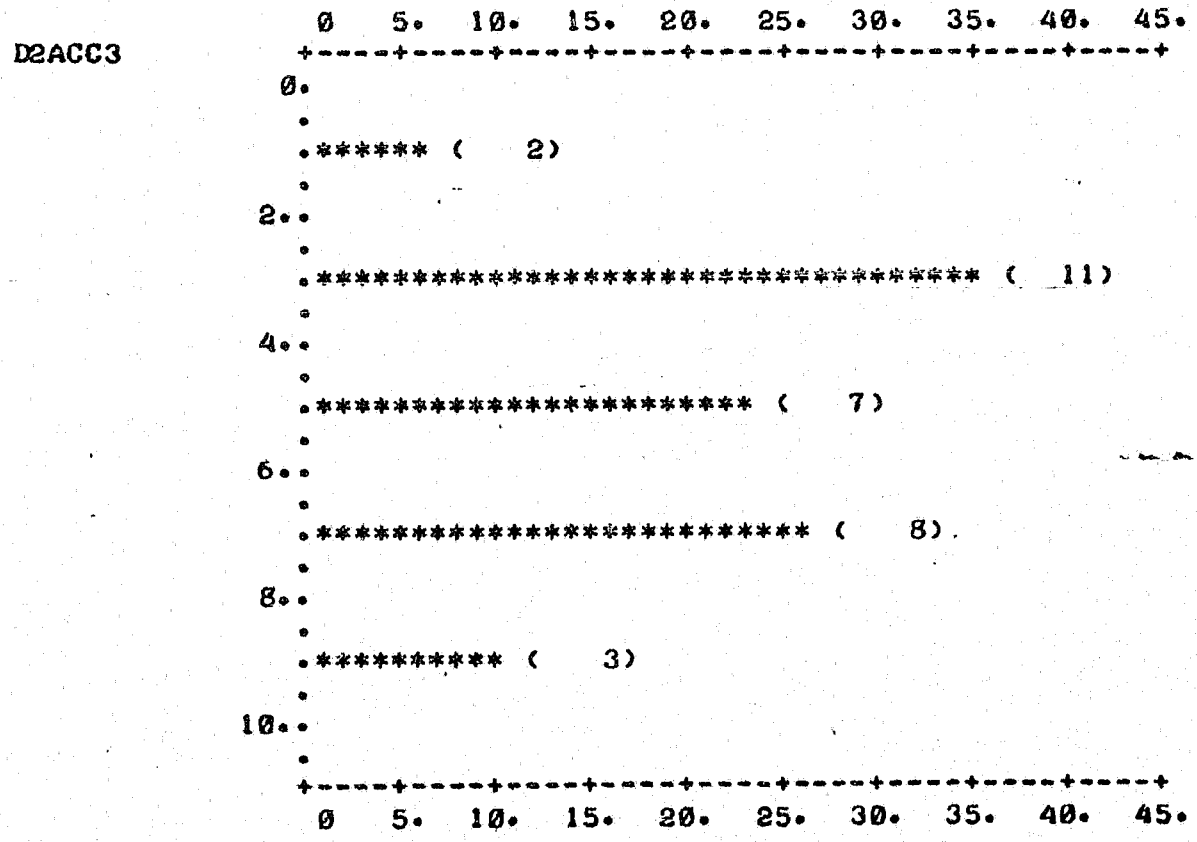
Graph 4.4 shows histograms of accidents for divisions during March, 1977, and Table 4.6 is an abstract of these histograms, indicating modes by an asterisk. Accidents in Divisions I and II were very similar and the modes for these divisions are the same. The mode for Division III increased from Divisions I and II and the mode for Division IV increased from Division III.

Graph 4.5 shows histograms of arrests by division for March and Table 4.7 is an abstract of these histograms indicating modes. The mode for the experimental group, using saturation type patrol, is in excess of 25 arrests which was the same as last month in the experimental group. As stated earlier, this indicates that the

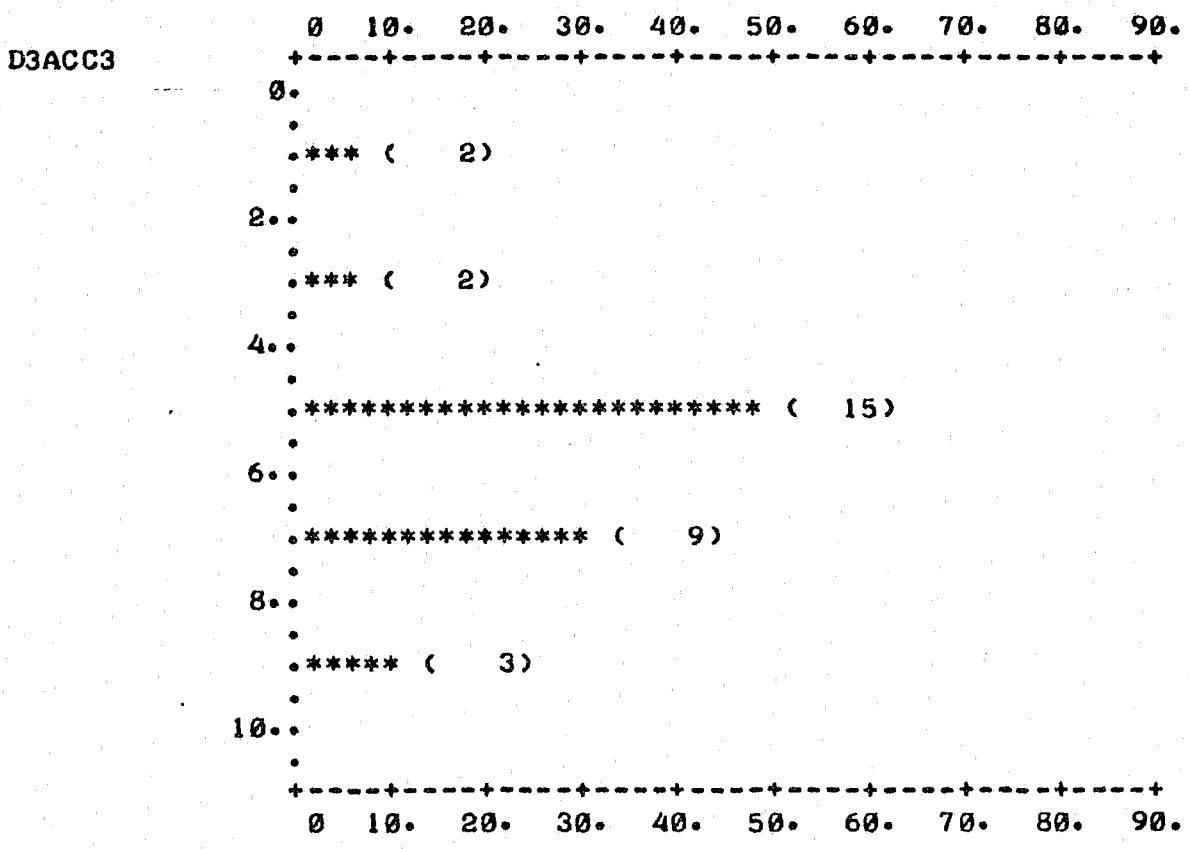
HISTOGRAM FOR D1ACC3



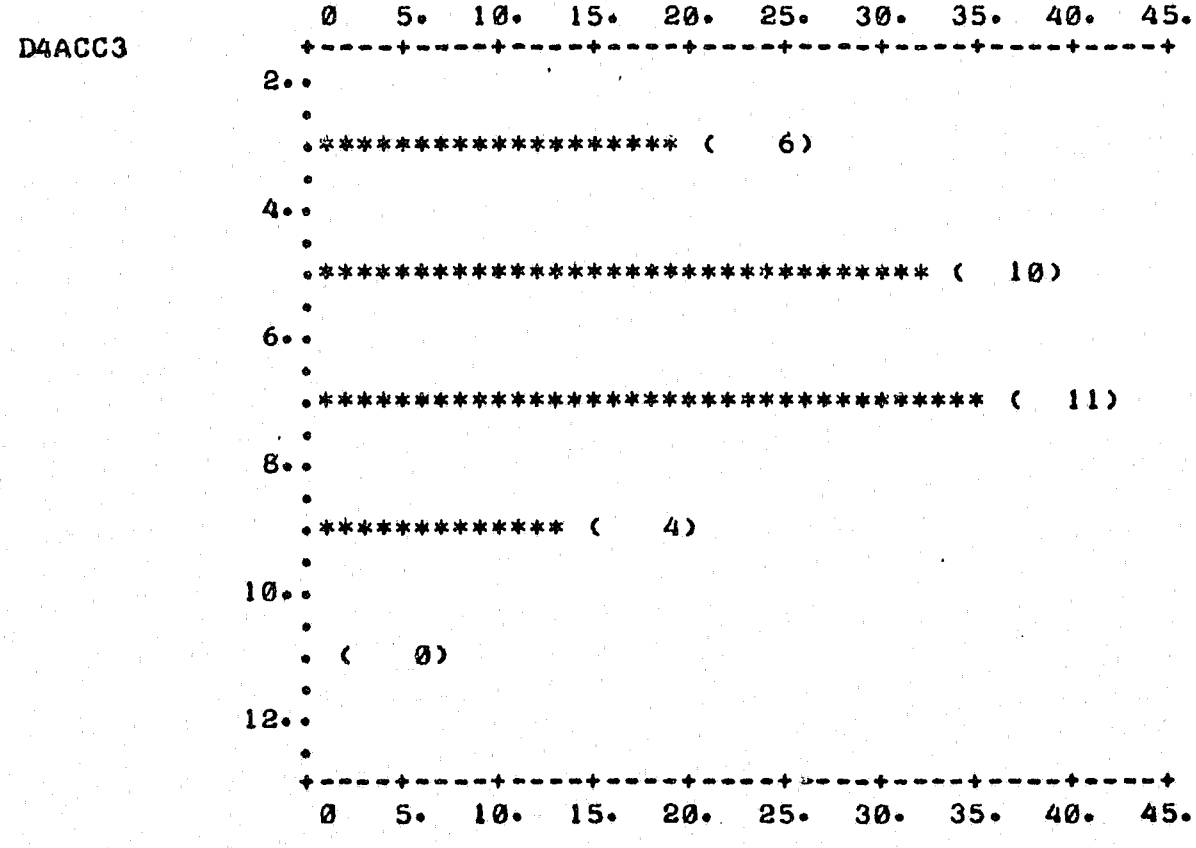
HISTOGRAM FOR D2ACC3



HISTOGRAM FOR D3ACC3



HISTOGRAM FOR D4ACC3



number of traffic arrests will not be reduced by officers operating marked police vehicles. In fact, the data suggests the opposite, that officers will effect more traffic arrests while patroling in marked police vehicles.

TABLE 4.7

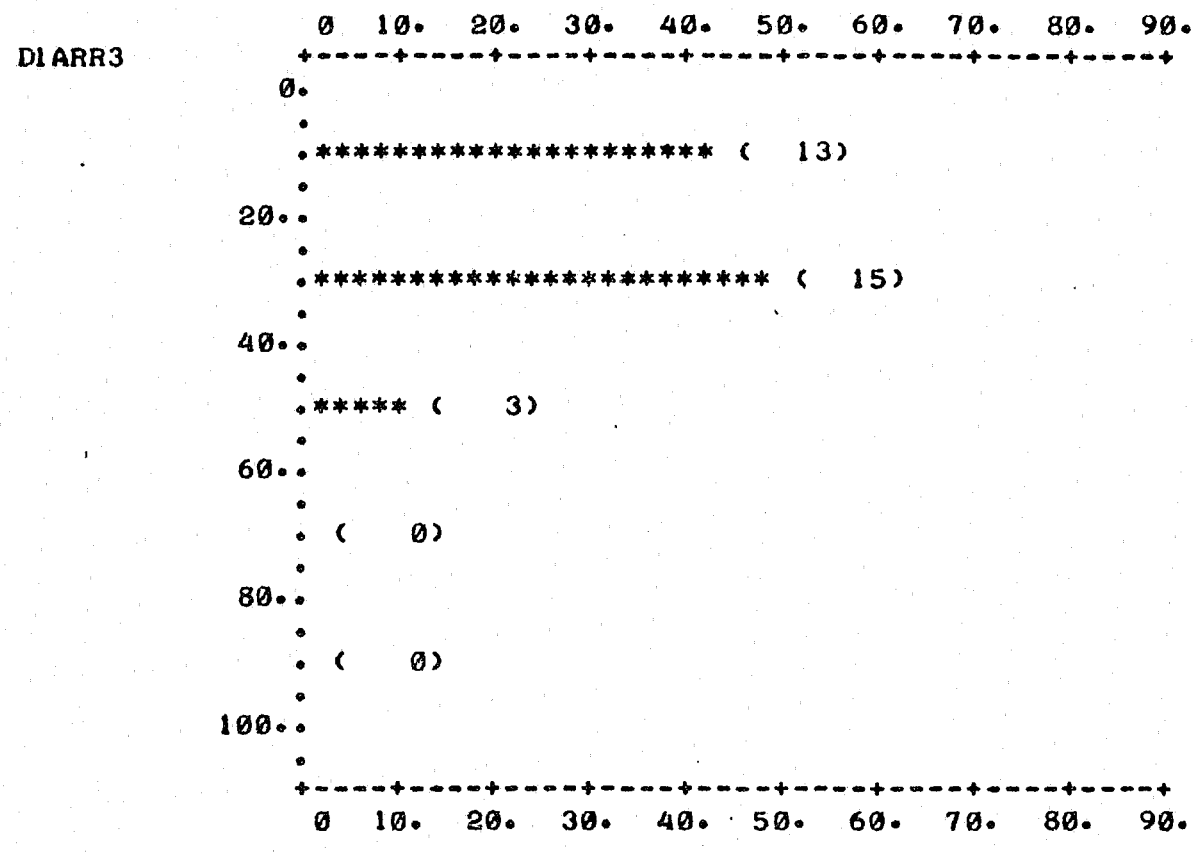
ABSTRACT OF HISTOGRAMS OR ARRESTS BY DIVISION FOR MARCH, 1977, SHOWING FREQUENCIES WITHIN FIVE ARREST INTERVALS

Arrest Intervals	Div. I	Div. II	Div. III	Div. IV
0-4	1	4	2	3
5-9	5	*12	*13	*15
10-14	0	12	10	7
15-19	7	2	5	4
20-24	3	1	1	1
25	*15			1

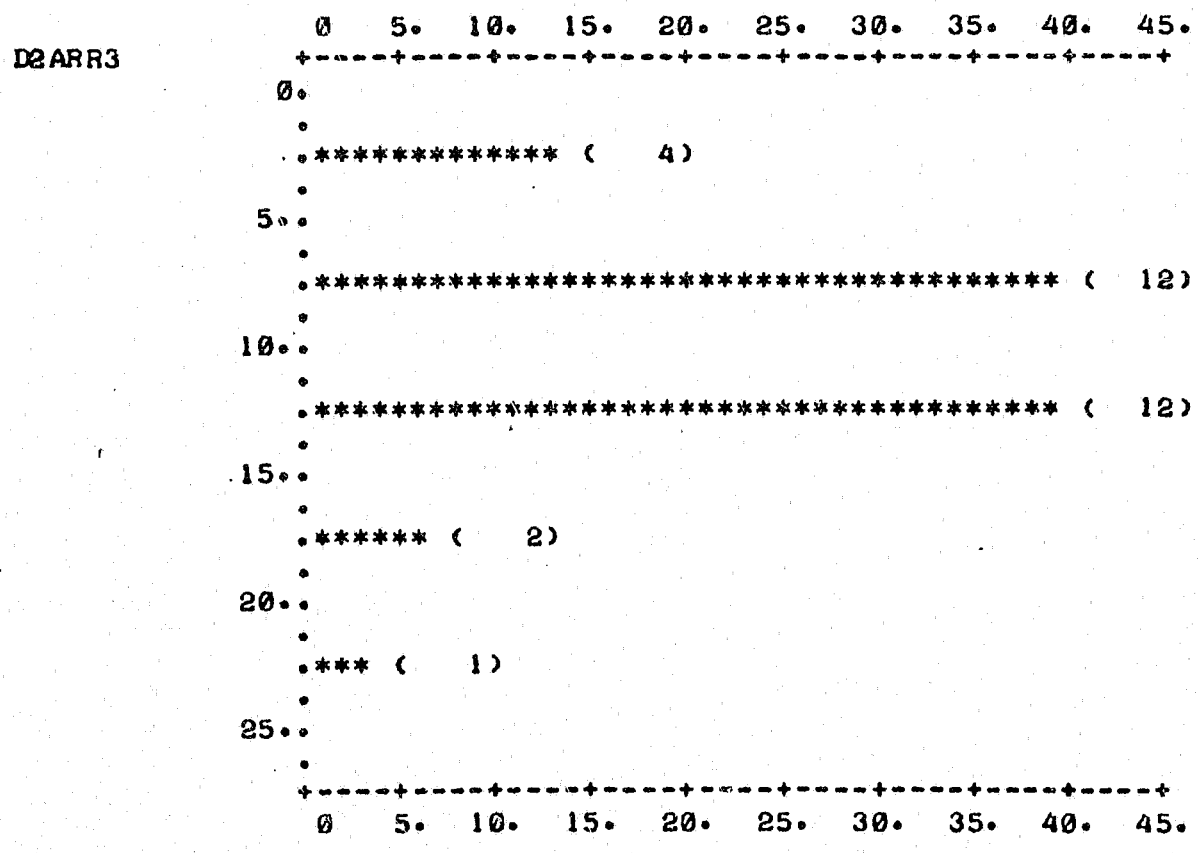
* = Mode

The mode for each control group remained the same as for previous months, at the interval between 5 and 9 arrests. For each experimental month, December through March, for each control group, the mode remained at the same interval, between 5 and 9 arrests. This corroborates the conception of a "normal rate of traffic enforcement" where a saturation patrol is not utilized.

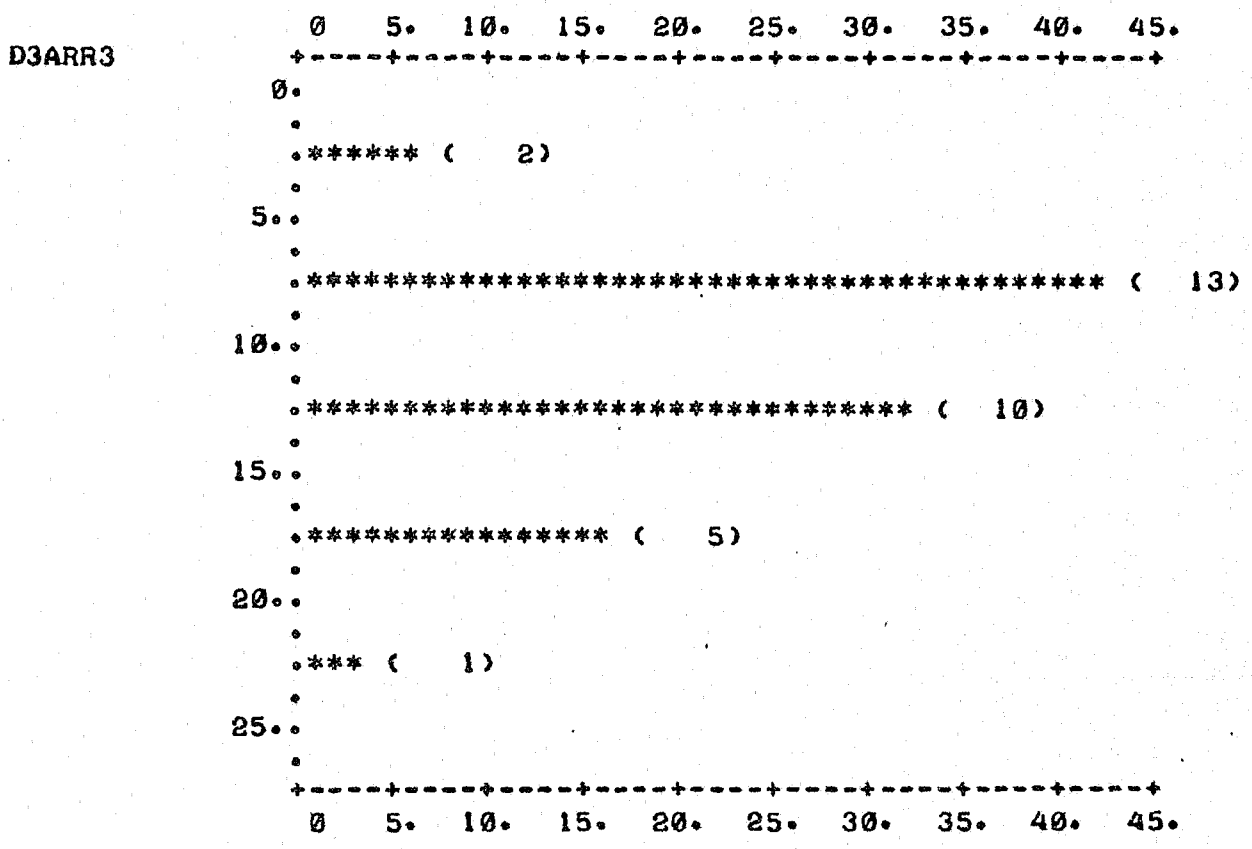
HISTOGRAM FOR D1ARR3



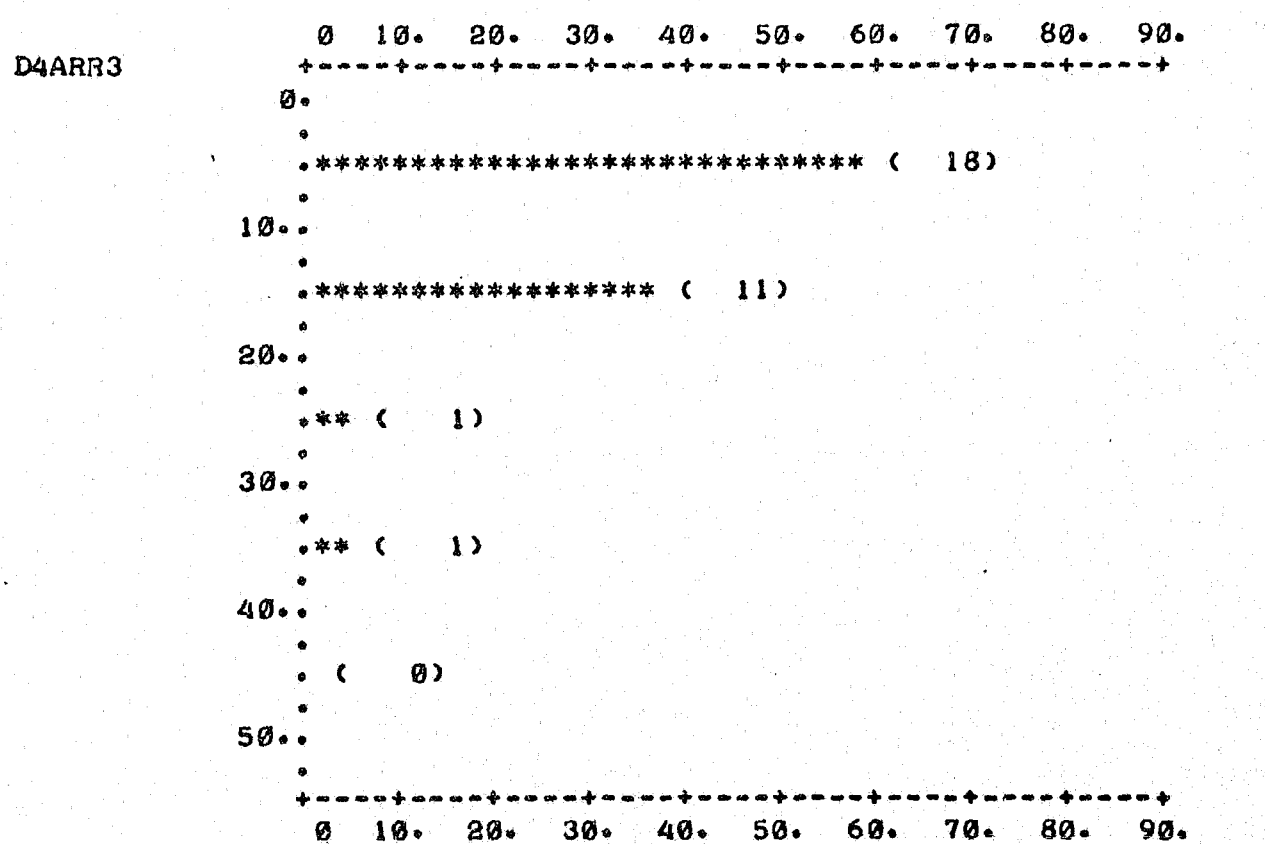
HISTOGRAM FOR D2ARR3



HISTOGRAM FOR D3ARR3



HISTOGRAM FOR D4ARR3



Graph 4.6 shows crosstabulations of arrests and accidents by division for March and Table 4.8 is an abstract of these cross-tabulations showing relative modes.

