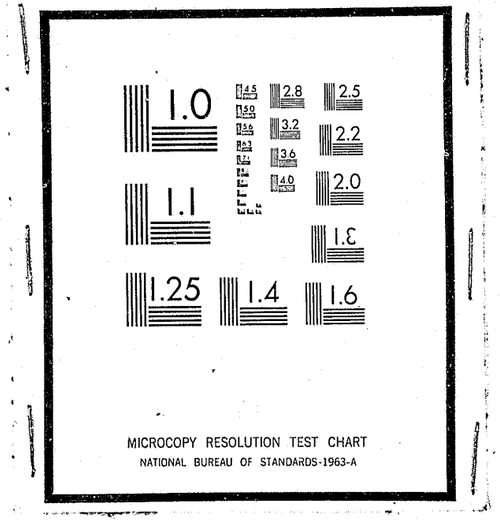

JUVENILE CRIME

ANALYSIS OF

FULTON COUNTY JUVENILE COURT

IMPACT OUTREACH PROJECT

by

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and

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This report provides an in-depth analysis of trends and seasonality of offenses by juveniles committed in Fulton County and in an area termed the Impact Area. The residence of the offender is the basis of measurement. The study was conducted in an attempt to understand the changing pattern of juvenile crime as a function of the Outreach Probation Project of the Fulton County Juvenile Court.

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Summary

This study concerns the residence of juvenile offenders convicted of the target crimes of aggravated assault, aggravated battery, burglary, homicide, rape and robbery. Data used in the analyses was provided by the Fulton County Juvenile Court as part of its regular submission to the Crime Analysis Team, Atlanta Regional Commission.

The first step of the study was a comparison of the number of court cases and the total number of offenses cited in the cases. It was found that these two numbers (cases versus total offenses) were highly correlated (>0.97). This result permitted the removal of court cases as a variable, i.e., all inferences about total offenses would hold true for court cases.

In pursuing the analysis of offenses, it was found that although the total number of offenses was comprised of 6 sub-categories, the three categories of assault, burglary and robbery, combined to form 95% of the total, leaving 5% to battery, rape and homicide. Simple linear regression was performed on the data of each offense type. The results are graphically displayed in Appendix 2. At this point two questions were raised. (1) What effect did changes in population have on the data? (2) Were there significant seasonal patterns evident in the data? Estimates of population growth made by the Atlanta Regional Commission reported a 4% decrease in the population over the past four years. This was considered insignificant to form a bias in the data. Seasonality was investigated by using sine-cosine pairs in a multiple regression analysis. Statistically significant seasonal patterns were observed in assault, burglary and total offense categories and Appendices 4 and 5 contain graphs of the observed seasonal patterns. Appendix 3 contains graphs of actual data versus predicted values.