TABLE 4.8

ABSTRACT OF CROSSTABULATION OF ARRESTS AND ACCIDENTS BY DIVISION FOR MARCH, 1977, SHOWING RELATIVE MODES

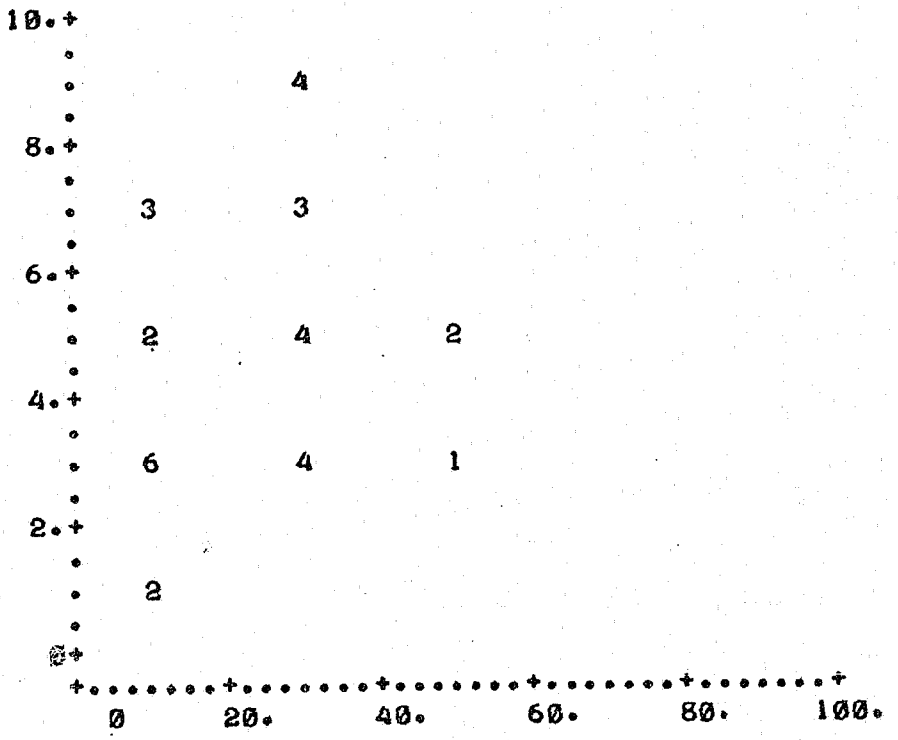
Horizontal = Arrest, Vertical = Accidents

10						
8						
6						
	IV	III				
4						
			II			I
2						
0	5		10	15	20	25

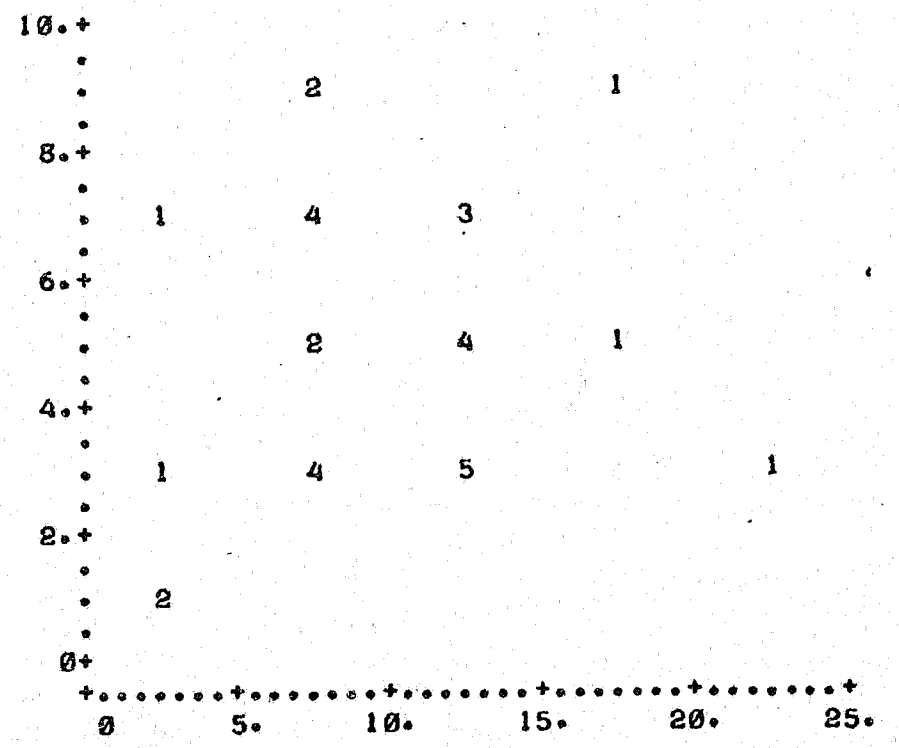
The experimental group is in a lower interval than two of three control groups although not in the lowest interval. It is again illustrated that the experimental group received more traffic

GRAPH 4.6a

CROSSTABULATION HORIZONTAL=D1ARR3 , VERTICAL=D1ACC3

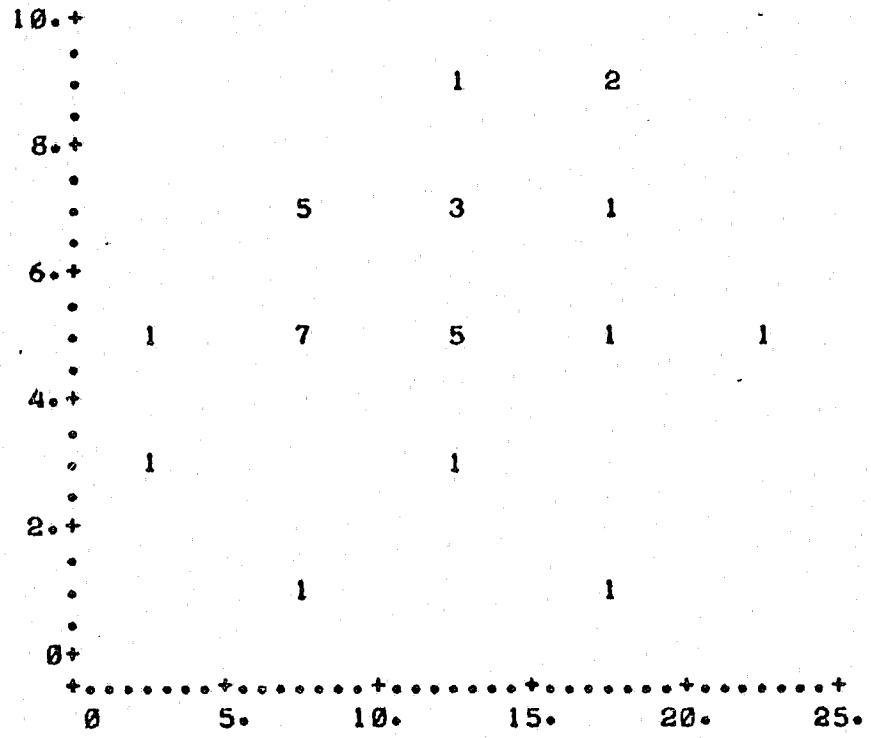


CROSSTABULATION HORIZONTAL=D2ARR3 , VERTICAL=D2ACC3

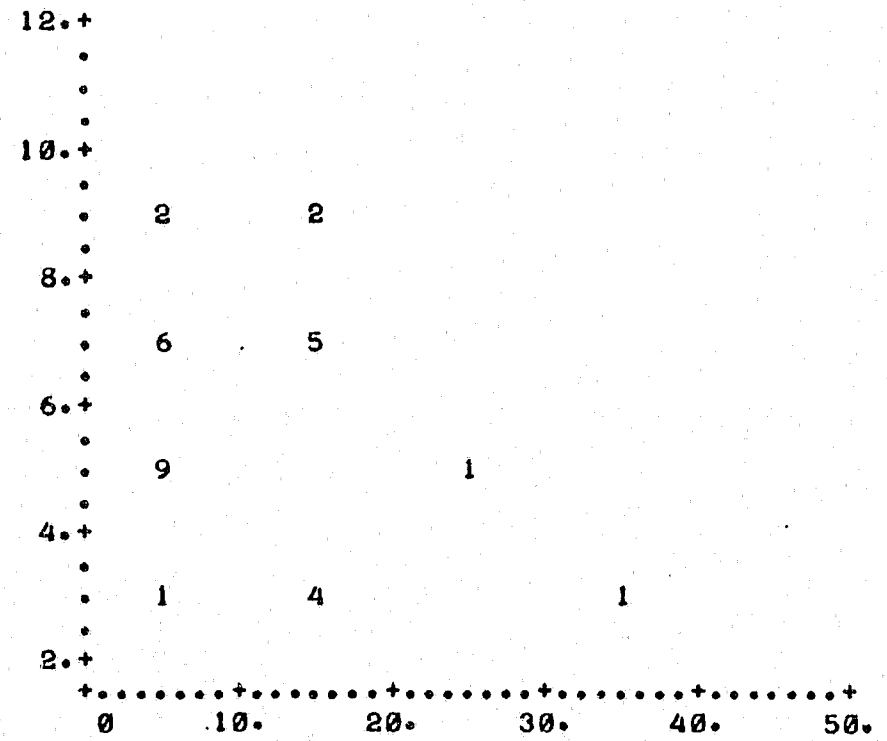


GRAPH 4.6b

CROSSTABULATION HORIZONTAL=D3ARR3 , VERTICAL=D3ACC3



CROSSTABULATION HORIZONTAL=D4ARR3 , VERTICAL=D4ACC3



enforcement than control groups without a sharp decrease in the number of traffic accidents. Examination of the histograms for Division I shows accidents increasing with more arrests.

There were 13 days when enforcement ranged from 0 to 19 arrests per day; there were 15 days when enforcement ranged from 20 to 39 arrests per day. Taking the medium number of the interval for accidents and multiplying by the frequency shown, there were 51 accidents when arrests ranged from 0 to 19; there were 89 accidents when arrests ranged from 20 to 39. This represents a 74 percent increase in traffic accidents with a possible 200 percent increase in traffic arrests.

CHAPTER II

ANALYSIS OF ARRESTS AND ACCIDENTS

Section V - Analysis of Histograms

Table 5.1 is an analysis of histograms of accidents comparing modes of one experimental group with three control groups for each test period. This table is presented to give a visual presentation of the relative levels of interval with the modes of each division during each test period.

TABLE 5.1

ANALYSIS OF HISTOGRAMS OF ACCIDENTS COMPARING MODES OF ONE EXPERIMENTAL GROUP WITH THREE CONTROL GROUPS FOR EACH TEST PERIOD

		Relative Levels of Interval*				
		1	2	3	4	5
December	E	X				
	C		XXX			
January	E	X				
	C	XX	X			
February	E			X		
	C		XXX			
March	E		X			
	C		X	X	X	

*Levels of interval are ranked 1 through 5 from lowest frequency interval to highest - ranked levels are relative to appropriate abstract by month.

E = Experimental Group
C = Control Group

Ideally, the experimental group would be in the lowest ranking for each test period and control groups would be in a higher level of interval. As can be seen, this is not the case. In December, the experimental group was in a lower level than the control groups, but this is the one exception. During all other test periods, at least one control group was equal to or lower than the experimental group in the relative level of interval. For example, in February, all control groups were at a lower level of interval than the experimental group. The reason for the variance cannot be explained by any data obtained during these experiments. In reviewing research data, it can be noted that variances occur within divisions by month throughout the year. One objective of the experiments was to control the variance of the experimental division, which, as can be seen, was not accomplished. The histograms and crosstabulations presented in this report suggest that something more than a saturation type patrol of using 260 extra man-hours will be needed to control accidents regardless of the type patrol vehicle that officers operate.

Section VI - Correlation of Arrests and Accidents

Table 6.1 gives summary statistics of arrests and accidents for all divisions for December, 1976, through March, 1977.

TABLE 6.1

SUMMARY STATISTICS OF ARRESTS AND ACCIDENTS FOR ALL DIVISIONS FOR DECEMBER, 1976, THROUGH MARCH, 1977

	Mean	Std. Dev.	Maximum	Minimum	Range
Arrests	46.070	18.157	92	10	82
Accidents	18.632	7.338	49	4	45

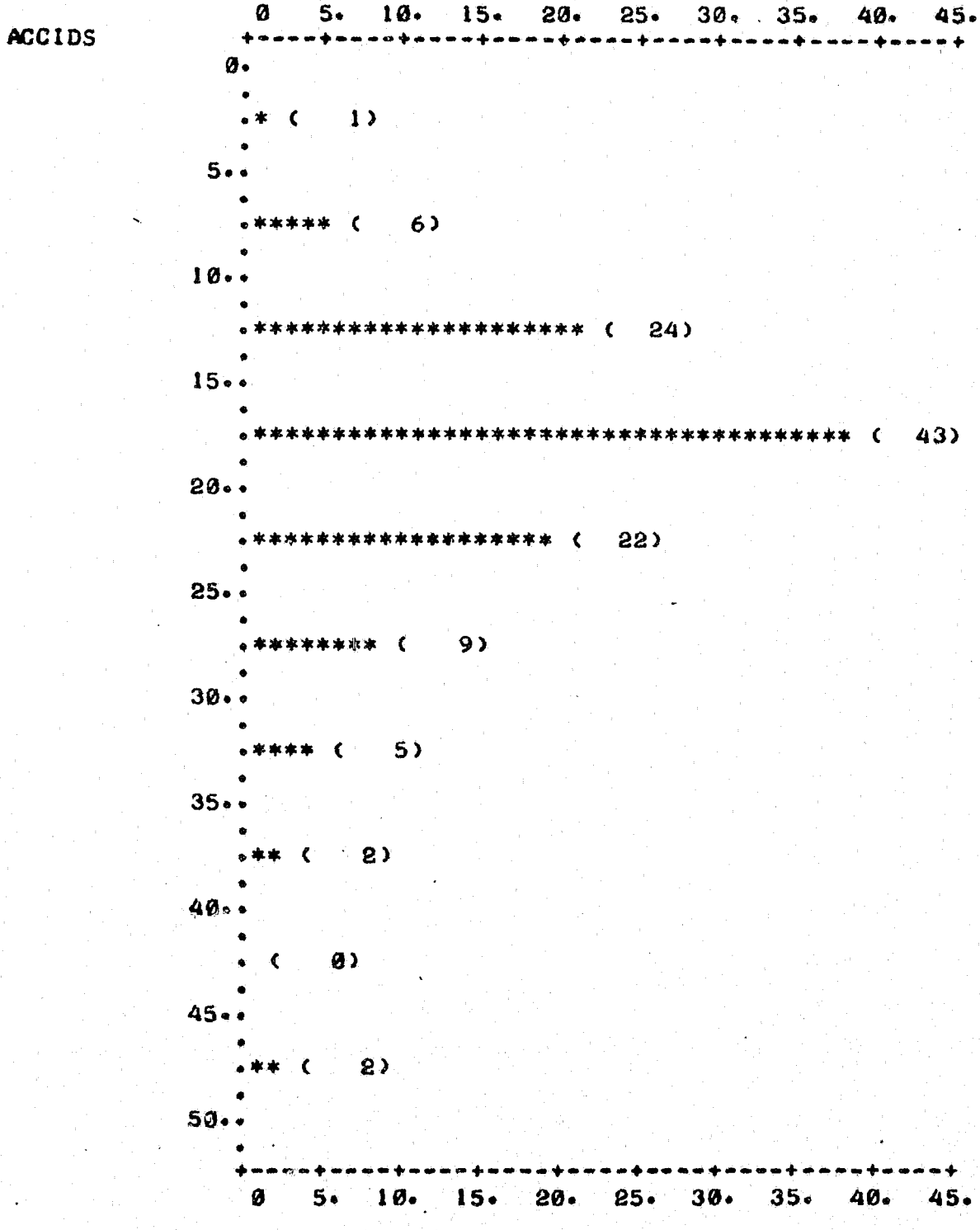
These statistics are based on 114 days since snow days are omitted (31 days in December, 25 days in January, 27 days in February, and 31 days in March). There was an average of 46 traffic arrests made per day in the city during this period and more than 18 traffic accidents. These averages include all divisions in the city over the 114 day period. As shown, there is a substantial amount of deviation from this mean in both traffic arrests and traffic accidents.

In addition, ranges of both arrests and accidents are high. This indicates a large variance (also note standard deviation to find variance) and inconsistency in enforcement and accidents. As can be seen from previous histograms and from charts in Appendix A, some days many arrests are made while few arrests are made on other days. The same inconsistency is noticed for accidents. It is here suggested that traffic accidents cannot be fully controlled by traffic enforcement. To what degree this is possible is certainly unknown at this point.

Graph 6.1 is a histogram of accidents for all divisions during the test period, December through March, and Table 6.2 is an abstract of this histogram. Most of the days during this period fall within three accident intervals, 10-14, 15-19, and 20-24. These three accident intervals account for 78 percent of the days during this period with the mode being 43 days in the interval of 15-19 accidents, accounting for 38 percent of the time during this test period. In other words, for most days, traffic accidents in the city will range from 10 to 24 accidents per day.

GRAPH 6.1

HISTOGRAM FOR ACCIDS



COUNTS APPEAR AT ENDS OF BARS. FREQUENCY PERCENTAGES GRAPHED

TABLE 6.2

ABSTRACT OF HISTOGRAM OF ACCIDENTS FOR ALL DIVISIONS FOR DECEMBER, 1976, THROUGH MARCH, 1977

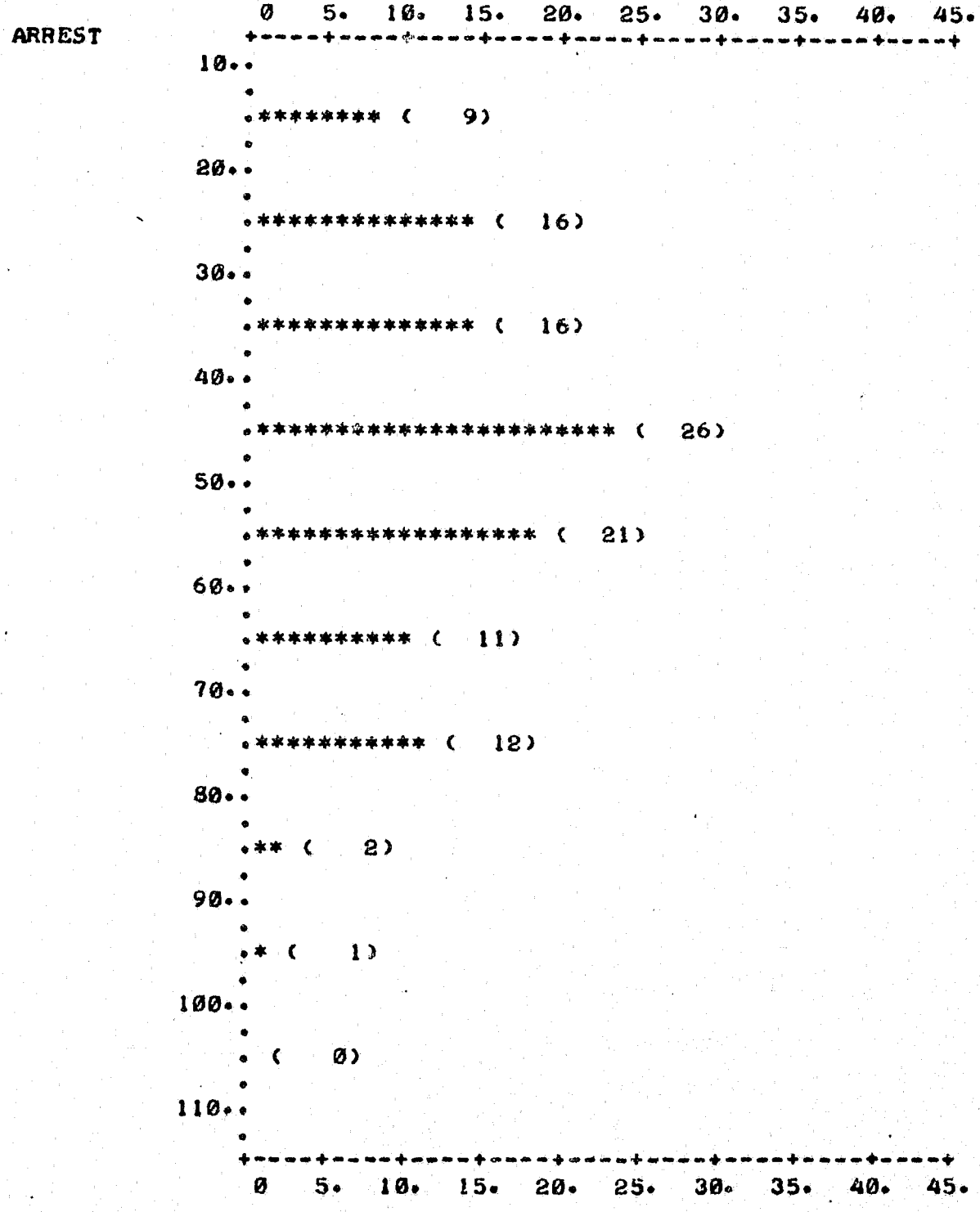
Accident Interval	Frequency (Number of Days)	Frequency Percentage
10-14	24	21
15-19	43	38
20-24	22	19
10-24 accidents	89 days	78 percent

As can be noted, Graph 6.1 resembles a normal curve. This suggests the four month test period is a good representation of any four month period in that the normality of the number of traffic accidents did not significantly vary during our test period. One objective of any traffic enforcement program would be to increase the number of days in low accident frequency intervals and decrease the number of days in high accident frequency intervals, thus, positively skewing the curve. As noted, this skewness is not present during the test period.

Graph 6.2 is a histogram of arrests for all divisions for December through March. This graph also resembles a normal curve with the mode being the interval of 40 to 49 arrests. This means for 26 days of the four month period or 22.8 percent, officers made between 40 and 49 traffic arrests per day. Both graphs, 6.1 and 6.2, correlate with the similar statistics given in Table 6.1. The mean number of traffic arrests during the period

GRAPH 6.2

HISTOGRAM FOR ARREST



COUNTS APPEAR AT ENDS OF BARS. FREQUENCY PERCENTAGES GRAPHED

was 46 traffic arrests and as seen in Graph 6.2, is representative of the mode. The mean number of traffic accidents during the period was 18, which corresponds with the mode of Graph 6.1.

Graph 6.3 is a crosstabulation of traffic arrests and traffic accidents for all divisions which shows the mode to be 40 to 60 traffic arrests with 10 to 20 traffic accidents. There were 26 days during this period when traffic arrest was in excess of 60 citations each day, but traffic accidents did not drop below 10 accidents per day for these 26 days, which suggest that traffic enforcement had a little effect on the number of traffic accidents.

If increasing traffic law enforcement would have a negative effect on the number of traffic accidents, that is, if there was a negative correlation, it would be suspected that as larger numbers moved across and to the right of the crosstabulation, the numbers would also move down toward the bottom of the crosstabulation. This would represent more traffic arrests and fewer traffic accidents. Graph 6.3 does not show this relationship.

Table 6.3 shows percentages of accidents with no traffic arrests made by investigating officers for 1975 and 1976. Statistics used to make this table were taken from all accidents occurring at selected intersections (see data base) during 1975 and 1976. There were 109 intersections selected as test areas and, therefore, stand as a sample.

GRAPH 6.3

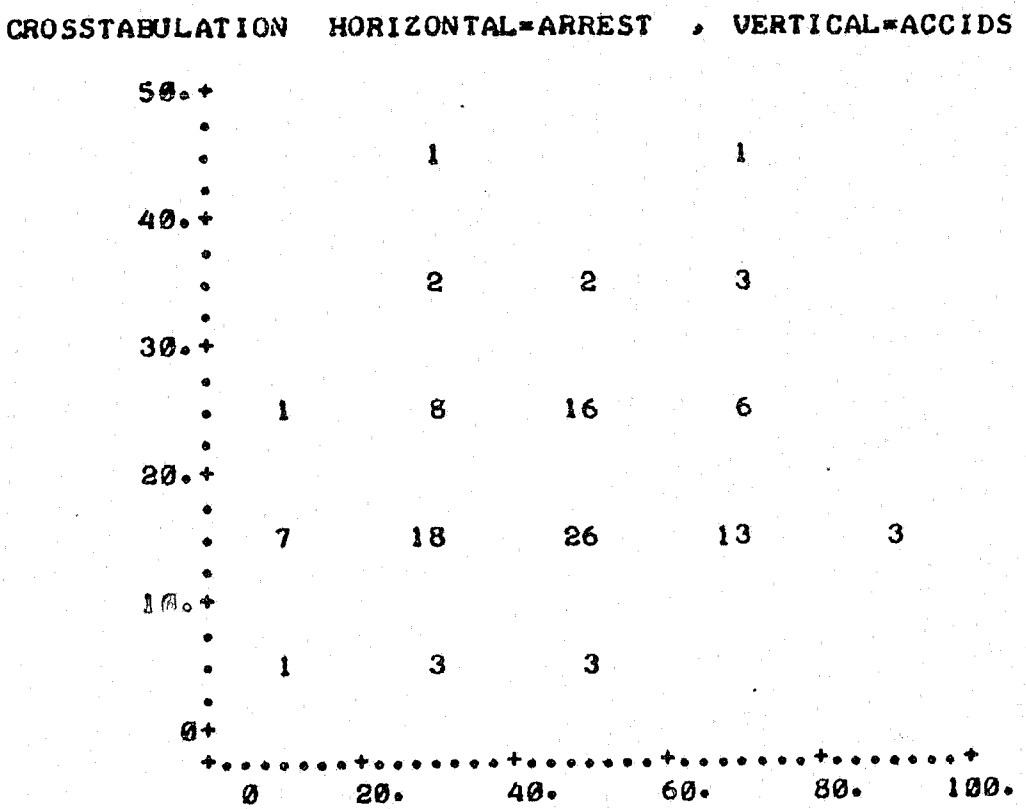

CROSSTABULATION HORIZONTAL=ARREST , VERTICAL=ACCIDS
50.
40.
30.
20.
10.
0
1 1
2 2 3
1 8 16 6
7 18 26 13 3
1 3 3
0 20. 40. 60. 80. 100.

TABLE 6.3

PERCENTAGES OF ACCIDENTS WITH NO TRAFFIC ARRESTS MADE BY INVESTIGATING OFFICERS FOR 1975 AND 1976

Division	1975	1976
I	30.2	36.3
II	31.6	42.0
III	39.0	37.8
IV	28.2	34.9
	129.0%	151.0%

$$\frac{129 + 151}{8} = 35\%$$

Since these areas were selected and not randomly chosen, the 35 percent is very possibly a low figure because these were the most hazardous intersections and those where traffic law violations may be more easily detected after an accident. This table shows that in 65 percent of reported accidents, some enforcement action is taken by the investigating officer. The table itself is presented so each commander/supervisor can evaluate his individual division and, to document the expected number of traffic arrests made at accident scenes.

Table 6.4 shows the number of observed and expected traffic arrests by division for December through March, 1977. The number of expected traffic arrests shown in Table 6.4 is computed from Table 6.3 and from

the number of traffic accidents occurring in each division during each month of the test period. For example, in Division I for December, there were 237 traffic arrests. It is expected that 119 of these traffic arrests were made at accident scenes, leaving 118 traffic arrests suspected as nonaccident enforcement. Both Tables 6.3 and 6.4 are to give commanding officers and superiors some notion of the number of traffic arrests being made in their division and the number of reported accidents when enforcement action is not taken by investigating officers.

The purpose of Table 6.4 is to distinguish between accident enforcement and nonaccident enforcement. Accident enforcement is not a preventative action, rather, it is a punative action and is not selective traffic enforcement. Nonaccident enforcement is also punative, being a negative reinforcer, but is made as a preventative measure and may be selective traffic enforcement. The difference (indicated as Column D) between Column "O" and Column "E" is the expected number of nonaccident traffic arrests made by each division. Commanding officers/supervisors may compare their divisions and enforcement action; what part of this enforcement action may be considered as "selective traffic enforcement" is not known, but it can be seen that overall traffic enforcement is low. For example, Division I averaged 5 traffic arrests per day during December and February (nontest months). Considering that three squads worked daily (approximately ten men squads), it can be approximated that

one of every six patrolmen made one arrest per day. Division II averaged 6.3 arrests per day (January through March); Division IV averaged 6.4 arrests per day (December through March).

City-wide, there were 22.4 traffic arrests made each day, or an average of 5.6 arrests per division. Considering an eight man squad (8 X 3 X 4 = 96), an average of

TABLE 6.4

NUMBER OF OBSERVED AND EXPECTED TRAFFIC ARRESTS BY DIVISION FOR DECEMBER, 1976, THROUGH MARCH, 1977*

	Division I			Division II		
	O	E	D	O	E	D
Dec.	237	119	118	215	110	105
Jan.	407	60	347	153	45	108
Feb.	238	69	169	183	51	132
Mar.	734	90	644	281	90	191

	Division III			Division IV		
	O	E	D	O	E	D
Dec.	531	109	422	268	123	145
Jan.	202	70	132	247	92	155
Feb.	605	72	533	292	76	216
Mar.	325	104	221	317	104	213

*All months are computated without snow days.

O = Observed

E = Expected

D = Expected number of non-accident traffic arrest

An examination of the correlation between traffic arrests and traffic accidents has been made, using the Pearson product--moment correlation coefficient. The Pearson product moment correlation coefficient formula is as follows:

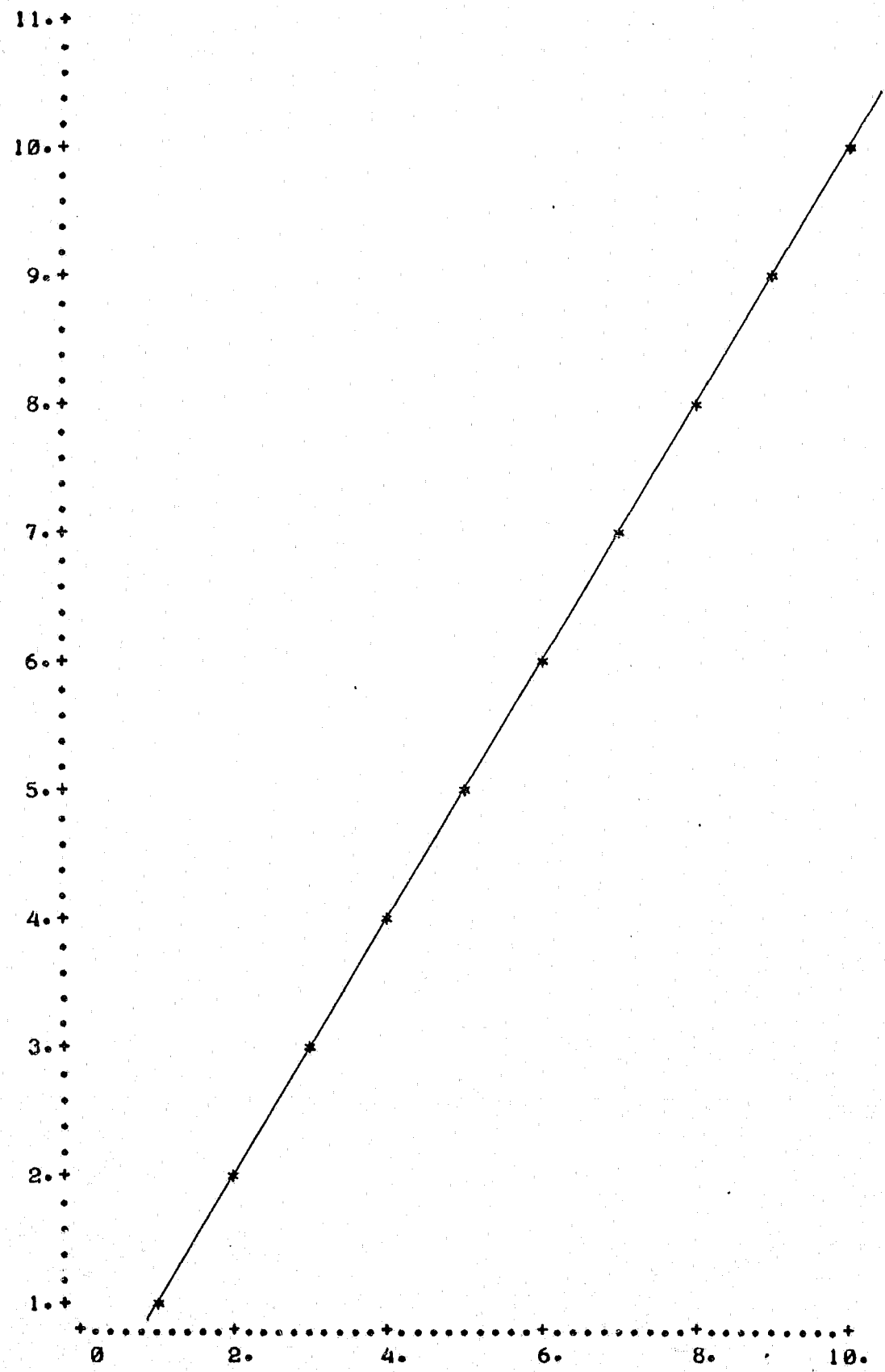
$$r = \frac{\Sigma X Y - \frac{(\Sigma X)(\Sigma Y)}{N}}{\sqrt{\left[\Sigma X^2 - \frac{(\Sigma X)^2}{N}\right]\left[\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}\right]}}$$

The Pearson product moment coefficient is based on individual Z-scores that expresses each variable in terms of its own standard deviation for each of the two observations, and reflects the linear relationship between the two variables. That is, the formula measures the strength of the relationship between two variables by measuring the amount of spread about the regression line. This provides a certain amount of predicting power to the observer so when a perfect positive correlation coefficient is observed, expressed as r = 1.00 (or +1.00), the observer can predict exactly the value of y from the value of x, or vice-versa. This exact prediction can also be made with a perfect negative correlation expressed as r = -1.00. As the correlation moves toward r = 0.00, the predictive power deminishes. When r = 0.00, there is considered to be no relationship between the two variables in that the occurrence of one variable will, in no way, affect the occurrence of the second variable.

Graphs 6.4 and 6.5 are given as illustrations of perfect positive and perfect negative correlation coefficients. Graph 6.4 illustrates a per-

GRAPH 6.4

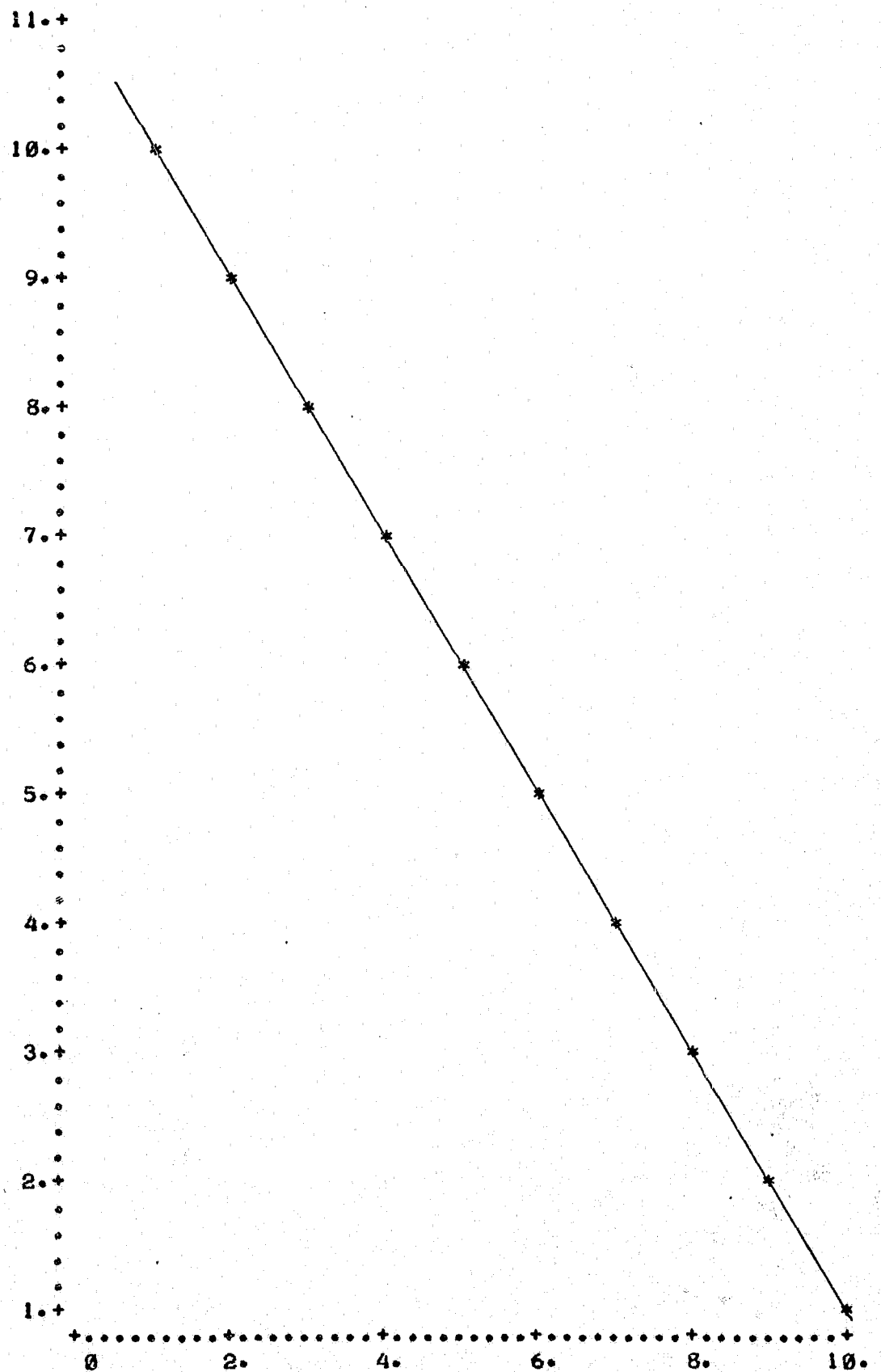
ARREST AND ACCIDS FOR EXAMPLE ONLY



HORIZONTAL=ACCIDS , VERTICAL=ARREST

GRAPH 6.5

ARREST VS ACCIDS FOR EXAMPLE ONLY



HORIZONTAL=ACCIDS , VERTICAL=ARREST

fect positive correlation of r = 1. It can be noticed that the regression line is at a right, 45 degree angle, and that all dots on the scatter pot touch the regression line. This positive relationship shows that when there are six traffic arrests, six traffic accidents are also present. Graph 6.5 illustrates a perfect negative correlation with r = -1. Again it will be noticed that in a perfect correlation, all dots of the scattered pot touch the regression line and in a negative correlation, the regression line is at a left, 45 degree angle. In the negative correlation, more traffic arrests result in fewer traffic accidents, and conversely, fewer traffic arrests result in more traffic accidents. Ideally, a negative correlation would be present during the experiment periods.

TABLE 6.5

ARREST AND ACCIDS ALL DIVS FOR DEC THRU MAR

MULTIPLE REGRESSION FOR ACCIDS

VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
ARREST	.08323	.03737	2.22745	.20596
INTERCEPT=	14.79694			
STD. ERR. INTCP.=	.199862026 0E+01			
COMPUTED T INTCP.=	7.40358			

MULTIPLE CORRELATION	.20596	(ADJUSTED R =	.20596)
R-SQUARED	.04242	(ADJ. R-SQUARED=	.04242)
STD. ERROR OF ESTIMATE	7.21260	(ADJUSTED SE=	7.21260)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	258.107	258.107	4.962
DEVIATION FROM REGRESSION	12	5826.420	52.022	
TOTAL	13	6084.526		

Table 6.5 is a regression analysis for traffic arrests and traffic accidents during the test period. Graph 6.6 is a scatter pot and of arrests and accidents, showing the regression line. The rounded correlation coefficient for traffic arrests and accidents during this period is .21. These results indicate an extremely weak positive correlation between traffic arrests and traffic accidents. In fact, the results approach a zero correlation much more than a strong positive correlation. As a result of this correlation, it can be said that traffic arrests account for about four percent of the variance in the number of traffic accidents. This data tends to verify previous data presented in this report, that the number of traffic arrests per se has little effect on the number of traffic accidents.

Table 6.6 shows correlation coefficients of arrests and accidents by division for the test period.

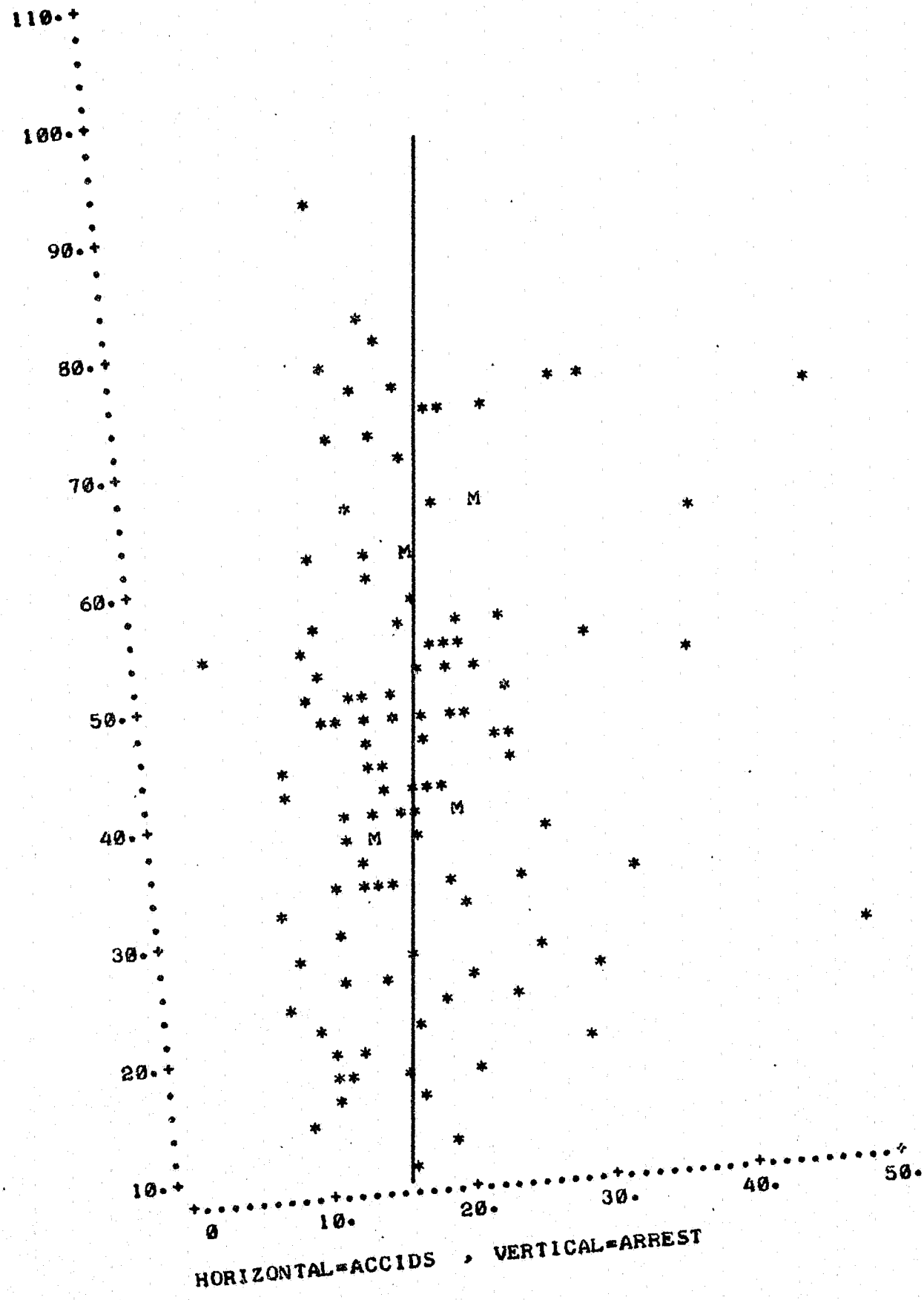
TABLE 6.6

CORRELATION COEFFICIENTS FOR ARRESTS AND ACCIDENTS
BY DIVISION DECEMBER, 1976, THROUGH MARCH, 1977

	Div. I	Div. II	Div. III	Div. IV
Dec.	.20	.52	.39	.52
Jan.	.04	.22	.00	.35
Feb.	-.05	.39	.13	.47
Mar.	.39	.18	.38	-.39

GRAPH 6.6

ARREST AND ACCIDS ALL DIVS FOR DEC THRU MAR



HORIZONTAL=ACCIDS , VERTICAL=ARREST

None of the correlations rose above .52, which is an extremely poor association. This data indicates there was only a small association between traffic arrests and traffic accidents in the city during this four month period. This data should not be misinterpreted; for example, arrests cause accidents as the correlation increases. As correlations approach 1.00, then the prediction ability increases that when an accident occurs, then an arrest occurs (remembering that even a .52 correlation has poor predictive power). This means that traffic arrests and traffic accidents are more closely associated or paired and nonaccident enforcement is low and having little effect on the number of traffic accidents.

In test areas with saturation patrol, the correlations did not rise above .39 nor drop below .04. Furthermore, there is an insignificant difference between correlations during test periods with unmarked police vehicles and marked police vehicles.

This data indicates that the number of traffic arrests is not strongly associated with traffic accidents and, therefore, have little effect in the variation of traffic accidents. It can be stated that an increase or decrease in the number of traffic arrests will not significantly effect the number of traffic accidents. This statement is substantiated by data in Table 6.6. An examination of this data shows there were no correlations approaching -1.00 in the test areas; corre-

lations in test areas are not symetrically different than control areas; correlations and test areas do not change greatly during test periods from the same division during nontest periods.

Regression analysis and scatter pots showing regression lines corresponding to the correlations in Table 6.6 are given as Appendix B in this report as documentation for the correlations.

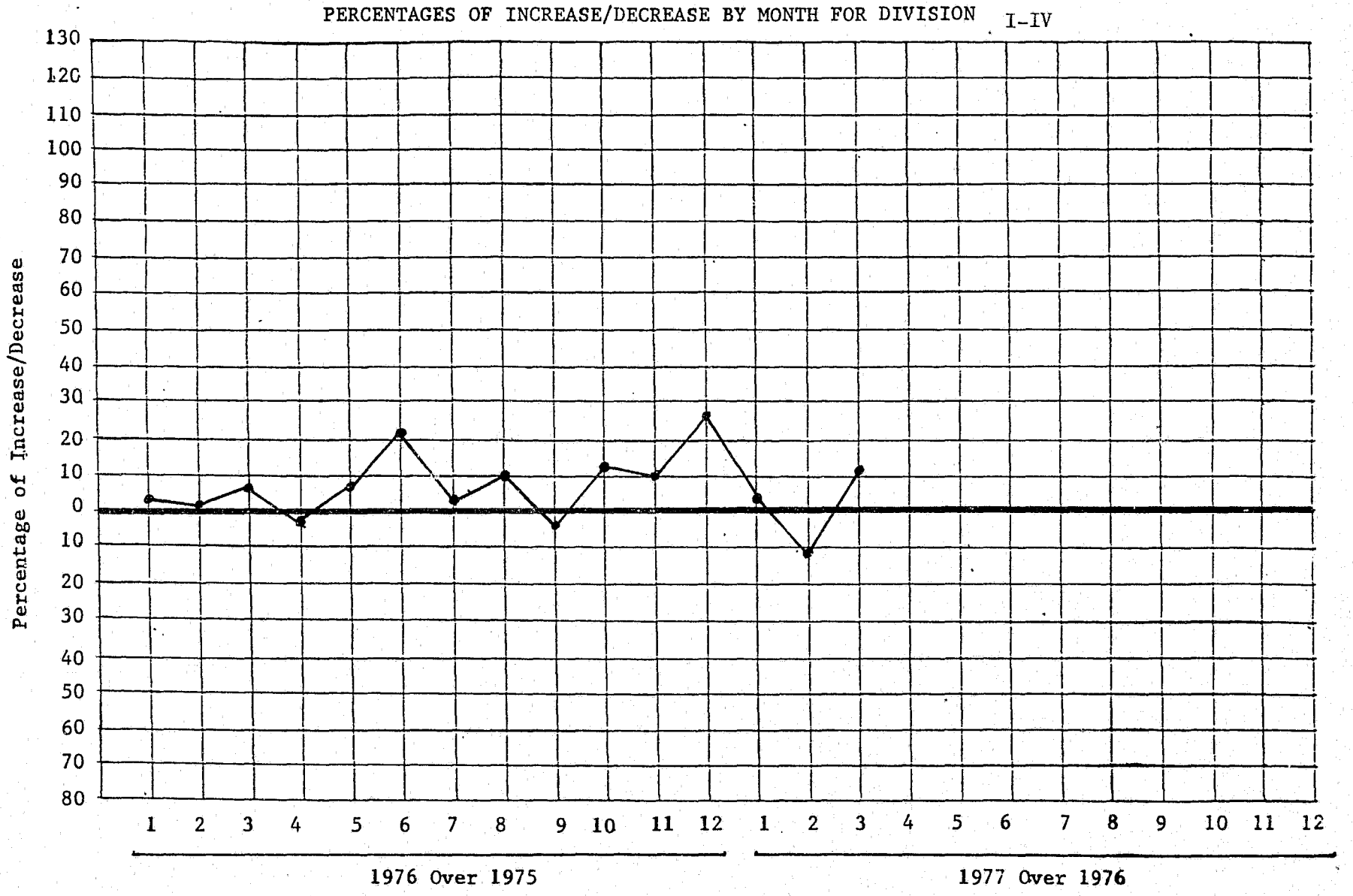
CHAPTER III

EVALUATION OF EXPERIMENT

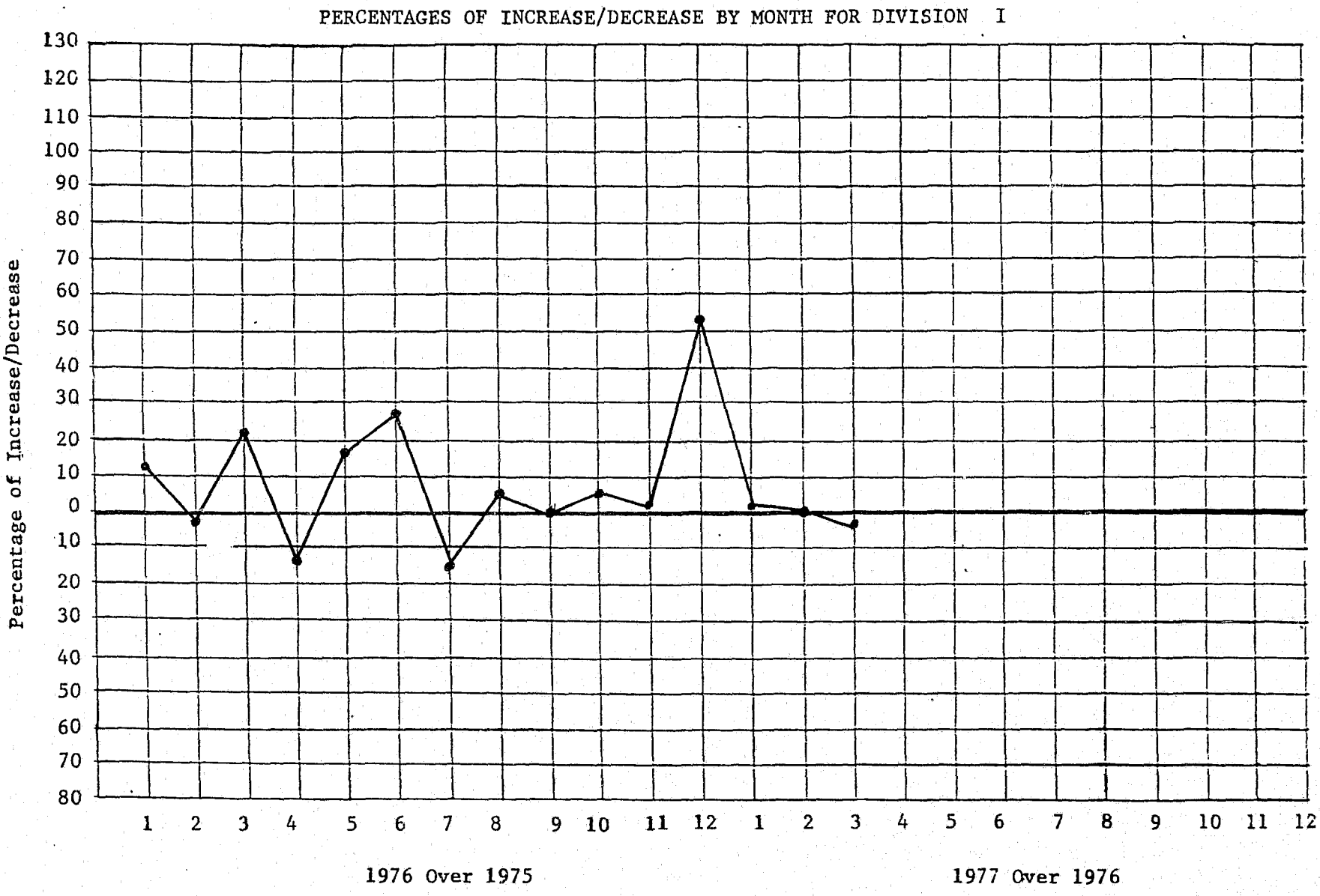
Section VII - Chi-Square Test

This section of the report examines and explains various statistical tests used to measure the difference between experimental and control groups. Merely, to examine the number of traffic accidents occurring in each division is not sufficient to explain whether variations between divisions are due to chance, or, to imperically determine if any reduction in the number of accidents actually occurred. The statistical tests examined in this section are designed to measure these differences, if any.

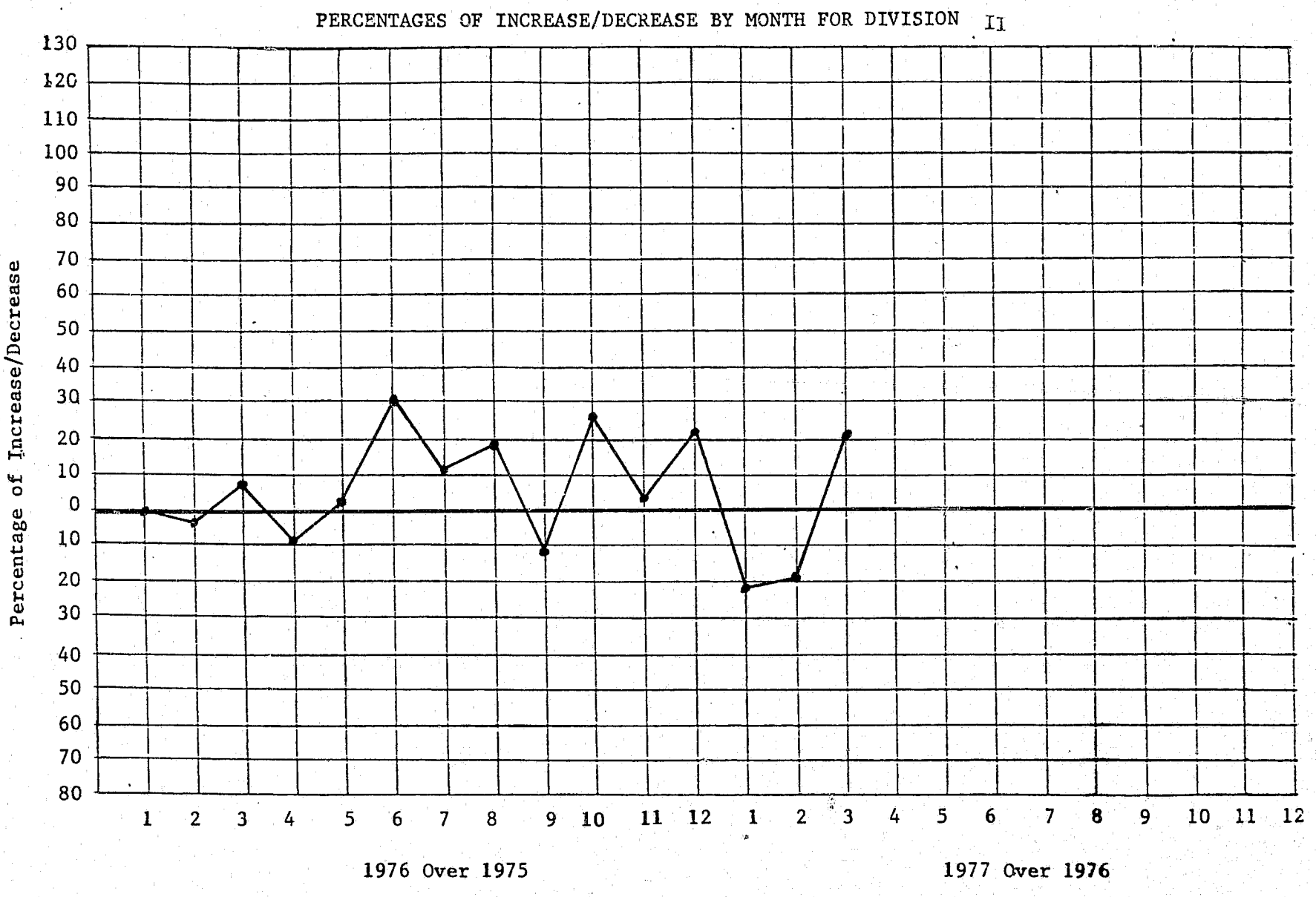
Graphs 7.1 through 7.5 are presented to show the percentages of increase or decrease by month for all divisions and each division separately. The graphs show the increase or decrease in public street accidents as compared to the same month of the previous year. For example, December, 1976, is compared with December, 1975. Graph 7.1 shows accident trends for the entire city. It is shown that traffic accidents demonstrate a substantial variance month by month. The remaining graphs show this variance month by month by division. Since there is so much variance, it is important to use statistical tests to actually determine the impact of our experiment.


PERCENTAGES OF INCREASE/DECREASE BY MONTH FOR DIVISION I-IV
Percentage of Increase/Decrease
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
1 2 3 4 5 6 7 8 9 10 11 12
1 2 3 4 5 6 7 8 9 10 11 12
1976 Over 1975
1977 Over 1976
Months

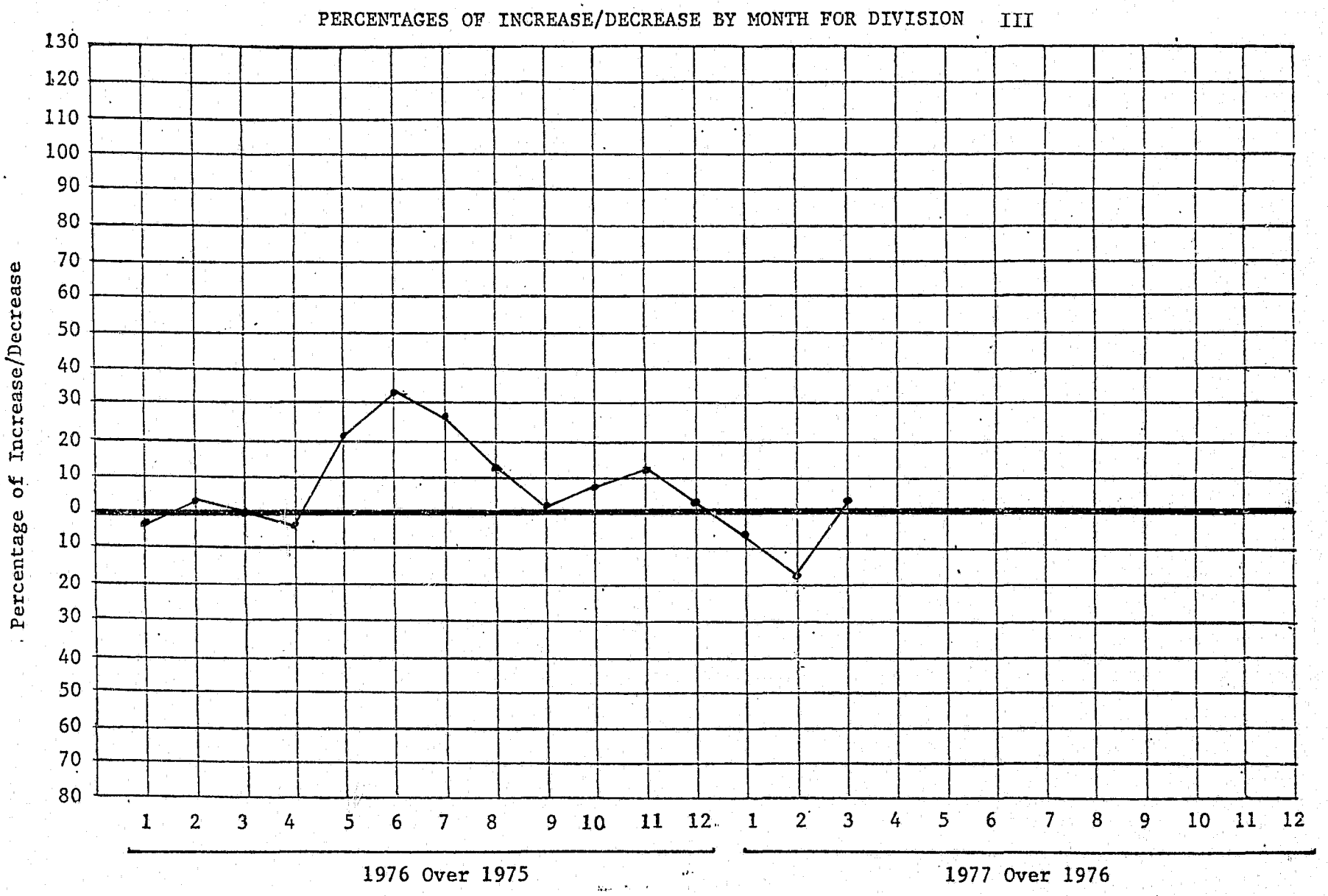
Graph 7.1


PERCENTAGES OF INCREASE/DECREASE BY MONTH FOR DIVISION I
Percentage of Increase/Decrease
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1976 Over 1975
1977 Over 1976
Months

Graph 7.2

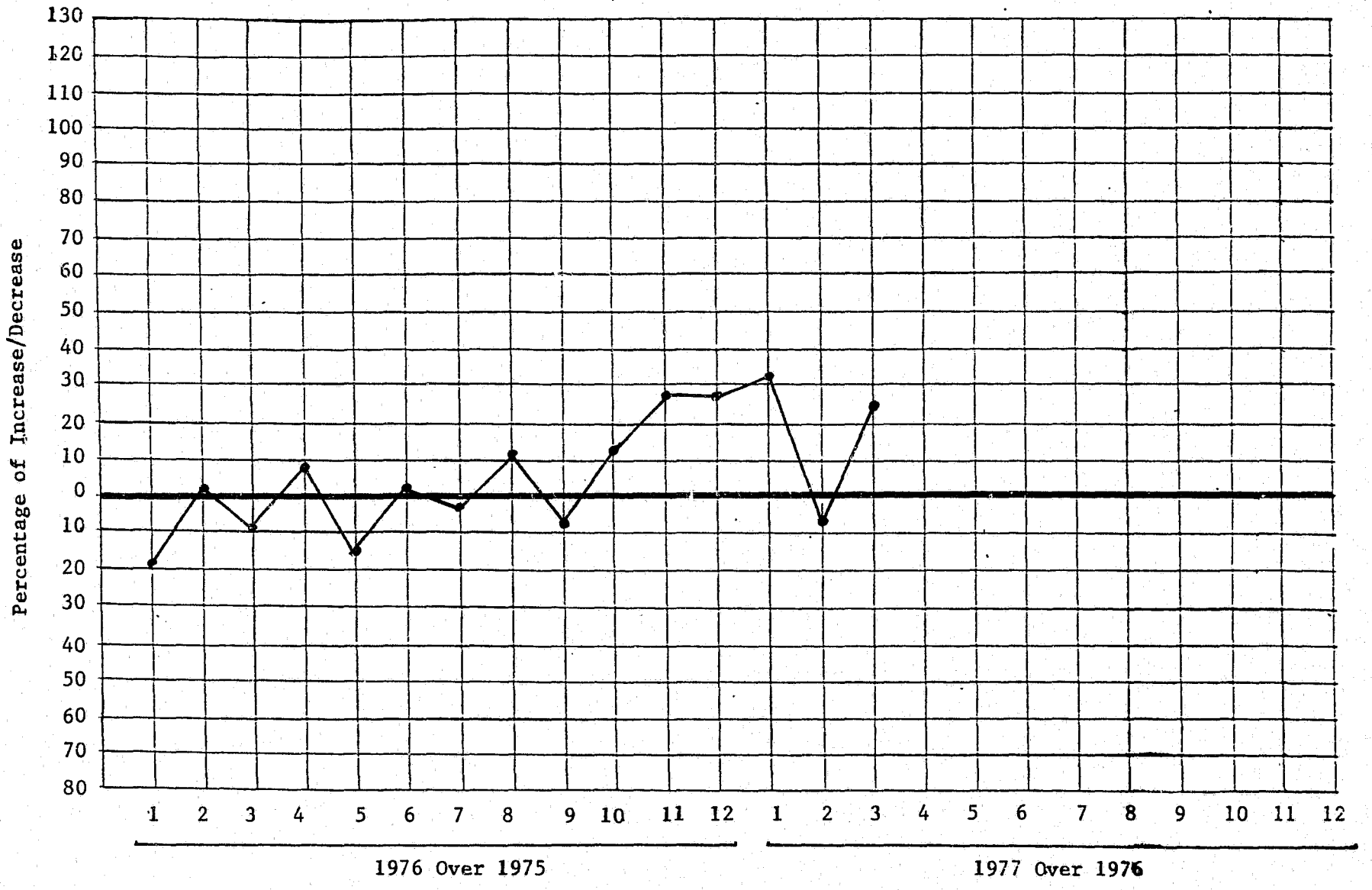

PERCENTAGES OF INCREASE/DECREASE BY MONTH FOR DIVISION II
Percentage of Increase/Decrease
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1976 Over 1975
1977 Over 1976
Months

Graph 7.3


PERCENTAGES OF INCREASE/DECREASE BY MONTH FOR DIVISION III
Percentage of Increase/Decrease
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
1 2 3 4 5 6 7 8 9 10 11 12
1 2 3 4 5 6 7 8 9 10 11 12
1976 Over 1975
1977 Over 1976
Months

Graph 7.4

PERCENTAGES OF INCREASE/DECREASE BY MONTH FOR DIVISION IV



Graph 7.5

The first statistical test utilized in this evaluation is the chi-square test; a very general test which is used to evaluate whether or not frequencies which have been actually observed differ significantly from those which would be expected under a certain set of theoretical assumptions. Therefore, a measure of the difference between observed and expected frequencies is obtained by utilizing the chi-square using the formula:

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

Since the observed frequencies are not likely to equal the expected frequencies exactly, the chi-square will rarely be 0 so a significant level of difference is set with the hypothesis. As the difference between the observed and expected frequencies increase, the value of the chi-square also increases, which, in turn, increases the probability that the null hypothesis will be rejected. A large chi-square will tend to reject or discredit the null hypothesis while a small value of chi-square will tend to credit or uphold the null hypothesis, leading to its acceptance. Because the chi-square values are not likely to be 0, a measure of its significance is obtained by the degrees of freedom calculated as $(r - 1)(c - 1)$ and the probability of making an error.

First, an examination was made of the number of accidents occurring during the test periods as compared to the number of accidents oc-

curring during the previous year. The chi-square test was performed, using the following formula for expected frequencies:

$$\frac{(n \text{ column}) \cdot (n \text{ row})}{N}$$

Table 7.1 is a table of the chi-square values and the levels of significance for accidents during the test periods. Compared with the previous years accidents, the difference between observed and expected frequencies were significant in the December/January test at the .10 and .05 significant levels, respectively. These values indicate that there was a significant difference in the number of accidents observed and in the number of accidents that was expected. The chi-square values of for the February and March experiments were significant at the .70 level. This value indicates there was not a significant difference between the number of accidents observe and the number of accidents that were expected during these two months.

TABLE 7.1

TABLE OF CHI-SQUARE VALUES AND LEVELS OF SIGNIFICANCE FOR ACCIDENTS DURING TEST PERIODS COMPARED WITH PREVIOUS YEAR'S ACCIDENTS*

Dec.		Jan.		Feb.		Mar.	
χ^2	Sig. Level	χ^2	Sig. Level	χ^2	Sig. Level	χ^2	Sig. Level
6.665	.10	8.600	.05	2.190	.70	1.693	.70

*Df = 3 for each month

TABLE 7.2

TABLE OF EXPECTED FREQUENCY PERCENTAGES BY MONTH FOR EACH DIVISION

	Dec. 1975		Jan. 1975	
	N	%	N	%
I	120	20.91	112	22.90
II	129	22.47	106	21.68
III	163	28.40	139	28.43
IV	162	28.22	132	26.99
Total	574	100.00	489	100.00

	Feb. 1976		Mar. 1976	
	N	%	N	%
I	111	22.24	141	26.36
II	105	21.04	113	21.12
III	146	29.26	142	26.54
IV	137	27.46	139	25.98
Total	499	100.00	535	100.00

Table 7.2 shows the expected frequency percentages by month for each division which can be used in additional chi-square tests. This table is given for documentation to show that the expected frequencies used in the following chi-square tests were not arbitrary figures. The table shows the total number of accidents for the city for December,

1975, through March, 1976, and the percentage of this total by division. Because there are demographic variances and frequency variances, each division was computated separately for each month. It can be noticed that these percentages are very similar by division for each month. The expected frequencies in the chi-square test were determined by these exact percentages because of the different variances. For example, Division III may have more accidents in December than in March because of Christmas shopping at the Four Seasons Mall. Therefore, using these exact percentages would account for time and demographic differences in divisions.

Statistical computation sheets, 7.1 through 7.4, give the chi-square computation for each experimental group during each month.

TABLE 7.3

SUMMARY OF CHI-SQUARE VALUES AND LEVELS OF SIGNIFICANCE BY DIVISION, DECEMBER, 1976, THROUGH MARCH, 1977

	Exp. Gp.	Control Gp.		Level of Significance
Dec.	Div. III	All Divisions	15.591	.01
		I	14.480	.001
		II	6.229	.02
		IV	6.328	.02
Jan.	Div. I	All Divisions	14.104	.01
		II	4.505	.05
		III	.873	.50
		IV	8.747	.01
Feb.	Div. III	All Divisions	4.338	.30
		I	3.306	.10
		II	1.764	.20
		IV	.975	.50
Mar.	Div. I	All Divisions	3.666	.30
		II	3.428	.10
		III	2.291	.20
		IV	2.517	.20

STATISTICAL COMPUTATION SHEET 7.1

Chi-Square for December

	Observed Frequency	Expected Frequency
Div I	184	148
Div II	169	160
Div III	168	202
Div IV	189	200

$$\chi^2_K = \frac{(168 - 202)^2}{202} + \frac{(184 - 148)^2}{148} + \frac{(169 - 160)^2}{160} + \frac{(189 - 200)^2}{200} = 15.591 \quad \nu = 3$$

$$\chi^2_I = \frac{(168 - 202)^2}{202} + \frac{(184 - 148)^2}{148} = 14.480 \quad \nu = 1$$

$$\chi^2_{II} = \frac{(168 - 202)^2}{202} + \frac{(169 - 160)^2}{160} = 6.229 \quad \nu = 1$$

$$\chi^2_{IV} = \frac{(168 - 202)^2}{202} + \frac{(189 - 200)^2}{200} = 6.328 \quad \nu = 1$$

STATISTICAL COMPUTATION SHEET 7.2

Chi-Square for January

Observed Frequency		Expected Frequency
Div I	92	93
Div II	69	89
Div III	106	116
Div IV	141	110

$$\chi^2_K = \frac{(92 - 93)^2}{93} + \frac{(69 - 89)^2}{89} + \frac{(106 - 116)^2}{116} + \frac{(141 - 110)^2}{110} = 14.104 \quad \nu = 3$$

$$\chi^2_{II} = \frac{(92 - 93)^2}{93} + \frac{(69 - 89)^2}{89} = 4.505 \quad \nu = 1$$

$$\chi^2_{III} = \frac{(92 - 93)^2}{93} + \frac{(106 - 116)^2}{116} = .873 \quad \nu = 1$$

$$\chi^2_{IV} = \frac{(92 - 93)^2}{93} + \frac{(141 - 110)^2}{110} = 8.747 \quad \nu = 1$$

STATISTICAL COMPUTATION SHEET 7.3

Chi-Square for February

	Observed Frequency	Expected Frequency
Div I	106	91
Div II	78	87
Div III	110	120
Div IV	117	113

$$\chi^2_K = \frac{(110 - 120)^2}{120} + \frac{(106 - 91)^2}{91} + \frac{(78 - 87)^2}{87} + \frac{(117 - 113)^2}{113} = 4.338 \quad \nu = 3$$

$$\chi^2_I = \frac{(110 - 120)^2}{120} + \frac{(106 - 91)^2}{91} = 3.306 \quad \nu = 1$$

$$\chi^2_{II} = \frac{(110 - 120)^2}{120} + \frac{(78 - 87)^2}{87} = 1.764 \quad \nu = 1$$

$$\chi^2_{IV} = \frac{(110 - 120)^2}{120} + \frac{(117 - 113)^2}{113} = .975 \quad \nu = 1$$

STATISTICAL COMPUTATION SHEET 7.4

Chi-Square for March

Observed Frequency		Expected Frequency
Div I	139	158
Div II	138	126
Div III	160	159
Div IV	161	155

$$\chi^2_K = \frac{(139 - 158)^2}{158} + \frac{(138 - 126)^2}{126} + \frac{(160 - 159)^2}{159} + \frac{(161 - 155)^2}{155} = 3.666 \quad \nu = 3$$

$$\chi^2_{II} = \frac{(139 - 158)^2}{158} + \frac{(138 - 126)^2}{126} = 3.428 \quad \nu = 1$$

$$\chi^2_{III} = \frac{(139 - 158)^2}{158} + \frac{(160 - 159)^2}{159} = 2.291 \quad \nu = 1$$

$$\chi^2_{IV} = \frac{(139 - 158)^2}{158} + \frac{(161 - 155)^2}{155} = 2.517 \quad \nu = 1$$

Table 7.3 is a summary of chi-square values and levels of significance by division for December through March.

The level of significance is the probability of making a type I error, rejecting a true hypothesis. Assuming the hypothesis is true, the level of significance sets the probability that the experimenter will get data that will fall in the rejection region. A level of significance of $\alpha = .05$ means the probability of obtaining this type data and of making a type I error is 5/100, or one in twenty times. Conversely, the experimenter or statistian will obtain correct data 95 percent of the time. This is to say that, even with sophisticated formulas, one cannot be 100 percent sure of the findings. However, these are the best, and most scientific means of analyzing data.

With the level of significance set at .05 or above, chi-square values for December and January were all significant with the exception of the chi-square between Division I and Division III for January. At this level of significance, none of the chi-square values are significant for experiments conducted in February and March. These chi-square values are in agreement with those presented in Table 7.1.

Section VIII - T-Test

A t-test was made to substantiate the findings of the chi-square test. The t-test is a statistical test that determines the significant degree of difference between two sample means considering the population mean and variances corresponding to each sample. This test attempts to measure the difference between the experimental and control groups. This is more sensitive statistical test than the chi-square and attempts to distinguish the difference between group means. The test relies on the difference between sample means, the difference between population means, and the difference of standard deviations which are estimated from the sample data. The following t-formula was used:

$$t = \frac{\bar{D} - (\mu_{\bar{x}} - \mu_{\bar{y}})}{\sqrt{\frac{\Sigma D^2 - \frac{(\Sigma D)^2}{N}}{N - 1}}{\sqrt{N}}}$$

This t-test formula was used to define the difference between two correlated or dependent scores. This particular formula was chosen becuase all divisions are considered to be correlated, although the correlation may be small, since all divisions are in the same geographic environment. Traffic related variables, as day of the week, rain, hot or cold weather conditions (etc.) occur simultaneously in all divisions and, therefore, all divisions are correlated. Table

8.1 shows the t-values at levels of significance for experimental and control groups by month. The level of significance for this two tailed test was set at .05 which means that only two tests showed any significant difference, that is, the t-test between experimental group, Division I, and control group, Division IV, for January, and between experimental group, Division III, and control group, Division II, for February.

TABLE 8.1

TABLE OF T-VALUES AT LEVELS OF SIGNIFICANCE FOR EXPERIMENTAL AND CONTROL GROUPS FOR DECEMBER, 1976, THROUGH MARCH, 1977

	E	C	α = .50	α = .50	α = .20	α = .10	α = .05	α = .02	α = .01	α = .001
Dec.	III	I		.689						
		II	Ø							
		IV	.866							
	2 = 30									
Jan.	I	II			-1.610					
		III		.924						
		IV							2.895	
Feb.	III	I	-.302							
		II							-2.940	
		IV	.452							
	V = 26									
Mar.	I	II	-.056							
		III			1.378					
		IV			1.408					
	V = 30									

Section IX - Z-Test

Because of the differences between the levels of chi-square tests and t-tests, a Z-test was made which is similar to the t-test. The main difference between the two tests is that the standard deviation is estimated from sample data when using the t-test. The Z-test is conducted when the standard deviation of the populations are known, which have been calculated on statistical sheet 9.1. Table 9.1 gives statistical summaries of each division that was used in calculating the standard deviation using the formula given on the statistical computation sheet, 9.1.

TABLE 9.1

STATISTICAL SUMMARY ALL DIVISIONS DECMBER-MARCH

Div.	ΣX	N	μ	$(\Sigma X)2$	$\Sigma X2$
I	521	114	4.5702	271441	3183
II	454	114	3.9825	206116	2567
III	544	114	4.7719	295936	3548
IV	608	114	5.3333	369664	4100

In computing Z-scores, it is necessary to have the population mean, the sample mean, and the population standard deviation. Table 9.2 gives the additional information necessary for the Z-score computation which is the total number of accidents and the mean for each sample during each experimental month.

TABLE 9.2

PUBLIC STREET ACCIDENTS AND MEANS FOR ALL DIVISIONS
DECEMBER - MARCH WITHOUT SNOW DAYS

	I	$\bar{X}$	II	$\bar{X}$	III	$\bar{X}$	IV	$\bar{X}$
Dec. N=31	184	5.9355	169	5.4516	168	5.4194	189	6.0968
Jan. N=25	92	3.6800	69	2.7600	106	4.2400	141	5.6400
Feb. N=27	106	3.9259	78	2.8889	110	4.0741	117	4.3334
Mar.	139	4.4839	138	4.4516	160	4.1613	161	5.1935

Totals

Dec.	710
Jan.	408
Feb.	411
Mar.	598

As previously stated, the Z-score resembles the t-test with the exception that the standard deviation is known and used in the formula. The following formula is used in computing the Z-scores:

$$Z = \frac{(\bar{X} - \bar{Y}) - (\mu_{\bar{x}} - \mu_{\bar{y}})}{\sqrt{\frac{\sigma_x^2}{N_x} + \frac{\sigma_y^2}{N_y}}}$$

The hypothesis given on the computation sheets state that (a) the mean of X is equal to the mean of Y, that there is no difference; or (b) the mean of X is not equal to the mean of Y, that there is some difference between the two means.

In stating that Z-scores use the known population standard deviation is to say this formula accounts for variances within each sample tested. As was previously noted, Division III historically has more accidents than Divisions I, II, and IV. Each division has its different characteristics which include the total number of accidents occurring within that division. This formula accounts for the differences and the variances between divisions and, therefore, is a more sensitive and appropriate test in validating the chi-square values.

Table 9.3 is a table of Z-scores that have been computed on statistical computation sheets, 9.2 through 9.5.

TABLE 9.3

TABLE OF Z SCORES

$\alpha = .05$

	E	C	Accept H_0	Accept H_1
		I		-1.96
Dec.	III	II		-2.26
		IV	- .312	
		II	.961	
Jan.	I	III	.974	
		IV		-3.349
		I	- .146	
Feb.	III	II	1.092	
		IV	-. 808	
		II	1.600	
Mar.	I	III		2.394
		IV	1.494	

STATISTICAL COMPUTATION SHEET 9.1

Population Standard Deviations For All Divisions December 1976 through March 1977

$$\sigma = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N}}$$

Division I

$$\sigma_I = \sqrt{\frac{3183 - \frac{271441}{114}}{114}} = \sqrt{\frac{3183 - 2381.0614}{114}} = \sqrt{\frac{801.9386}{114}} = \sqrt{7.035} = 2.6524$$

Division II

$$\sigma_{II} = \sqrt{\frac{2567 - \frac{206116}{114}}{114}} = \sqrt{\frac{2567 - 1808.0351}{114}} = \sqrt{\frac{758.9649}{114}} = \sqrt{6.658} = 2.5803$$

Division III

$$\sigma_{III} = \sqrt{\frac{3548 - \frac{295936}{114}}{114}} = \sqrt{\frac{3548 - 2595.9298}{114}} = \sqrt{\frac{952.0702}{114}} = \sqrt{8.352} = 2.89$$

Division IV

$$\sigma_{IV} = \sqrt{\frac{4100 - \frac{369664}{114}}{114}} = \sqrt{\frac{4100 - 3242.6667}{114}} = \sqrt{\frac{857.333}{114}} = \sqrt{7.521} = 2.742$$

STATISTICAL COMPUTATION SHEET 9.2

Z-Scores for December

H_0: $\mu_X = \mu_Y$ $\quad \alpha = \frac{.05}{2}$ $\quad F(z) = .9750$, $z = 1.96$

H_1: $\mu_X \neq \mu_Y$

X = Division III, experimental group

Y = Divisions I, II, IV, control groups

Division III vs Division I

$$Z = \frac{(5.4194 - 5.9355) - (4.772 - 4.570)}{\sqrt{\frac{8.352}{114} + \frac{7.035}{114}}} = -1.96$$

Division III vs Division II

$$Z = \frac{(5.4194 - 5.4516) - (4.772 - 3.983)}{\sqrt{\frac{8.352}{114} + \frac{6.658}{114}}} = -2.26$$

Division III vs Division IV

$$Z = \frac{(5.4194 - 6.0968) - (4.772 - 5.333)}{\sqrt{\frac{8.352}{114} + \frac{7.521}{114}}} = -.3119$$

STATISTICAL COMPUTATION SHEET 9.3

Z-Scores for January

H_0: $\mu_x = \mu_y$ $\quad \alpha = \frac{.05}{2}$ $\quad F(z) = .9750$, $z = 1.96$

H_1: $\mu_x \neq \mu_y$

X = Division I, experimental group

Y = Divisions II, III, IV, control groups

Division I vs Division II

$$Z = \frac{(3.6800 - 2.7600) - (4.570 - 3.983)}{\sqrt{\frac{7.035}{114} + \frac{6.658}{114}}} = .9608$$

Division I vs Division III

$$Z = \frac{(3.6800 - 4.2400) - (4.570 - 4.772)}{\sqrt{\frac{7.035}{114} + \frac{8.352}{114}}} = -.9744$$

Division I vs Division IV

$$Z = \frac{(3.6800 - 5.6400) - (4.570 - 5.333)}{\sqrt{\frac{7.035}{114} + \frac{7.521}{114}}} = -3.349$$

CONTINUED

2 OF 3

STATISTICAL COMPUTATION SHEET 9.4

Z-Scores for February

H_0: $\mu_X = \mu_Y$ $\quad\quad$ $\alpha = \frac{.05}{2}$ $\quad\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_X \neq \mu_Y$

X = Division III, experimental group

Y = Division I, II, IV, control groups

Division III vs Division I

$$Z = \frac{(4.0741 - 3.9259) - (4.772 - 4.570)}{\sqrt{\frac{8.352}{114} + \frac{7.035}{114}}} = -.1464$$

Division III vs Division II

$$Z = \frac{(4.0741 - 2.8889) - (4.772 - 3.983)}{\sqrt{\frac{8.352}{114} + \frac{6.658}{114}}} = 1.0918$$

Division III vs Division IV

$$Z = \frac{(4.0741 - 4.3334) - (4.772 - 5.333)}{\sqrt{\frac{8.352}{114} + \frac{7.521}{114}}} = -.8084$$

STATISTICAL COMPUTATION SHEET 9.5

Z-Scores for March

H_0: $\mu_x = \mu_y$ $\quad$ $\alpha = \frac{.05}{2}$ $\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_x \neq \mu_y$

X = Division I, experimental group

Y = Divisions II, III, IV, control groups

Division I vs Division II

$$Z = \frac{(4.4839 - 4.4516) - (4.570 - 3.983)}{\sqrt{\frac{7.035}{114} + \frac{6.658}{114}}} = 1.600$$

Division I vs Division III

$$Z = \frac{(4.4839 - 5.1613) - (4.570 - 4.772)}{\sqrt{\frac{7.035}{114} + \frac{8.352}{114}}} = 2.394$$

Division I vs Division IV

$$Z = \frac{(4.4839 - 5.1935) - (4.570 - 5.333)}{\sqrt{\frac{7.035}{114} + \frac{7.521}{114}}} = -.1494$$

With a significant level of .05 and a two tailed test it can be seen that only four tests reached a level of significance. Three of those four tests were the results of experiments during December and January, one as a result of experiment in Division I during March. It should be noted, however, that the Z-score between Division I and Division III in March is in reverse order from the three above. This is, the test verifies that, in fact, significantly more accidents occurred in the experimental group than in the control groups.

Section X - Evaluation Design and Statistical Test

All the statistical tests described so far are simply comparing the experimental group with controlled groups during the month of the test. These tests are important to show the differences by month. However, additional tests are necessary to determine the overall effectiveness of the experiments.

TABLE 10.1

EXPERIMENTAL AND EVALUATION DESIGN FOR EXPERIMENT OF SATURATION/NORMAL TYPE PATROL AND MARKED/UNMARKED POLICE VEHICLES

Division IV	Division I
B Dec.- Mar.	A/C Jan. A/D Mar.
A/C Dec. A/D Feb.	B Dec.- Mar.
Division III	Division II

A = Saturation

B = Normal Type Patrol (No Saturation)

C = Unmarked Police Vehicles

D = Marked Police Vehicles

Table 10.1 shows the experimental and evaluation design for experiments of saturation/normal type patrol, and marked/unmarked police vehicles.

Essentially, this table is a visual representation of the City divided into four patrol divisions. It can be seen that Divisions II and IV remained as control groups throughout the experiment. Division III used a saturation patrol in unmarked vehicles in December and a saturation type patrol in marked police vehicles in February. Division I used a saturation type patrol in unmarked police vehicles in January and a saturation type patrol with marked vehicles in March.

Table 10.2 is an evaluation matrix showing six different statistical tests which will be used to evaluate the experiments. Test 1 evaluates the saturation type patrol vs. the normal type patrol. To test the difference, the experimental group for each of the four months is combined and compared against the two control groups for the four month period. That is, Division III in December and February was combined with Division I for January and March, and compared with Divisions II and IV for December through March.

TABLE 10.2

EVALUATION MATRIX

Test 1: A vs. B

A = Div. III, Dec./Feb. & Div. I, Jan./Mar.
B = Div. II & Div. IV, Dec.-Mar.

Test 2: A/C vs. B

A = Div. III, Dec. & Div. I, Jan.
B = Div. II & Div. IV, Dec.-Mar.

Test 3: A/D vs. B

A = Div. III, Feb. & Div. I, Mar.
B = Div. II & Div. IV, Dec.-Mar.

Test 4a: C vs. D

A = Div. III, Dec.
B = Div. III, Feb.

Test 4b: C vs. D

A = Div. I, Jan.
B = Div. I, Mar.

Test 4c: C vs. D

A = Div. III, Dec. & Div. I, Jan.
B = Div. III, Feb. & Div. I, Mar.

Test 2 compares a saturation type patrol in unmarked police vehicles with a normal type patrol. The two experimental groups, using a saturation patrol in unmarked police vehicles are compared against the two control groups. Division III in December and Division I in

January are combined, and compared with control groups, Divisions II and IV, December through March.

Test 3 compares a saturation type patrol in marked police vehicles with a normal type patrol. The experimental groups, using the saturation type patrol in marked police vehicles were compared with the control groups, using a normal type patrol. Division III for February and Division I for March were combined and compared against Division II and Division IV, December through March, which were the control groups.

Test 4a through 4c are designed to compare the experiment group using unmarked police vehicles vs. marked police vehicles. Test 4a compares Division III for December, using unmarked police vehicles with Division III for February, using marked police vehicles. Since these experiments were repeated in Division I, so was the statistical test to evaluate the experiment in Test 4b. Division I for January, using an unmarked police vehicle was compared against Division I in March using marked police vehicles.

Test 4c combines the two month period where unmarked police vehicles were used and was compared with the two month period when marked police vehicles were used. Division III for December and Division I for January are combined, and compared against Division III for February and Division I for March.

Statistical computation sheets 10.1 through 10.6 show computations of z-scores for test 1 through test 4c. The hypothesis, and therefore the z-formula, are slightly different for these scores than for previous z-scores. The null hypothesis state that the difference between population means is zero, or, that there is no difference between population means. The alternative hypothesis states that the difference between populations is not zero, or, that there is some difference between the group means.

The different z-formula is shown on the computation sheets. The difference between the two z-formulas is that the first is testing the difference between sample means and the latter is testing the difference between population means. In the first computation of z-scores, individual groups were compared with each other one at a time. With the z-scores now being described, groups are combined and then compared with two or more groups or, compared with the same group at a different time (for example, test 4a through 4c). In these tests, differences between sample means cannot be subtracted from the differences in population means; instead, one mean is used as the population mean and subtracted from zero.

The probability of a type I error was set at .05. Since, according to the hypothesis, these were two-tailed tests, the significant level is .025 at either end of the probability curve, hence, $F(z) = .9750$ and the corresponding z-value is $z = 1.96$.

Table 10.2 is a summary of z-scores for test 1 through test 4c. All null hypotheses were accepted; no alternative hypotheses were accepted. This

STATISTICAL COMPUTATION SHEET 10.1

Z-Scores for Test 1

H_0: $\mu_A - \mu_B = 0$ $\quad\quad$ $\alpha = \frac{.05}{2}$ $\quad\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_A - \mu_B \neq 0$

$_A$ = Division I, January/March & Division III, December/February

$_B$ = Divisions II & IV, December - March

$\mu_A = 509 \div 114 = 4.465$

$\mu_B = 1062 \div 228 = 4.658$

$$\sigma_A^2 = \frac{3083 - \frac{259081}{114}}{114} = 7.108$$

$$\sigma_B^2 = \frac{6667 - \frac{1127844}{228}}{228} = 7.545$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(4.465 - 4.658) - 0}{\sqrt{\frac{7.108}{114} + \frac{7.545}{228}}} = -.625$$

STATISTICAL COMPUTATION SHEET 10.2

Z-Scores for Test 2

H_0: $\mu_A - \mu_B = 0$ $\quad$ $\alpha = \frac{.05}{2}$ $\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_A - \mu_B \neq 0$

A = Division I, January & Division III, December

B = Divisions II & IV, December - March

$\mu_A = 276 \div 56 = 4.929$

$\mu_B = 1062 \div 228 = 4.658$

$$\sigma_A^2 = \frac{1814 - \frac{76176}{56}}{56} = 8.102$$

$$\sigma_B^2 = \frac{6667 - \frac{1127844}{228}}{228} = 7.545$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(4.929 - 4.658) - 0}{\sqrt{\frac{8.102}{56} + \frac{7.545}{228}}} = .643$$

STATISTICAL COMPUTATION SHEET 10.3

Z-Scores for Test 3

H_0: $\mu_A - \mu_B = 0$ $\quad\quad$ $\alpha = \frac{.05}{2}$ $\quad\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_A - \mu_B \neq 0$

A = Division I, March & Division III, February

B = Divisions II & IV, December - March

$\mu_A = 249 \div 58 = 4.293$

$\mu_B = 1062 \div 228 = 4.658$

$$\sigma_A^2 = \frac{1269 - \frac{62001}{58}}{58} = 3.446$$

$$\sigma_B^2 = \frac{6667 - \frac{1127844}{228}}{228} = 7.545$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(4.293 - 4.658) - 0}{\sqrt{\frac{3.446}{58} + \frac{7.545}{228}}} = -1.200$$

STATISTICAL COMPUTATION SHEET 10.4

Z-Scores for Test 4a

H_0: $\mu_A - \mu_B = 0$ $\quad$ $\alpha = \frac{.05}{2}$ $\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_A - \mu_B \neq 0$

A = Division III, December

B = Division III, February

$\mu_A = 5.4194$

$\mu_B = 4.0741$

$$\sigma_A^2 = \frac{1326 - \frac{28224}{31}}{31} = 13.405$$

$$\sigma_B^2 = \frac{512 - \frac{12100}{27}}{27} = 2.365$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(5.4194 - 4.0741) - 0}{\sqrt{\frac{13.405}{31} + \frac{2.365}{27}}} = 1.865$$

STATISTICAL COMPUTATION SHEET 10.5

Z-Scores for Test 4b

H_0: $\mu_A - \mu_B = 0$

H_1: $\mu_A - \mu_B \neq 0$

$\alpha = \frac{.05}{2}$

$F(z) = .9750$

$z = 1.96$

A = Division I, January

B = Division I, March

$\mu_A = 3.6800$

$\mu_B = 4.4839$

$$\sigma_A^2 = \frac{488 - \frac{8464}{25}}{25} = 5.978$$

$$\sigma_B^2 = \frac{757 - \frac{19321}{31}}{31} = 4.314$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(3.6800 - 4.4839) - 0}{\sqrt{\frac{5.978}{25} + \frac{4.314}{31}}} = -1.307$$

STATISTICAL COMPUTATION SHEET 10.6

Z-Scores for Test 4c

H_0: $\mu_A - \mu_B = 0$ $\quad$ $\alpha = \frac{.05}{2}$ $\quad$ $F(z) = .9750$, $z = 1.96$

H_1: $\mu_A - \mu_B \neq 0$

A = Division III, December & Division I, January

B = Division III, February & Division I, March

$\mu_A = 260 \div 56 = 4.643$

$\mu_B = 249 \div 58 = 4.293$

$$\sigma_A^2 = \frac{1814 - \frac{67600}{56}}{56} = 10.837$$

$$\sigma_B^2 = \frac{1269 - \frac{62001}{58}}{58} = 3.449$$

$$Z = \frac{(\mu_A - \mu_B) - 0}{\sigma_{\bar{A} - \bar{B}}} = \frac{(4.643 - 4.293) - 0}{\sqrt{\frac{10.837}{56} + \frac{3.449}{58}}} = .6958$$

means that no differences were shown, in either direction of the curve, between the group means tested. Allowing for error by using a .05 level of significance, the differences between the group means for each test equals zero. There are neither more accidents, nor fewer accidents, between the experimental and control groups tested.

TABLE 10.3

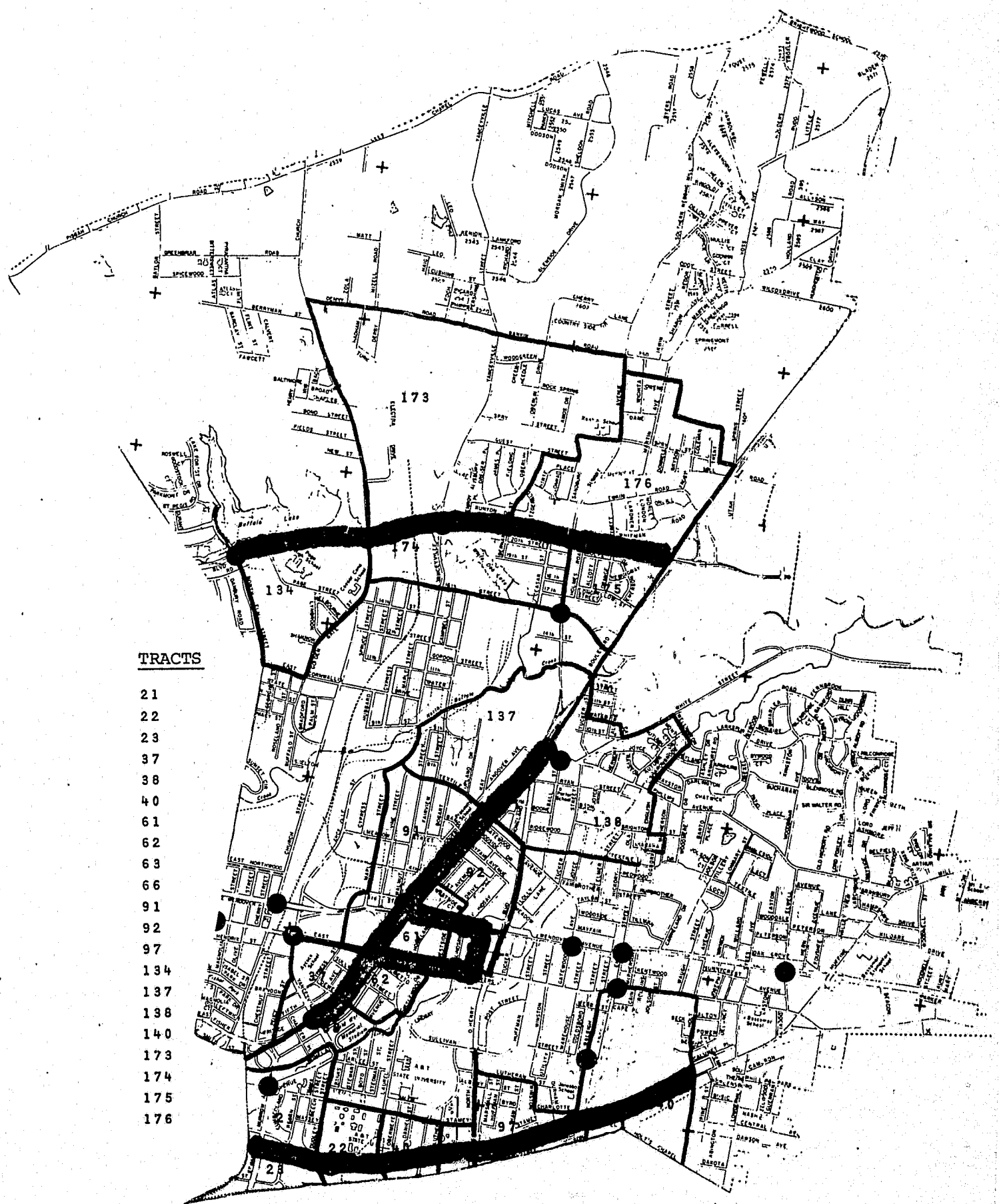
TABLE OF Z-SCORES FOR TEST 1 THROUGH 4

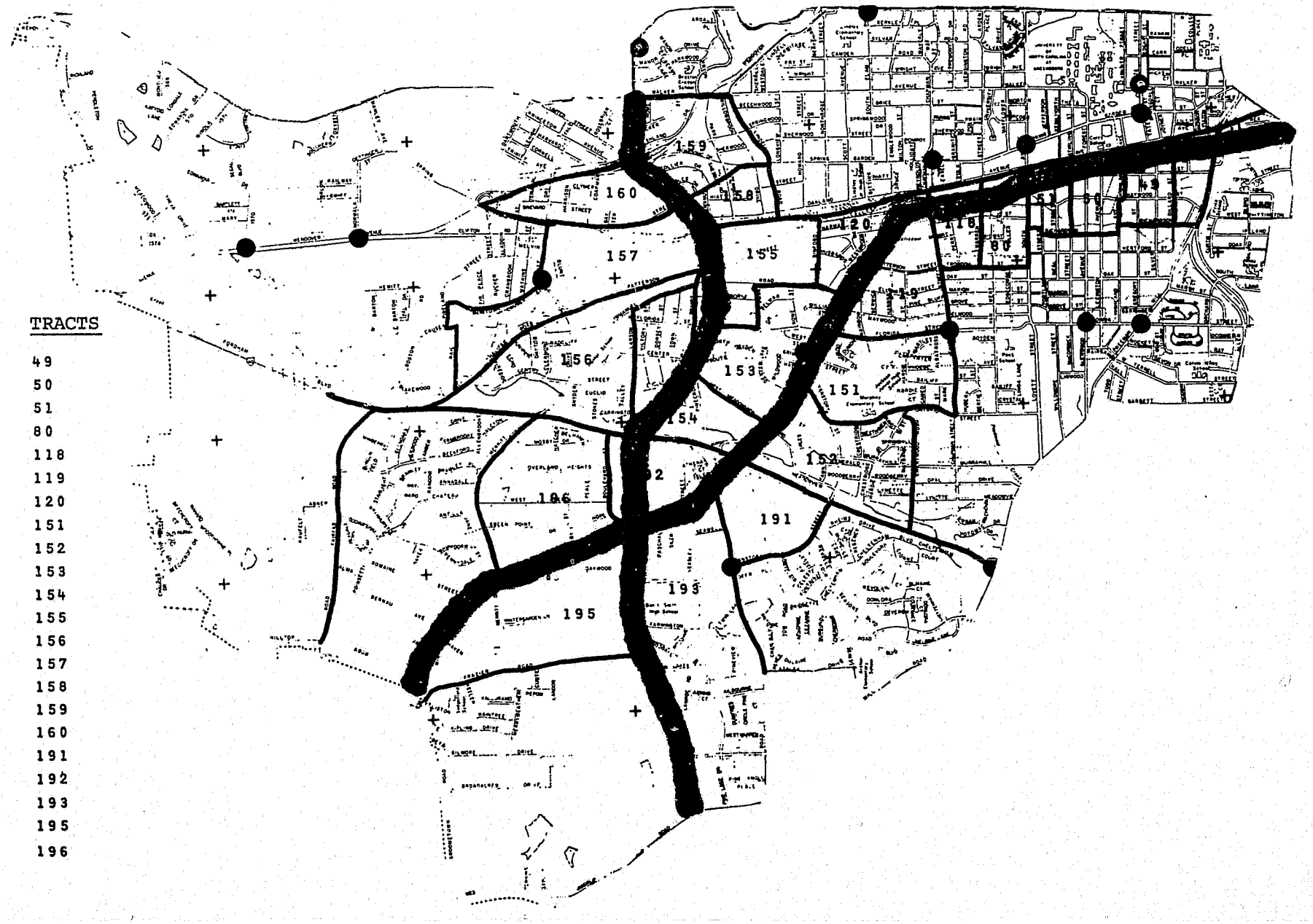
Test	Accept H_0	Accept H_1
1	- .625	
2	.643	
3	-1.200	
4a	1.799	
4b	1.400	
4c	.696	

Section XI - Demographic Analysis

Field implementation of the experimental design is an important part of the experiment; this section of the report documents that the field operations of the experiment were in accordance with this design and to describe demographic variances between the two experimental groups. These demographic differences and the subsequent assignment of patrol personnel constitutes an experiment in itself.

DIAGRAM 11.1


TRACTS
21
22
23
37
38
40
61
62
63
66
91
92
97
134
137
138
140
173
174
175
176


TRACTS
49
50
51
80
118
119
120
151
152
153
154
155
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160
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192
193
195
196

DIAGRAM 11.2

In effect, the City of Greensboro was a laboratory. Divisions III and I were experimental groups and Divisions II and IV were control groups. Since it would be quite impractical to saturate an entire division which, of course, would not be within the scope of a selective traffic enforcement program, certain areas within the experimental group were designated to receive the saturated type patrol, which was previously described. Diagrams 11.1 and 11.2 illustrate Divisions I and III; the areas receiving the concentration of the saturation patrol are shaded. The police tracts that surround these areas are also designated in the diagrams and are listed in the margin.

Tables 11.1 and 11.2 show the number of arrests and accidents by selected tracts for Divisions I and III. These police tracts are designated on each accident report and traffic arrest made within the city and they are the best means to document the Field Operations in this experiment. It should be noted, however, that these statistics will include some areas outside the saturation patrol since the tracts encompass more territory than was actually covered during the experiment.

There were 112 accidents in Division I in December, 90 in January, 70 in February, and 107 in March. Of all accidents in Division I by month, this represents 48 percent, 48 percent, 46 percent, and 52 percent, respectively. There were 147 accidents in Division III

for December, 98 in January, 83 in February, and 109 in March. Of all accidents in Division III by month, this represents 61 percent, 43 percent, 49 percent, and 57 percent, respectively. With simple examination of these percentages, it can be seen that these percentages do not decrease any significant degree during the experimental month for these divisions. The differences between the experimental and control groups had been well documented previously. The purpose of these percentages is to document that a saturation type patrol was utilized in those areas within the experimental division where most traffic accidents occur.

TABLE 11.1

ARRESTS AND ACCIDENTS BY TRACT FOR DIVISION I

Tract	Dec. 76		Jan. 77		Feb. 77		Mar. 77	
	Arr.	Acc.	Arr.	Acc.	Arr.	Acc.	Arr.	Acc.
21	12	4	22	6	10	4	53	4
22	2	1	18	4	3	2	36	6
23	5	3	12	3	10	1	28	3
37	4	4	9	1	4	1	13	3
38	6	6	12	3	4	2	2	1
40	1	1	3	4	1	0	2	2
61	8	19	27	6	4	6	22	7
62	7	8	20	2	3	2	17	5
63	4	3	15	3	3	1	10	6
66	1	1	2	3	1	0	7	0
91	9	12	28	4	15	8	25	4
92	7	7	18	2	10	3	41	7
97	2	6	3	6	5	6	9	9
134	3	8	12	10	11	12	14	14
137	3	3	6	2	0	3	30	1
138	19	6	17	8	7	2	45	9
140	5	4	10	2	4	5	94	7
173	5	2	6	3	8	3	6	9
174	3	1	11	5	4	4	8	6
175	11	5	37	4	16	2	39	0
176	11	8	28	9	21	3	38	4
TOTAL	128	112	316	90	144	70	539	107

TABLE 11.2

ARRESTS AND ACCIDENTS BY TRACT FOR DIVISION III

Tract	Dec. 76 Arr.	Dec. 76 Acc.	Jan. 77 Arr.	Jan. 77 Acc.	Feb. 77 Arr.	Feb. 77 Acc.	Mar. 77 Arr.	Mar. 77 Acc.
49	7	5	8	2	3	3	6	4
50	9	0	5	3	9	2	3	5
51	11	2	3	0	6	1	4	3
80	5	4	3	0	8	3	3	7
118	13	0	4	2	7	2	3	3
119	20	9	13	7	60	7	21	6
120	8	5	2	0	16	2	5	2
151	11	10	4	2	8	3	7	6
152	26	2	9	6	26	5	5	3
153	39	8	11	4	66	11	14	6
154	6	4	10	4	12	2	5	1
155	14	1	4	2	9	1	3	0
156	9	4	12	5	17	4	7	8
157	6	7	6	7	11	5	7	3
158	2	5	3	2	2	1	4	5
159	14	7	6	4	30	3	7	5
160	4	5	2	1	8	1	6	3
191	29	36	6	10	17	9	8	15
192	26	5	17	7	42	3	19	7
193	28	5	15	8	41	4	10	5
195	13	9	13	16	17	4	18	5
TOTAL	327	147	167	98	473	83	181	109

Because geographic and demographic differences exist in Divisions I and III, the areas of patrol were designed differently. Patrol areas and techniques have been previously explained in this report, but without reason or justification. Justification is given in the above paragraph; no other linear patrol could be designed to include as many selected intersections or as many high frequency accident locations. In other words, the areas of patrol were those areas where most accidents occur in the respective division. The percentages of accidents not accounted for include accidents spread throughout the remaining parts of the divisions and are not concentrated in specific areas. It is conceivable that an accident will occur at most intersections in the city at some point in time. However, in accordance with selective enforcement, the areas where more accidents occur received most of the patrol. In addition, patrol assignmnets were linearly designed to provide maximum effect of the saturation patrol.

As shown in the diagrams, this linear design was better accomplished in Division III than in Division I. Two main streets received most of the patrol in Division III, High Point Road, running east and west; and Holden Road running north and south. More than 53 percent of the selected intersections in Division III were located on these two streets. Therefore, most of the patrol officers were concentrated on these two streets.

In Division I, the patrol design was divided into four areas and, consequently, patrol officers were divided into four areas. Nearly 62 percent of selected intersections were located in these four areas. There were no "two streets" in Division I where this many accidents occurred, accordingly, the patrol design which resulted was a requisite.

Essentially, the difference between the patrol in Division I and III is that patrol officers were mostly concentrated together on two intersecting streets in Division III and officers were sparsely divided in Division I. In Division III, there was a "pack" effect where officers worked in close geographic proximity. In Division I, there was a "scattered" effect where officers worked in different areas throughout the division and were not grouped together.

The reason for variances in linear relationships of high frequency accident locations seems to be in the demographic variances of the two divisions. The two streets in Division III are the "thoroughfares" for that section of the city and are highly populated business districts, surrounded by residential areas. The business areas of Division I are less concentrated on individual streets. By examination of the variances in the percentage of accidents by tract, it seems to make little difference in the number of traffic accidents if officers are concentrated in a small area or sparsely divided into several areas in a division.

Z-scores presented in the statistical section of this report show no differences between group means of Division I and III. One additional z-test can be conducted to verify these findings:

H_0: $\mu_A = \mu_B$

H_1: $\mu_A = \mu_B$ $\qquad \alpha = .05$

X = Division III, December/February

Y = Division I, January/March

$$Z = \frac{(4.793 - 4.125) - (4.772 - 4.570)}{\sqrt{\frac{8.352}{114} + \frac{7.035}{114}}} = 1.268$$

The z-score did not exceed the value under the normal probability curve; therefore, the null hypothesis is accepted, that the mean of Division III equals the mean of Division I, for the periods specified. This statistic verifies there is no difference in the mean number of accidents that occurred between the experimental groups. The utility of this finding is that it demonstrates that during the experiment, there was no difference in the mean number of accidents with officers patroling in close proximity, (that is, "packed" together) or, when they were "scattered" throughout the experimental division. This suggests for example, that grouping ten officers in a single tracted area would be no more effective in reducing the mean number of accidents in a division than assigning one officer to that tract.

APPENDIX A

TRAFFIC ARREST AND ACCIDENTS BY DIVISION, BY MONTH

AND

TRAFFIC ACCIDENTS AND CORRESPONDING SQUARES

TRAFFIC ARREST AND ACCIDENTS BY
DIVISION FOR DECEMBER 1976

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.
1	3	6	8	6	33	5	11	5
2	4	1	4	2	6	6	4	7
3	8	1	8	8	36	9	15	6
4	7	3	8	4	30	3	4	3
5	4	7	2	3	2	2	2	4
6	5	12	3	4	9	3	4	10
7	3	6	5	2	13	12	7	6
8	11	13	15	7	19	11	8	7
9	9	7	4	5	38	3	12	4
10	13	5	7	3	34	5	23	6
11	4	9	14	12	41	18	16	9
12	3	3	5	9	15	3	2	4
13	4	4	9	3	14	4	19	14
14	5	5	7	5	20	2	8	6
15	7	11	2	6	19	10	7	6
16	5	5	4	8	19	3	17	9
17	20	7	12	10	24	5	21	8
18	10	3	5	7	14	3	6	3
19	9	7	2	0	8	2	11	3
20	14	8	15	7	24	11	12	13
21	10	5	12	7	17	4	7	3
22	10	11	6	2	10	4	9	8
23	5	7	6	9	10	6	6	8
24	8	8	7	8	6	4	3	4
25	1	0	5	7	3	6	3	6
26	7	4	3	1	6	4	3	2
27	10	3	4	3	15	2	6	7
28	13	3	9	6	11	3	5	3
29	12	6	8	3	11	2	5	3
30	5	5	8	6	12	8	1	2
31	8	9	8	5	12	5	11	8

TRAFFIC ARREST AND ACCIDENTS BY
DIVISION FOR JANUARY 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.
1	3	0	4	5	2	1	6	3
2	7	3	6	6	4	2	9	1
* 3	19	5	9	6	8	8	7	10
4	15	4	18	1	7	9	9	8
5	24	4	15	4	10	5	13	6
* 6	31	12	9	7	10	5	19	8
* 7	26	9	11	10	8	8	11	10
8	20	4	5	3	5	4	9	7
* 9	5	6	4	6	6	9	5	11
10	7	10	4	5	7	18	10	16
11	11	7	6	1	4	2	6	5
12	5	5	3	1	6	5	3	6
13	21	3	5	1	8	3	10	8
* 14	13	12	7	26	12	34	12	6
15	22	9	8	7	11	10	14	5
16	5	5	2	2	9	2	6	1
17	3	4	4	3	3	1	7	3
18	12	2	2	0	11	4	9	6
19	16	1	5	3	10	2	9	7
20	36	2	5	2	11	5	4	3
21	38	6	10	3	21	1	11	8
22	49	3	10	5	12	4	11	5
23	4	2	2	1	5	4	9	4
* 24	6	11	4	13	9	26	6	19
25	15	2	5	0	14	6	7	7
26	18	6	2	2	8	3	14	5
27	19	0	4	4	9	3	19	7
28	21	3	9	0	7	6	22	10
29	26	3	11	6	7	1	10	1
30	2	1	3	0	12	1	11	7
31	8	3	5	4	16	4	9	2

TRAFFIC ARREST AND ACCIDENTS BY
DIVISION FOR FEBRUARY 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.
1	3	0	7	6	20	6	11	9
2	7	3	4	1	20	3	2	1
3	13	4	1	0	28	5	7	3
4	13	3	6	2	35	4	19	5
5	9	3	9	4	28	4	4	4
6	7	4	3	2	6	4	4	3
7	9	7	3	2	27	4	17	9
8	9	2	10	5	22	3	10	7
9	16	1	12	4	16	4	8	3
10	5	6	6	1	14	3	9	4
11	17	7	16	3	33	4	10	2
12	14	5	5	2	31	4	21	8
13	12	3	9	1	14	2	9	3
14	4	9	9	3	23	2	18	7
15	12	6	4	3	22	6	10	2
16	6	2	8	4	24	2	5	1
17	11	2	4	3	25	4	22	3
* 18	8	15	4	15	22	31	11	39
19	3	6	6	2	23	8	19	9
20	3	3	1	4	8	4	7	1
21	10	0	9	2	19	2	16	0
22	11	3	5	0	20	3	15	5
23	11	4	14	8	19	5	9	4
24	9	6	10	2	15	2	9	9
25	6	4	3	1	29	4	10	6
26	9	5	4	2	42	5	7	4
27	4	4	5	8	7	7	3	2
28	5	4	10	3	35	6	11	3

TRAFFIC ARREST AND ACCIDENTS BY
DIVISION FOR MARCH 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.	Arrest	Accid.
1	41	5	11	4	12	6	11	7
2	30	7	9	4	5	5	22	5
3	31	8	21	2	19	7	4	8
4	37	8	9	7	19	9	11	8
5	57	3	10	5	10	4	15	2
6	7	3	5	3	6	7	5	4
7	29	3	4	3	18	8	4	6
8	26	3	5	2	7	5	8	5
9	9	3	13	3	9	4	7	5
10	16	4	11	3	20	5	31	2
11	31	5	15	9	13	4	8	6
12	17	3	9	3	8	5	6	6
13	4	0	3	6	11	5	10	6
14	16	6	11	3	14	9	15	7
15	20	4	5	2	9	6	8	6
16	30	8	10	3	15	1	12	3
17	24	5	16	5	17	5	16	2
18	31	6	7	6	10	4	9	2
19	46	5	12	5	9	7	7	4
20	7	4	8	8	13	5	5	4
21	18	3	12	4	11	6	12	6
22	33	4	10	7	10	3	9	5
23	27	2	8	8	7	4	6	5
24	19	7	0	1	6	6	19	2
25	28	6	10	7	4	4	11	6
26	24	3	7	5	9	6	8	7
27	8	3	4	0	5	1	7	4
28	19	3	10	6	10	6	3	5
29	15	6	11	2	8	5	7	8
30	8	1	8	6	7	5	12	8
31	26	8	7	6	4	3	9	7

TRAFFIC ACCIDENTS AND SQUARES
ALL DIVISIONS FOR DECEMBER 1976

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.
1	6	36	6	36	5	25	5	25
2	1	1	2	4	6	36	7	49
3	1	1	8	64	9	81	6	36
4	3	9	4	16	3	9	3	9
5	7	49	3	9	2	4	4	16
6	12	144	4	16	3	9	10	100
7	6	36	2	4	12	144	6	36
8	13	169	7	49	11	121	7	49
9	7	49	5	25	3	9	4	16
10	5	25	3	9	5	25	6	36
11	9	81	12	144	18	324	9	81
12	3	9	9	81	3	9	4	16
13	4	16	3	9	4	16	14	196
14	5	25	5	25	2	4	6	36
15	11	121	6	36	10	100	6	36
16	5	25	8	64	3	9	9	81
17	7	49	10	100	5	25	8	64
18	3	9	7	49	3	9	3	9
19	7	49	0	0	2	4	3	9
20	8	64	7	49	11	121	13	169
21	5	25	7	49	4	16	3	9
22	11	121	2	4	4	16	8	64
23	7	49	9	81	6	36	8	64
24	8	64	8	64	4	16	4	16
25	0	0	7	49	6	36	6	36
26	4	16	1	1	4	16	2	4
27	3	9	3	9	2	4	7	49
28	3	9	6	36	3	9	3	9
29	6	36	3	9	2	4	3	9
30	5	25	6	36	8	64	2	4
31	9	81	5	25	5	25	8	64

TRAFFIC ACCIDENTS AND SQUARES
ALL DIVISIONS FOR JANUARY 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.
1	0	0	5	25	1	1	3	9
2	3	9	6	36	2	4	1	1
3								
4	4	16	1	1	9	81	8	64
5	4	16	4	16	5	25	6	36
6								
7								
8	4	16	3	9	4	16	7	49
9								
10	10	100	5	25	18	324	16	256
11	7	49	1	1	2	4	5	25
12	5	25	1	1	5	25	6	36
13	3	9	1	1	3	9	8	64
14								
15	9	81	7	49	10	100	5	25
16	5	25	2	4	2	4	1	1
17	4	16	3	9	1	1	3	9
18	2	4	0	0	4	16	6	36
19	1	1	3	9	2	4	7	49
20	2	4	2	4	5	25	3	9
21	6	36	3	9	1	1	8	64
22	3	9	5	25	4	16	5	25
23	2	4	1	1	4	16	4	16
24								
25	2	4	0	0	6	36	7	49
26	6	36	2	4	3	9	5	25
27	0	0	4	16	3	9	7	49
28	3	9	0	0	6	36	10	100
29	3	9	6	36	1	1	1	1
30	1	1	0	0	1	1	7	49
31	3	9	4	16	4	16	2	4

TRAFFIC ACCIDENTS AND SQUARES
ALL DIVISIONS FOR FEBRUARY 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.
1	0	0	6	36	6	36	9	81
2	3	9	1	1	3	9	1	1
3	4	16	0	0	5	25	3	9
4	3	9	2	4	4	16	5	25
5	3	9	4	16	4	16	3	16
6	4	16	2	4	4	16	3	9
7	7	49	2	4	4	16	9	81
8	2	4	5	25	3	9	7	49
9	1	1	4	16	4	16	3	9
10	6	36	1	1	3	9	4	16
11	7	49	3	9	4	16	2	4
12	5	25	2	4	4	16	8	64
13	3	9	1	1	2	4	3	9
14	9	81	3	9	2	4	7	49
15	6	36	3	9	6	36	2	4
16	2	4	4	16	2	4	1	1
17	2	4	3	9	4	16	3	9
18								
19	6	36	2	4	8	64	9	81
20	3	9	4	16	4	16	1	1
21	0	0	2	4	2	4	0	0
22	3	9	0	0	3	9	5	25
23	4	16	8	64	5	25	4	16
24	6	36	2	4	2	4	9	81
25	4	16	1	1	4	16	6	36
26	5	25	2	4	5	25	4	16
27	4	16	8	64	7	49	2	4
28	4	16	3	9	6	36	3	9
	106	536	78	334	110	512	117	705

TRAFFIC ACCIDENTS AND SQUARES
ALL DIVISIONS FOR MARCH 1977

	DIV. I		DIV. II		DIV. III		DIV. IV	
	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.	Accid.	Sq.
1	5	25	4	16	6	36	7	49
2	7	49	4	16	5	25	5	25
3	8	64	2	4	7	49	8	64
4	8	64	7	49	9	81	8	64
5	3	9	5	25	4	16	2	4
6	3	9	3	9	7	49	4	16
7	3	9	3	9	8	64	6	36
8	3	9	2	4	5	25	5	25
9	3	9	3	9	4	16	5	25
10	4	16	3	9	5	25	2	4
11	5	25	9	81	4	16	6	36
12	3	9	3	9	5	25	6	36
13	0	0	6	36	5	25	6	36
14	6	36	3	9	9	81	7	49
15	4	16	2	4	6	36	6	36
16	8	64	3	9	1	1	3	9
17	5	25	5	25	5	25	2	4
18	6	36	6	36	4	16	2	4
19	5	25	5	25	7	49	4	16
20	4	16	8	64	5	25	4	16
21	3	9	4	16	6	36	6	36
22	4	16	7	49	3	9	5	25
23	2	4	8	64	4	16	5	25
24	7	49	1	1	6	36	2	4
25	6	36	7	49	4	16	6	36
26	3	9	5	25	6	36	7	49
27	3	9	0	0	1	1	4	16
28	3	9	6	36	6	36	5	25
29	6	36	2	4	5	25	8	64
30	1	1	6	36	5	25	8	64
31	8	64	6	36	3	9	7	49
	139	757	138	764	160	930	161	947

APPENDIX B

MULTIPLE REGRESSION BY DIVISION, BY MONTH

MULTIPLE REGRESSION FOR DIACC12

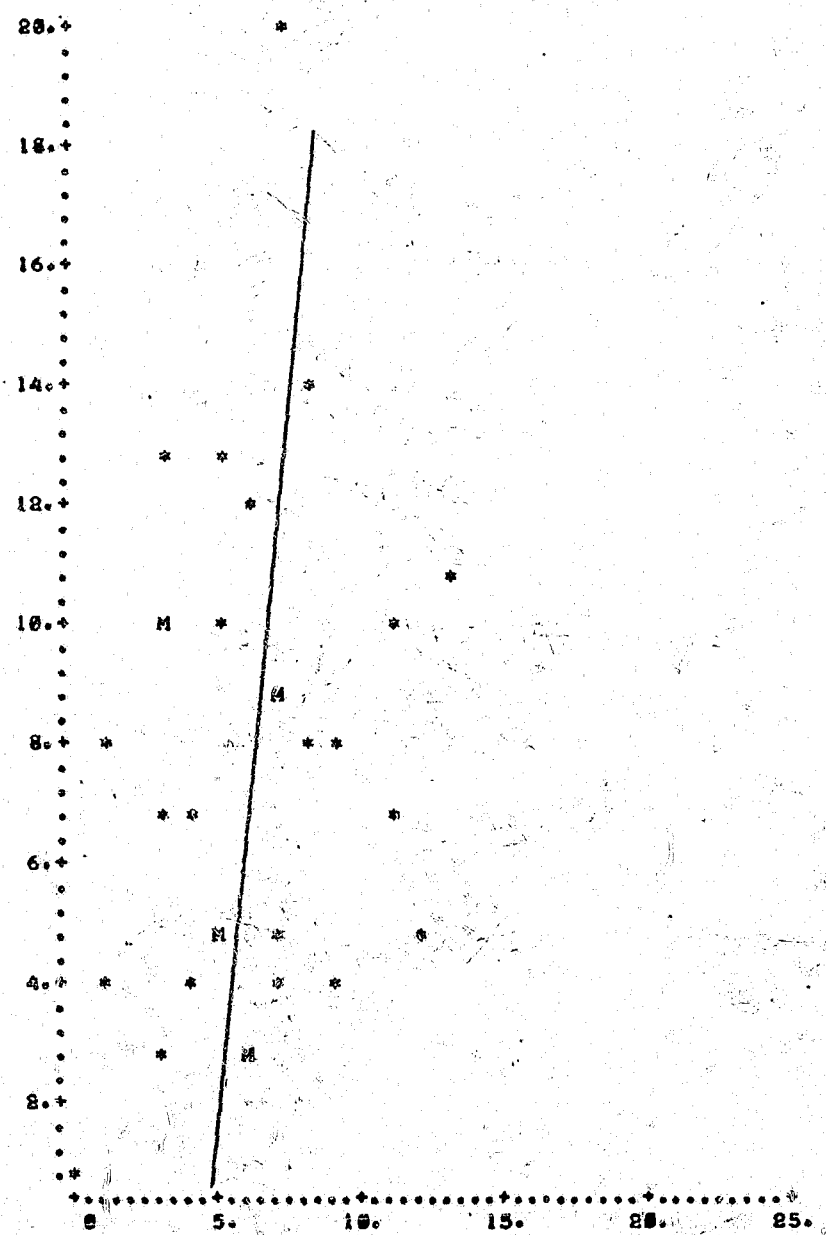
VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
DIARR12	.15698	.14250	1.10165	.20842

INTERCEPT= 4.73534
STD. ERR. INTCP.= .8928931340E+00
COMPUTED T INTCP.= 5.30575

MULTIPLE CORRELATION	.20842	(ADJUSTED R =	.20842)
R-SQUARED	.04017	(ADJ. R-SQUARED=	.04017)
STD. ERROR OF ESTIMATE	3.20250	(ADJUSTED SE=	3.20250)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	12.447	12.447	1.214
DEVIATION FROM REGRESSION	29	297.424	10.256	
TOTAL	30	309.871		



HORIZONTAL=DIACC12 , VERTICAL=DIARR12

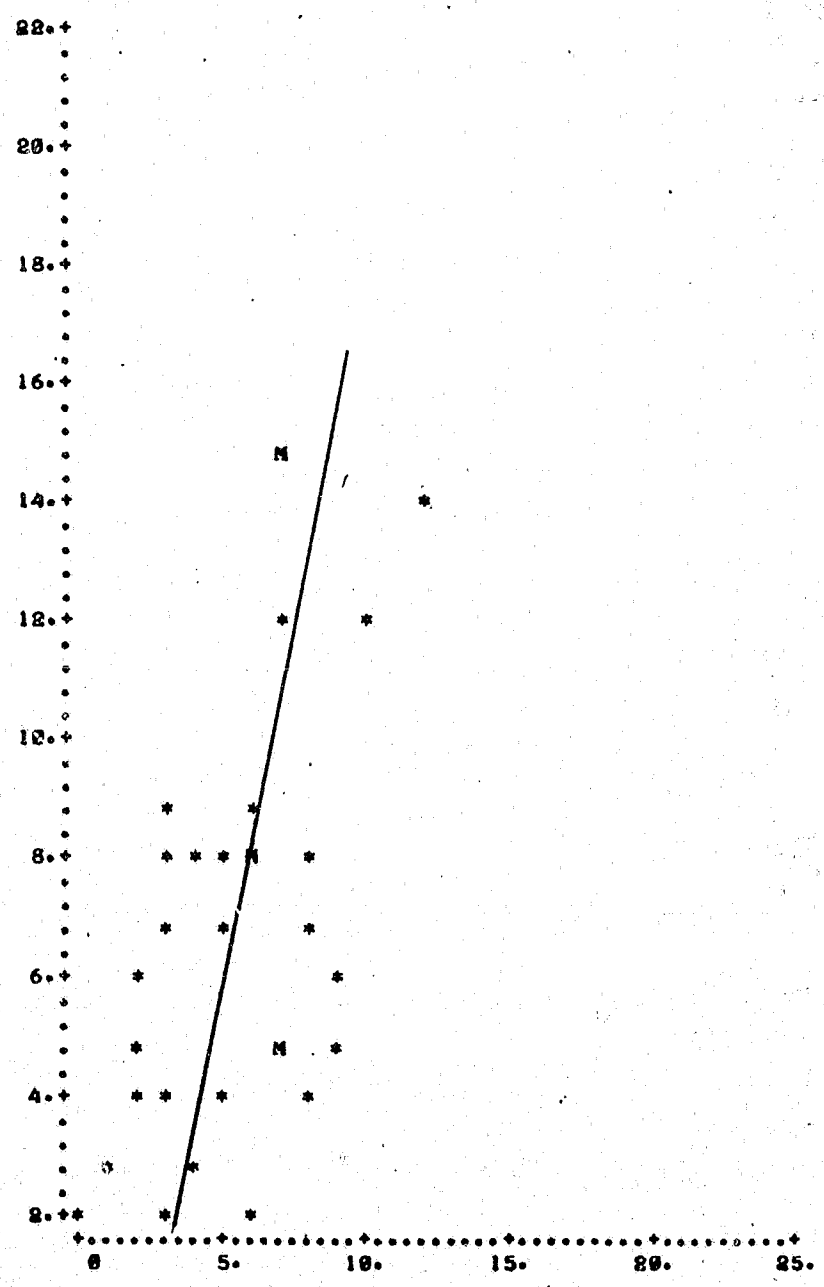
MULTIPLE REGRESSION FOR D2ACC12

VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
D2ARR12	.40271	.12308	3.27357	.51944
INTERCEPT=	2.62634			
STD. ERR. INTCP.=	.73708888369E-10			
COMPUTED T INTCP.=	3.56316			

MULTIPLE CORRELATION	.51944	(ADJUSTED R =	.51944)
R-SQUARED	.26982	(ADJ. R-SQUARED=	.26982)
STD. ERROR OF ESTIMATE	2.46614	(ADJUSTED SE=	2.46614)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF.	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	65.175	65.175	10.716
DEVIATION FROM REGRESSION	29	176.374	6.082	
TOTAL	30	241.548		



HORIZONTAL=D2ACC12 , VERTICAL=D2ARR12

MULTIPLE REGRESSION FOR D3ACC12

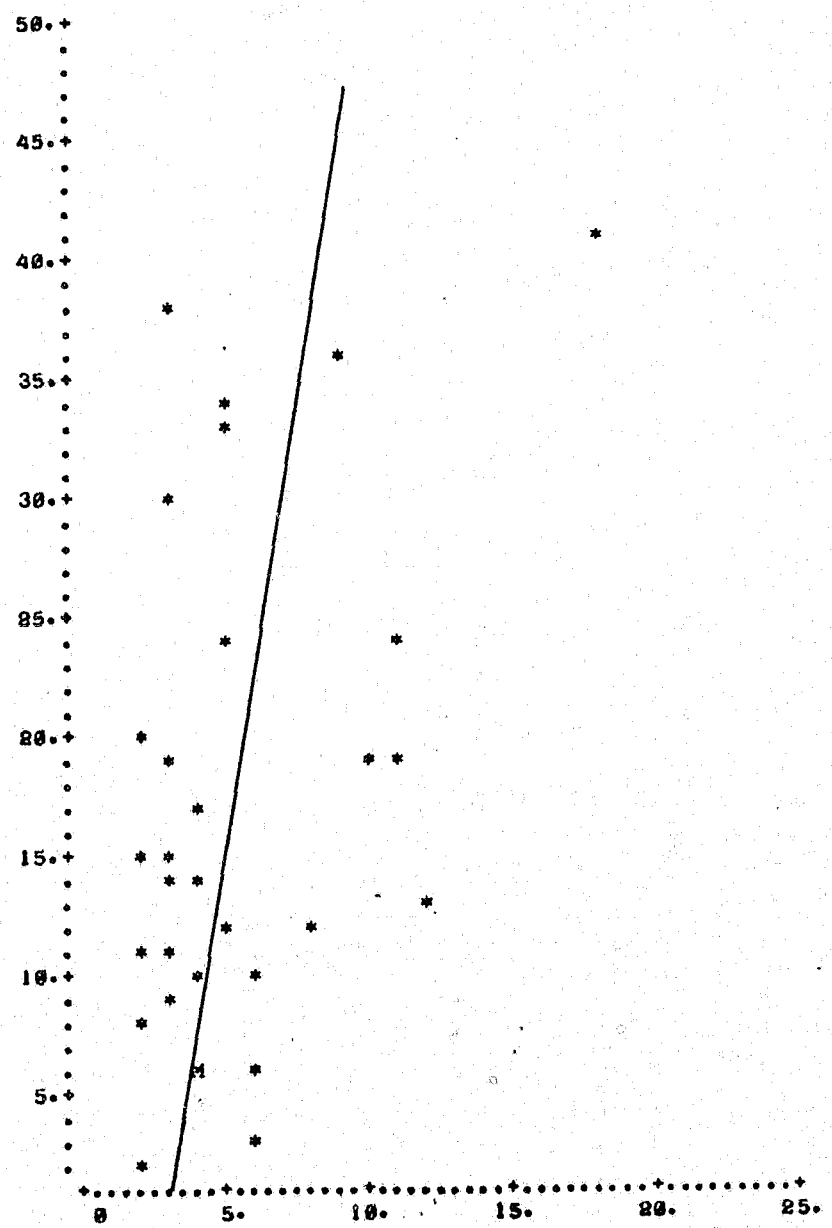
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D3ARR12	.13533	.05984	2.26144	.38718
INTERCEPT=	3.10128			

STD. ERR. INTCP.= .6892566374E+00
COMPUTED T INTCP.= 4.49946

MULTIPLE CORRELATION	.38718	(ADJUSTED R =	.38718)
R-SQUARED	.14991	(ADJ. R-SQUARED=	.14991)
STD. ERROR OF ESTIMATE	3.49015	(ADJUSTED SE=	3.49015)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	62.295	62.295	5.114
DEVIATION FROM REGRESSION	29	353.253	12.181	
TOTAL	30	415.548		



HORIZONTAL=D3ACC12 , VERTICAL=D3ARR12

MULTIPLE REGRESSION FOR D4ACC12

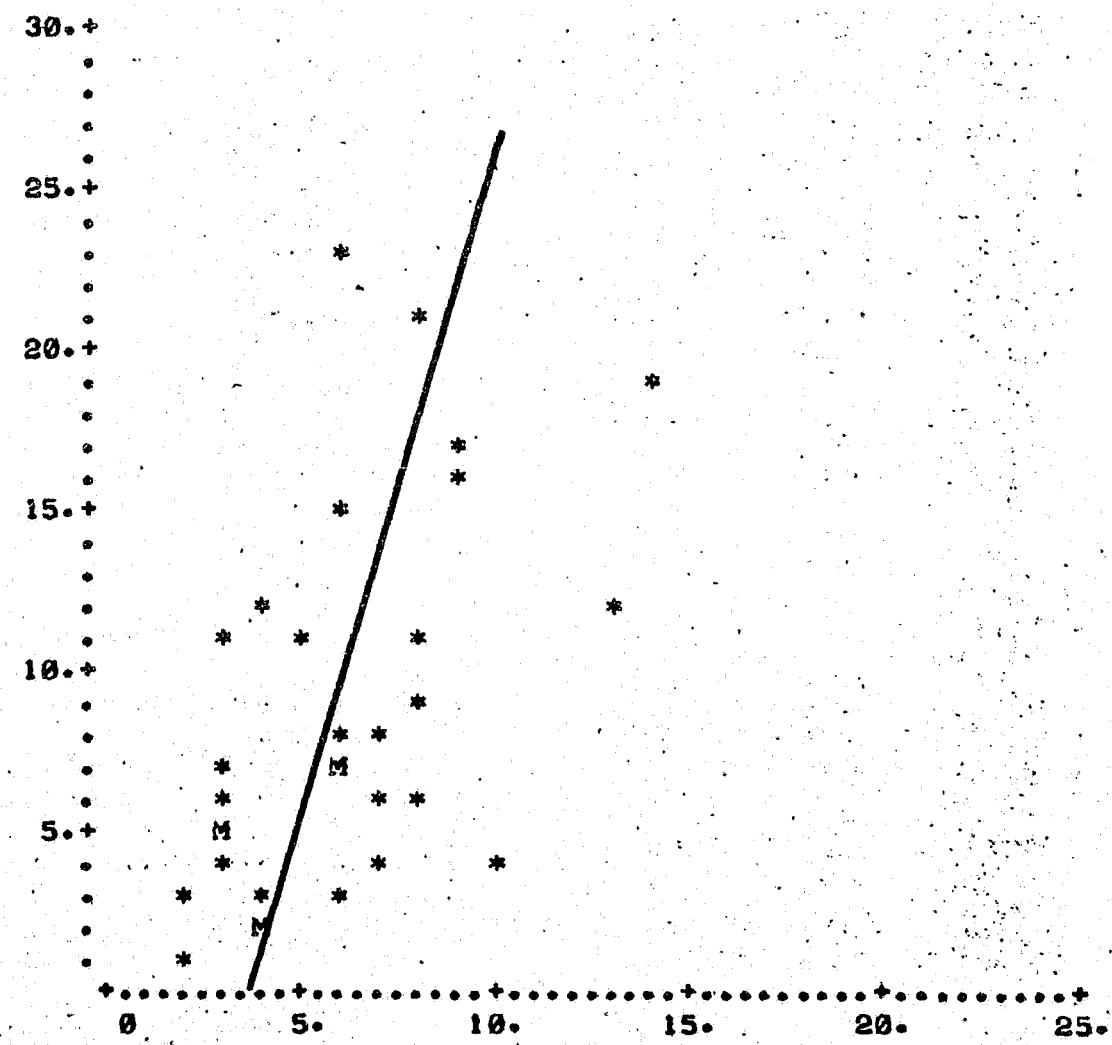
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D4ARR12	.26653	.08080	3.29885	.52236
INTERCEPT=	3.72803			

STD. ERR. INTCP.= .6060287693E+00
COMPUTED T INTCP.= 6.15158

MULTIPLE CORRELATION	.52236	(ADJUSTED R =	.52236)
R-SQUARED	.27286	(ADJ. R-SQUARED=	.27286)
STD. ERROR OF ESTIMATE	2.59692	(ADJUSTED SE=	2.59692)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	73.391	73.391	10.882
DEVIATION FROM REGRESSION	29	195.576	6.744	
TOTAL	30	268.968		



HORIZONTAL=D4ACC12 , VERTICAL=D4ARR12

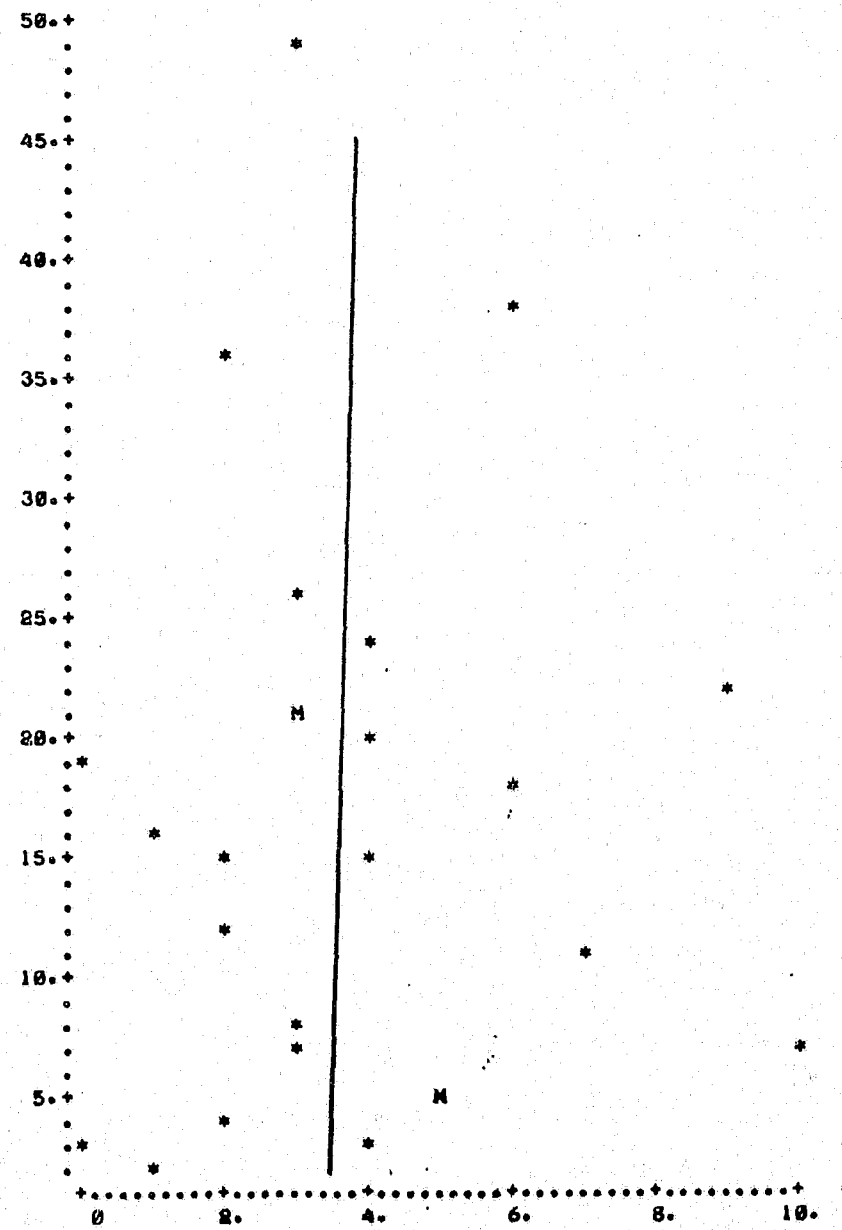
MULTIPLE REGRESSION FOR DIACC1

VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
DIARR1	.00850	.04343	.19577	.04079
INTERCEPT=	3.54158			
STD. ERR. INTCP.=	.5929446670E+00			
COMPUTED T INTCP.=	5.97287			

MULTIPLE CORRELATION	.04079	(ADJUSTED R =	.04079)
R-SQUARED	.00166	(ADJ. R-SQUARED=	.00166)
STD. ERROR OF ESTIMATE	2.54688	(ADJUSTED SE=	2.54688)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	.249	.249	.038
DEVIATION FROM REGRESSION	23	149.191	6.487	
TOTAL	24	149.440		



HORIZONTAL=DIACC1 , VERTICAL=DIARR1

MULTIPLE REGRESSION FOR D2ACC1

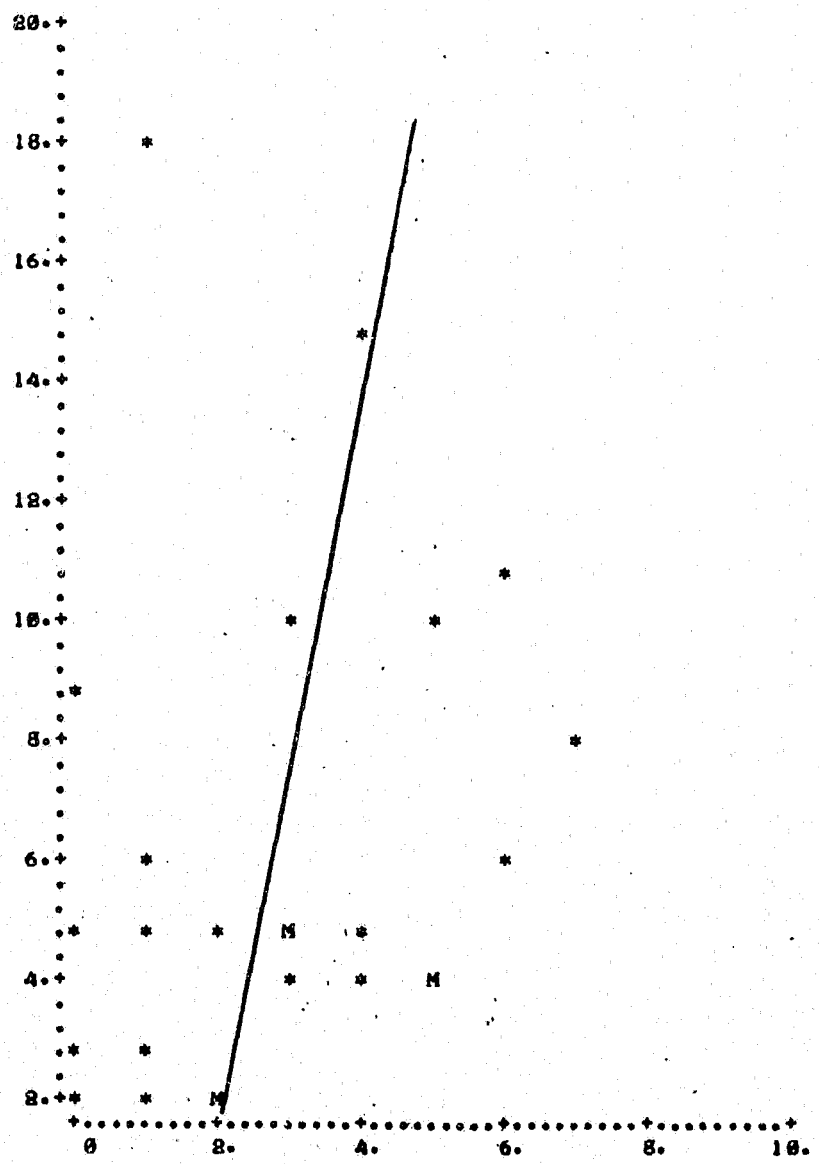
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D2ARR1	.11469	.10512	1.09104	.22183
INTERCEPT=	2.05810			

STD. ERR. INTCP.= .8461058745E+00
COMPUTED T INTCP.= 2.43243

MULTIPLE CORRELATION	.22183	(ADJUSTED R =	.22183)
R-SQUARED	.04921	(ADJ. R-SQUARED=	.04921)
STD. ERROR OF ESTIMATE	2.09882	(ADJUSTED SE=	2.09882)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	5.244	5.244	1.190
DEVIATION FROM REGRESSION	23	101.316	4.405	
TOTAL	24	106.560		



HORIZONTAL=D2ACC1 , VERTICAL=D2ARR1

MULTIPLE REGRESSION FOR D3ACC1

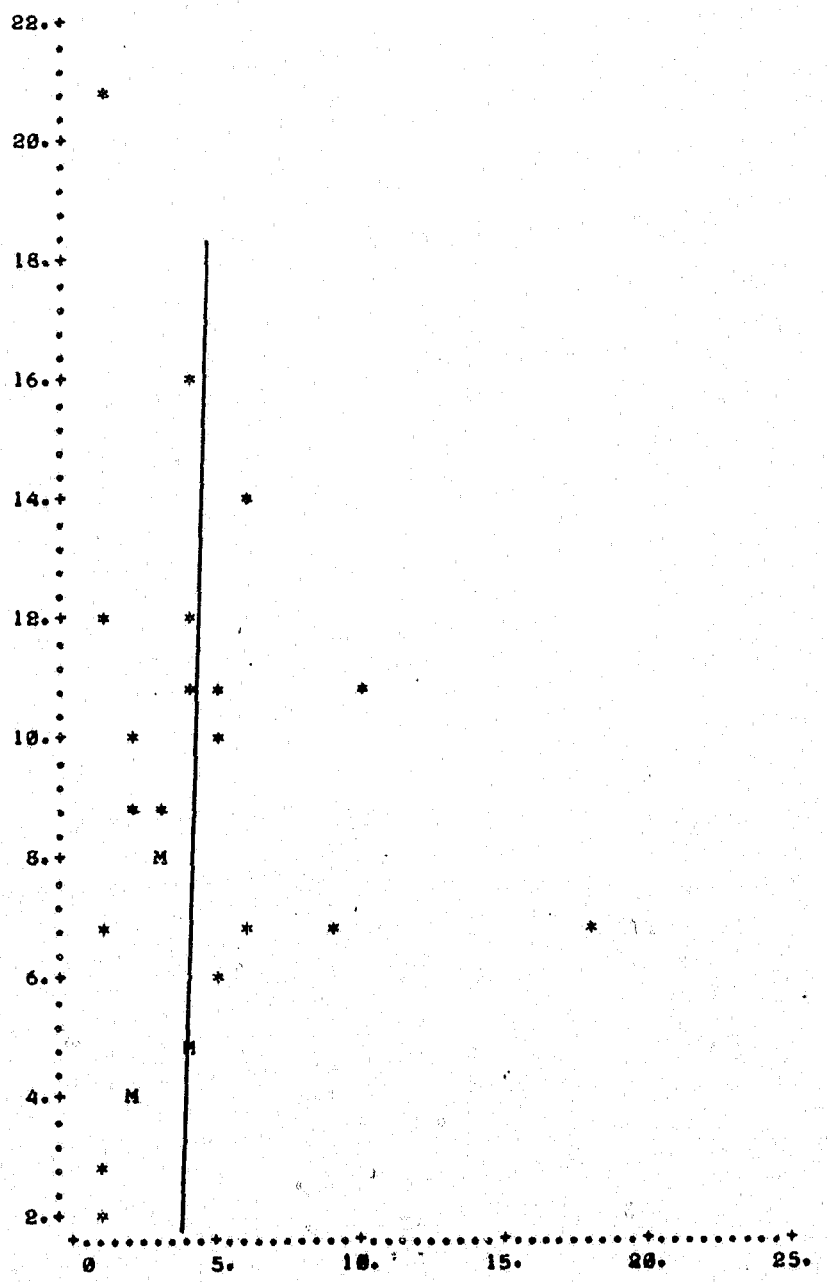
VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
D3ARR1	.00385	.18821	.01806	.00376

INTERCEPT= 4.21150
STD. ERR. INTCP.= .147001343 9E+01
COMPUTED T INTCP.= 2.86494

MULTIPLE CORRELATION	.00376	(ADJUSTED R =	.00376)
R-SQUARED	.00001	(ADJ. R-SQUARED=	.00001)
STD. ERROR OF ESTIMATE	3.79164	(ADJUSTED SE=	3.79104)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	.005	.005	.000
DEVIATION FROM REGRESSION	23	330.555	14.372	
TOTAL	24	330.560		



HORIZONTAL=D3ACC1 , VERTICAL=D3ARR1

MULTIPLE REGRESSION FOR D1ACC2

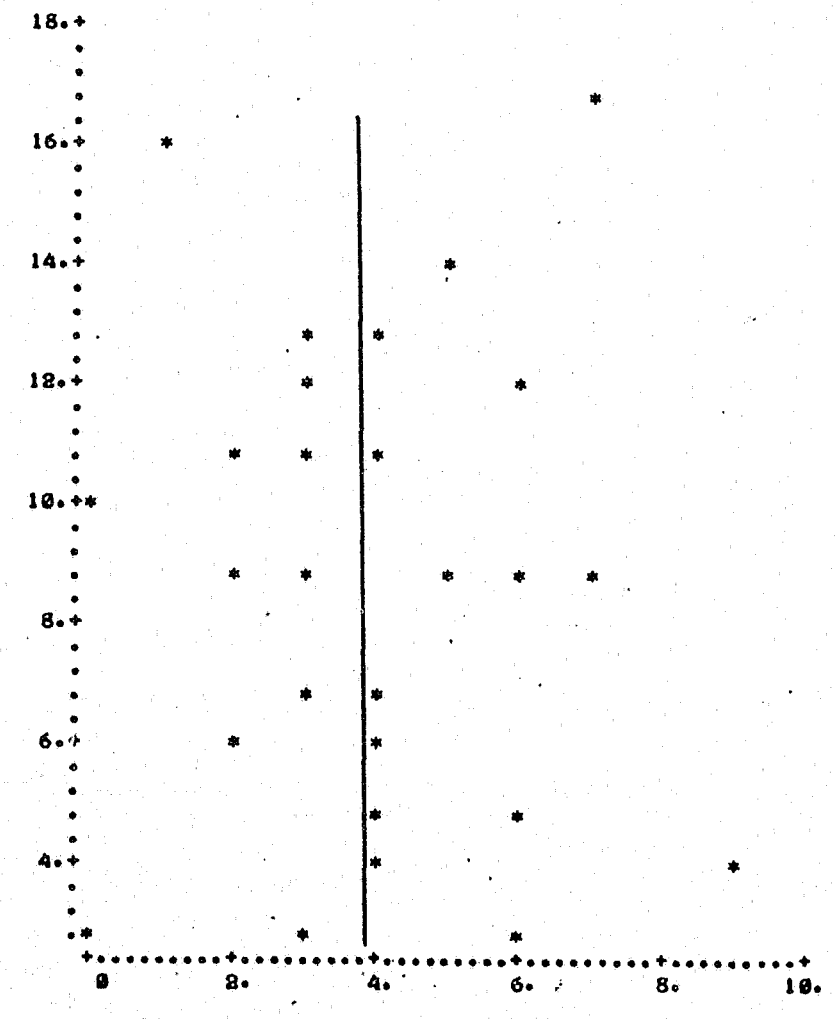
VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
D1ARR2	-.02492	.10723	-.23245	-.04644
INTERCEPT=	4.14563			

STD. ERR. INTCP.= .6936969848E+00
COMPUTED T INTCP.= 5.97614

MULTIPLE CORRELATION	.04644	(ADJUSTED R =	.04644)
R-SQUARED	.00216	(ADJ. R-SQUARED=	.00216)
STD. ERROR OF ESTIMATE	2.18718	(ADJUSTED SE=	2.18718)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	.258	.258	.054
DEVIATION FROM REGRESSION	25	119.593	4.784	
TOTAL	26	119.852		



HORIZONTAL=D1ACC2 VERTICAL=D1ARR2

MULTIPLE REGRESSION FOR D2ACC2

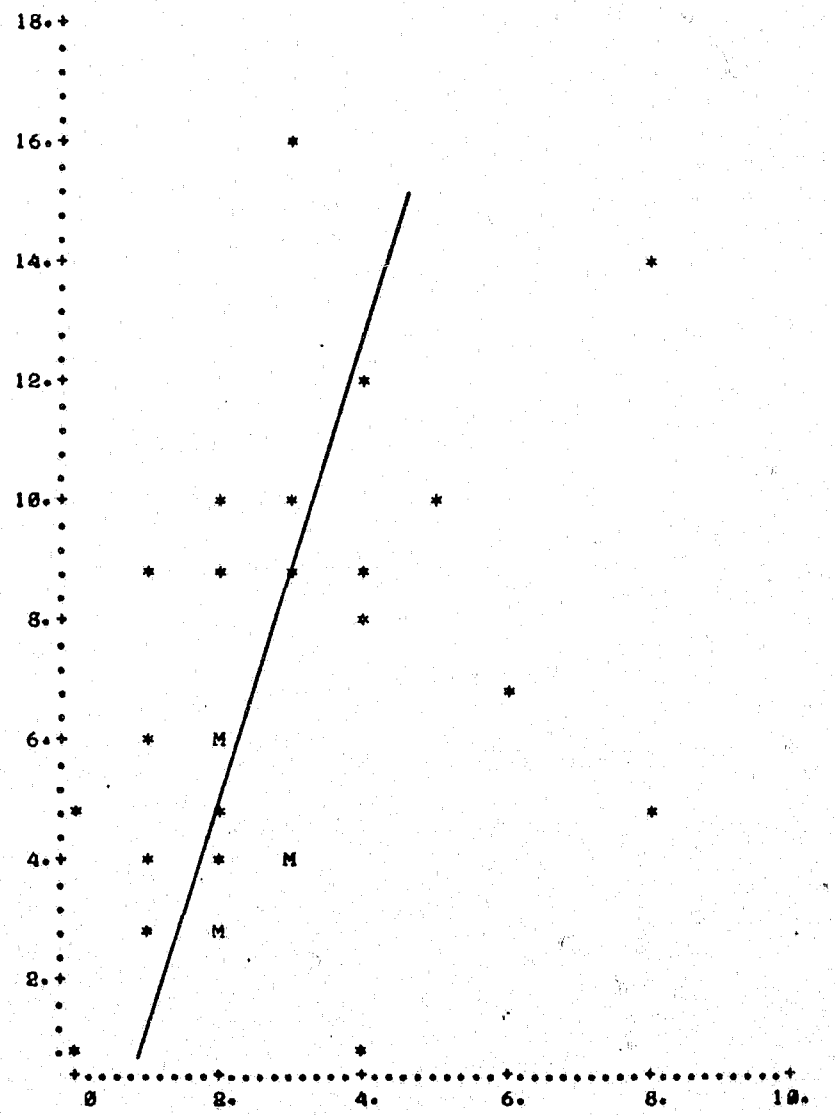
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D2ARR2	.21248	.09992	2.12644	.39136

INTERCEPT= 1.44876
STD. ERR. INTCP.= .6327407713E+00
COMPUTED T INTCP.= 2.28966

MULTIPLE CORRELATION	.39136	(ADJUSTED R =	.39136)
R-SQUARED	.15317	(ADJ. R-SQUARED=	.15317)
STD. ERROR OF ESTIMATE	1.91857	(ADJUSTED SE=	1.91857)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	16.644	16.644	4.528
DEVIATION FROM REGRESSION	85	92.023	3.681	
TOTAL	86	108.667		



HORIZONTAL=D2ACC2 , VERTICAL=D2ARR2

MULTIPLE REGRESSION FOR D3ACC2

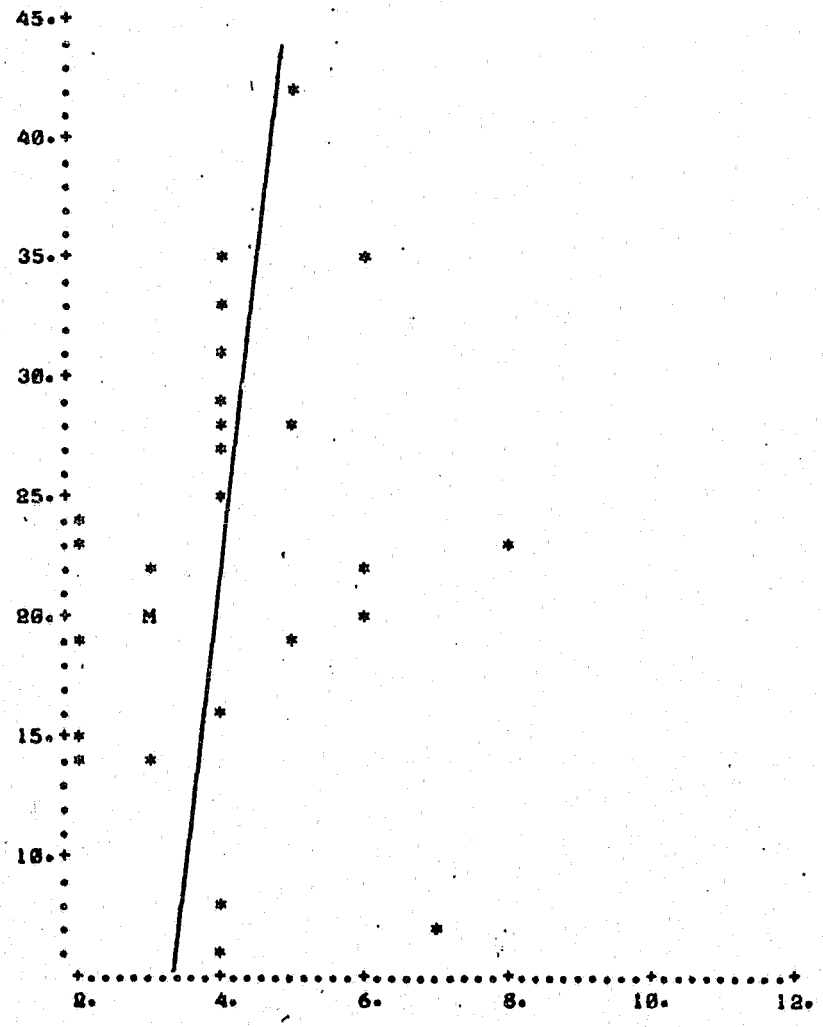
VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
D3ARR2	.02241	.03531	.63467	.12592
INTERCEPT=	3.57198			

STD. ERR. INTCP.= .3550466825E+00
COMPUTED T INTCP.= 10.06059

MULTIPLE CORRELATION	.12592	(ADJUSTED R =	.12592)
R-SQUARED	.01586	(ADJ. R-SQUARED=	.01586)
STD. ERROR OF ESTIMATE	1.58543	(ADJUSTED SE=	1.58543)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	1.012	1.012	.403
DEVIATION FROM REGRESSION	25	62.839	2.514	
TOTAL	26	63.852		



HORIZONTAL=D3ACC2 , VERTICAL=D3ARR2

MULTIPLE REGRESSION FOR D4ACC2

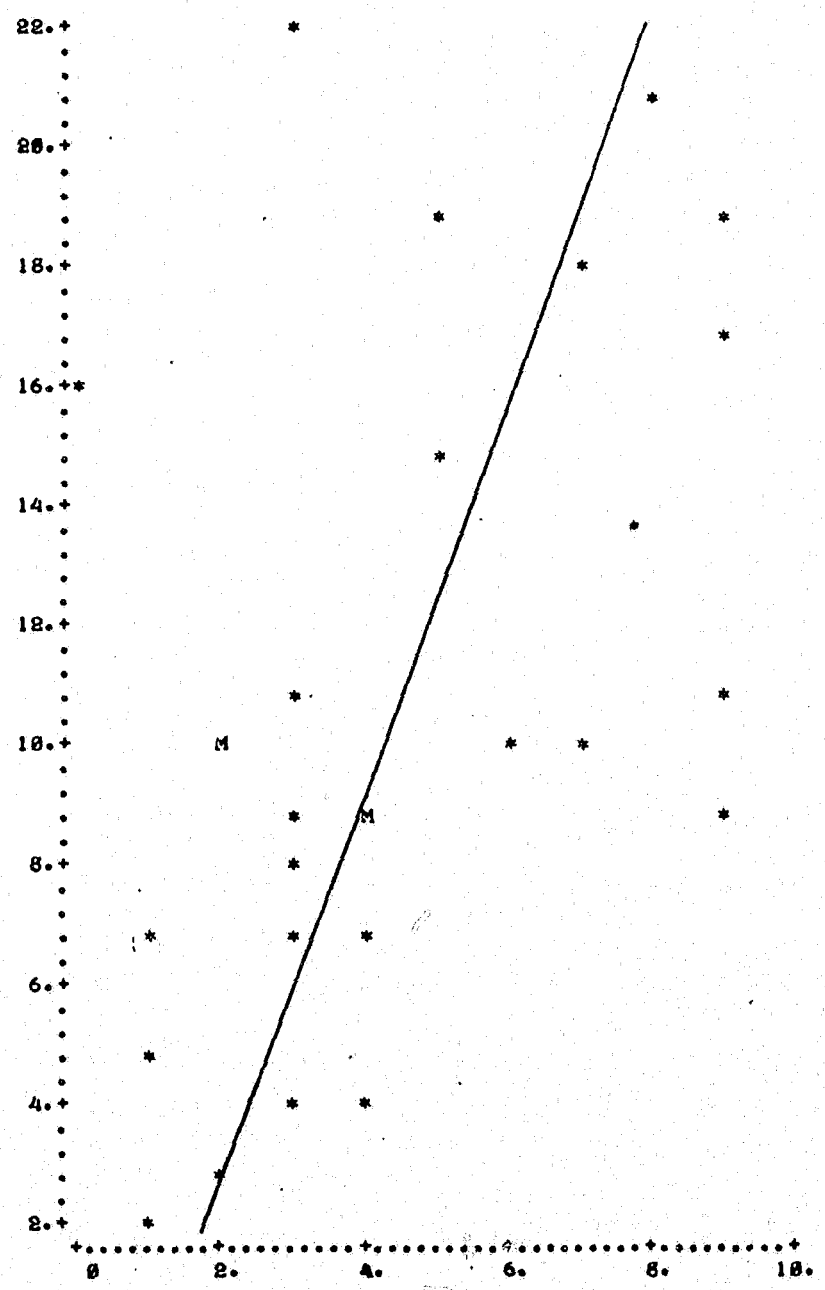
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D4ARR2	.23090	.08607	2.68262	.47278
INTERCEPT=	1.83616			

STD. ERR. INTCP.= .6509119456E+00
COMPUTED T INTCP.= 2.82090

MULTIPLE CORRELATION	.47278	(ADJUSTED R =	.47278)
R-SQUARED	.22352	(ADJ. R-SQUARED=	.22358)
STD. ERROR OF ESTIMATE	2.47987	(ADJUSTED SE=	2.47987)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.,	F VALUE
ATTRIBUTABLE TO REGRESSION	1	44.256	44.256	7.196
DEVIATION FROM REGRESSION	25	153.744	6.150	
TOTAL	26	198.000		



HORIZONTAL=D4ACC2 , VERTICAL=D4ARR2

MULTIPLE REGRESSION FOR D1ACC3

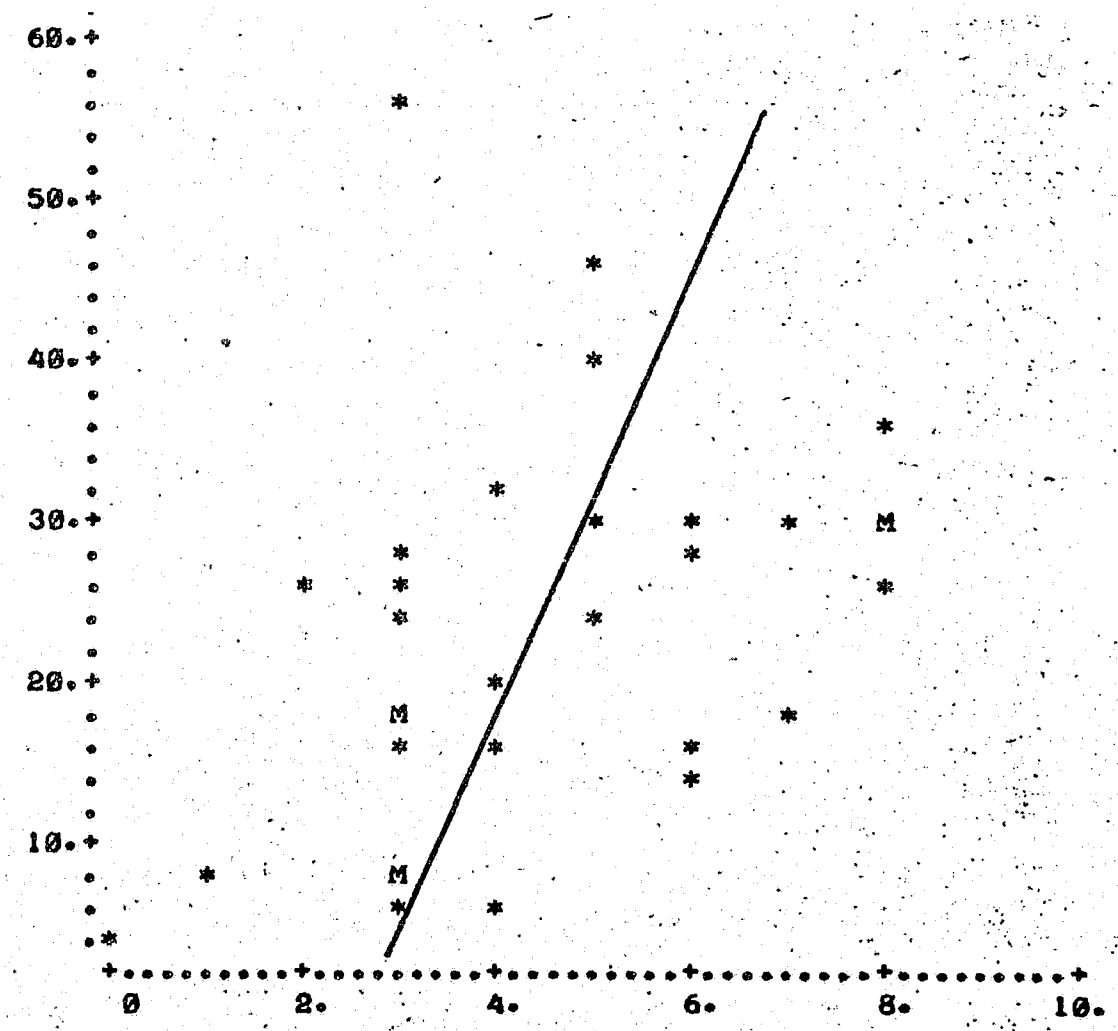
VARIABLE	REG.COEF.	STD.ERROR COEF.	COMPUTED T	BETA COEF.
D1ARR3	.06767	.02960	2.28623	.39078

INTERCEPT= 2.88174
STD. ERR. INTCP.= .9881400371E+00
COMPUTED T INTCP.= 2.91632

MULTIPLE CORRELATION	.39078	(ADJUSTED R =	.39078)
R-SQUARED	.15271	(ADJ. R-SQUARED=	.15271)
STD. ERROR OF ESTIMATE	1.97674	(ADJUSTED SE=	1.97674)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	20.424	20.424	5.227
DEVIATION FROM REGRESSION	29	113.318	3.908	
TOTAL	30	133.742		



HORIZONTAL=D1ACC3 , VERTICAL=D1ARR3

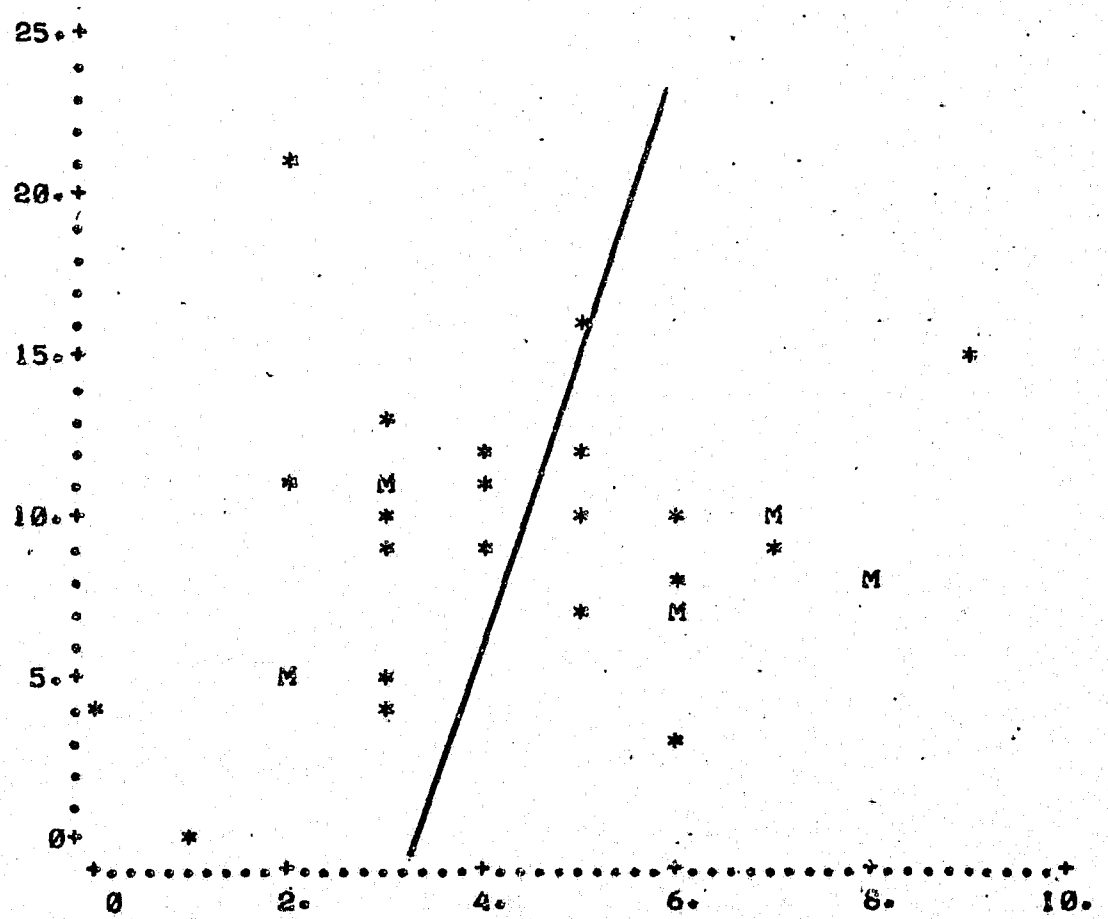
MULTIPLE REGRESSION FOR D2ACC3

VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D2ARR3	.09944	.09850	1.00945	.18424
INTERCEPT=	3.55028			
STD. ERR. INTCP.=	.3095200094E+01			
COMPUTED T INTCP.=	1.14703			

MULTIPLE CORRELATION	.18424	(ADJUSTED R =	.18424)
R-SQUARED	.03395	(ADJ. R-SQUARED=	.03395)
STD. ERROR OF ESTIMATE	2.23296	(ADJUSTED SE=	2.23296)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	5.081	5.081	1.019
DEVIATION FROM REGRESSION	29	144.597	4.986	
TOTAL	30	149.677		



HORIZONTAL=D2ACC3 , VERTICAL=D2ARR3

MULTIPLE REGRESSION FOR D3ACC3

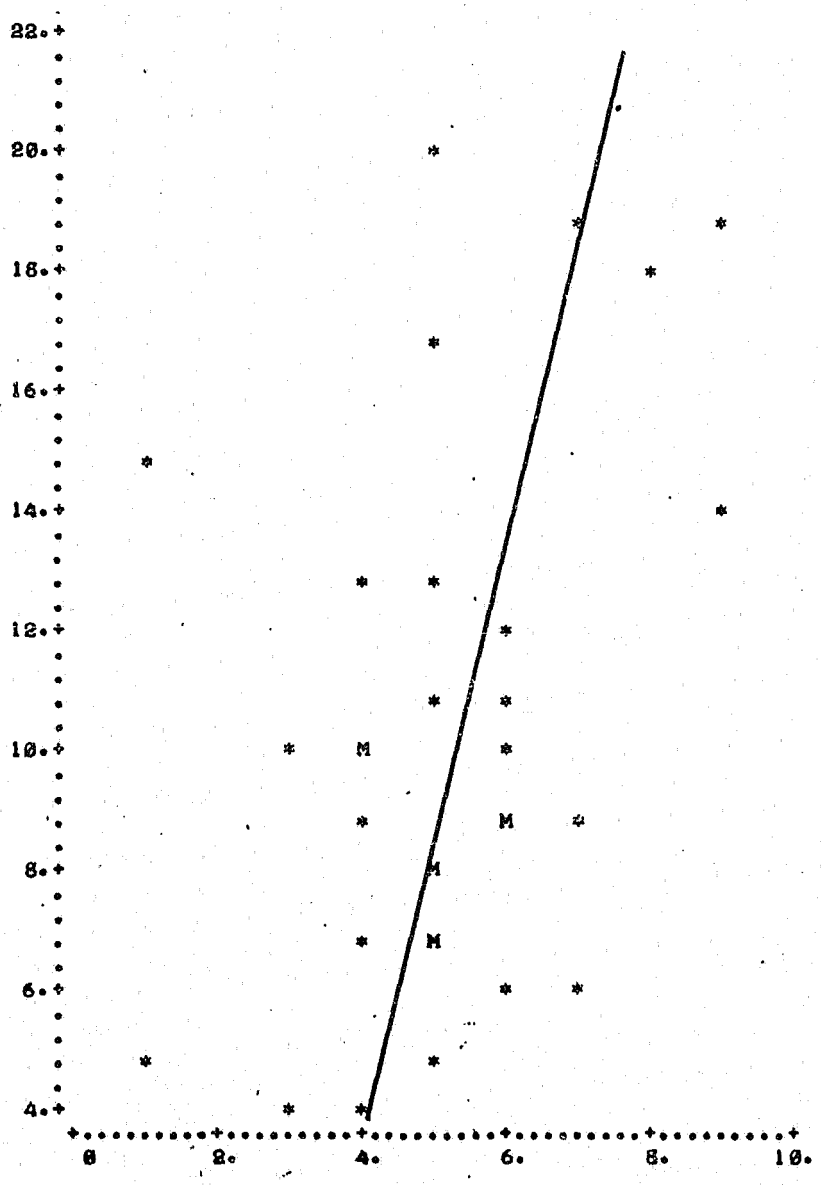
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D3ARR3	.15594	.07002	2.22704	.38216
INTERCEPT=	3.52639			

STD. ERR. INTCP.= .2204296454E+01
COMPUTED T INTCP.= 1.59979

MULTIPLE CORRELATION	.38216	(ADJUSTED R =	.38216)
R-SQUARED	.14605	(ADJ. R-SQUARED=	.14605)
STD. ERROR OF ESTIMATE	1.75161	(ADJUSTED SE=	1.75161)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	15.217	15.217	4.960
DEVIATION FROM REGRESSION	29	88.976	3.068	
TOTAL	30	104.194		



HORIZONTAL=D3ACC3 , VERTICAL=D3ARR3

MULTIPLE REGRESSION FOR D4ACC3

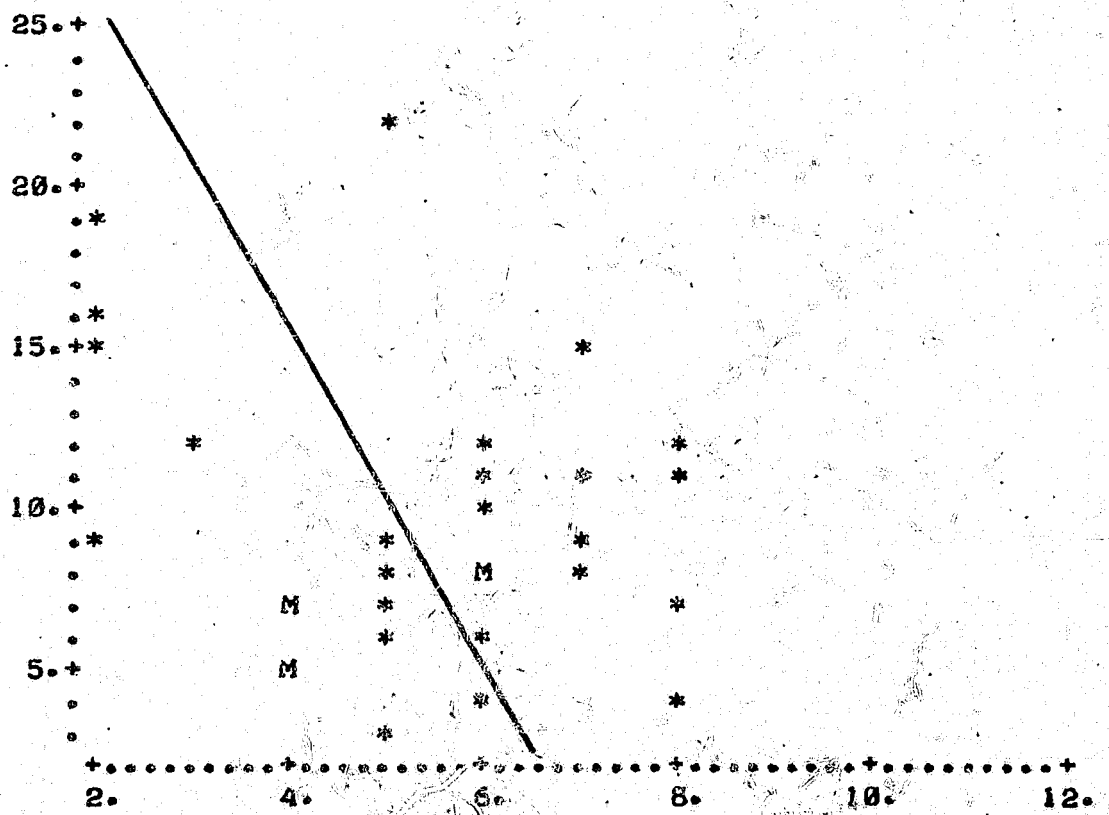
VARIABLE	REG. COEF.	STD. ERROR COEF.	COMPUTED T	BETA COEF.
D4ARR3	-.12933	.05619	-2.30140	-.39298
INTERCEPT=	6.51601			

STD. ERR. INTCP.= .1780390948E+01
COMPUTED T INTCP.= 3.65988

MULTIPLE CORRELATION	.39298	(ADJUSTED R = .39298)
R-SQUARED	.15443	(ADJ. R-SQUARED= .15443)
STD. ERROR OF ESTIMATE	1.79772	(ADJUSTED SE= 1.79772)

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DF	SUM OF SQ.	MEAN SQ.	F VALUE
ATTRIBUTABLE TO REGRESSION	1	17.117	17.117	5.296
DEVIATION FROM REGRESSION	29	93.722	3.232	
TOTAL	30	110.839		



HORIZONTAL=D4ACC3 VERTICAL=D4ARR3

END