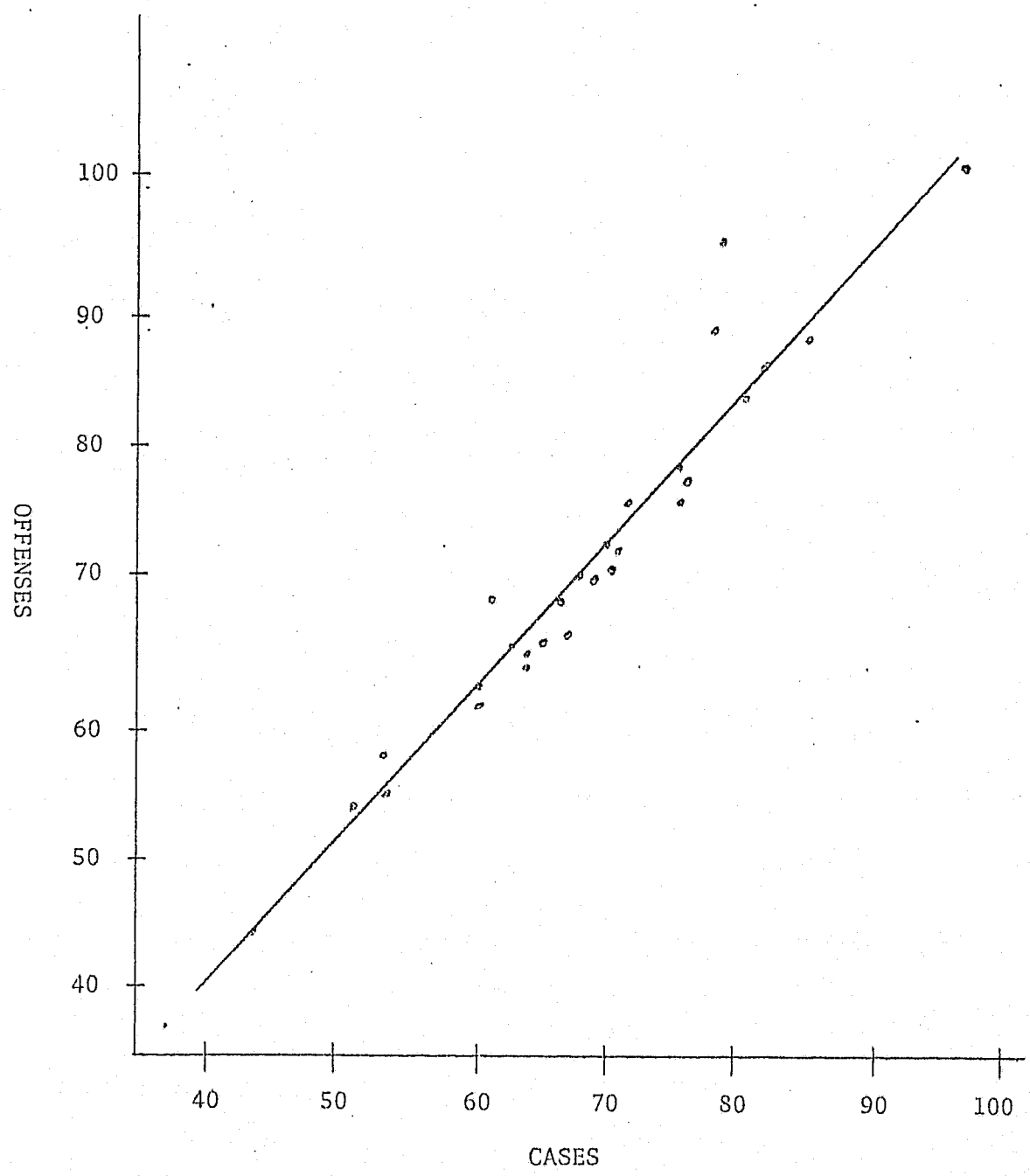
The data pertaining to the Impact Area was then compared to data for the City of Atlanta (a larger area than the Impact Area). Approximately eighty percent of the total offenses occured within the Impact Area. Due to this high percentage, it was not surprising that correlation studies of data from each area indicated a high correlation of 92 to 93 percent for each of the offense types. In order to analyze the impact of Project Outreach the Impact Area was compared to data from the non-Impact Area. This analysis indicated that the number of target offenses is growing more rapidly in the Impact Area than in the non-Impact Area. Only in the category of robbery, which comprises 12% of total offenses, does the Impact Area have a slower growth than the non-Impact Area.

Analysis

The analysis of the data began with an investigation of the relationship between the monthly number of court cases and the offenses generated by those cases. In order to establish this relationship, a plot of offenses versus cases was created as shown in Exhibit 1. Statistical analysis of the data produced a very high correlation coefficient of 0.97. It should be noted that the two points which deviate the most from the regression line happen to be the last two months of the data. Unless these last two months are indicative of a change in the causal system relating cases to offenses, it is satisfactory to treat the two variables as nearly identical. The next step of the analytical process was to perform a simple linear regression on each type of offense. The data and resulting linear models are shown in Appendix 2. The graphs in Appendix 2 also include a comparison of data between the Impact and total areas. Estimates of seasonal variation in the data were obtained through an approach similar to Winters's method for adaptive smoothing of seasonal data. The estimates indicate the percentage deviation of the actual data compared to the value obtained from the linear regression model. For example, a value of 1.15 for January indicates that, in general, the actual data values for January were 15% higher than the values which were estimated for January. Similarly, a value of 0.89 indicates that the actual values were 11% lower than estimated. Quarterly estimates of seasonal variation were computed as the average of the three included months. Appendix 4 shows seasonal estimates for assault and total offenses where the percentage deviation was multiplied by the data average to produce estimates of the actual number of units of deviation from the model. The magnitude of these estimates indicates that significant seasonality could be present. However, to test the significance of these estimates would involve approximating 12 values, one for

EXHIBIT 1

OFFENSES VERSUS CASES



each month. This could produce statistically unreliable estimates due to the limited data available. An alternate approach was selected - the use of sine-cosine pairs. It was noted that one sine-cosine pair will produce a single sine wave of estimable amplitude and phase angle. A second sine-cosine pair can be used to introduce a harmonic into the estimated pattern. Thus, the set of two sine-cosine pairs can model many complex seasonal patterns. The estimation of coefficients for the twin sine-cosine pairs would require only four estimates which have good statistical properties.

Multiple stepwise regression analysis was then performed on the offense data sets to detect significant patterns in the data. An initial model of $X_T = a_0 + a_1 t + a_2 t^2 + a_3 \sin(30t) + a_4 \cos(30t) + a_5 \sin(60t) + a_6 \cos(60t)$ was assumed. The regression program would estimate the a_i coefficients from the data to provide the best fit. This model would permit linear, quadratic and rather diverse seasonal patterns to be detected. The preliminary runs were made under the criteria that model component coefficients had to deviate from zero by more than twice their standard error. A summary of the output is presented in Exhibit 2. The model for each offense data set was then created under the following criteria:

1) Only components whose coeficients exceeded two times their standard error were considered significant.
2) If one member of a sine-cosine pair was significant, the other member was included as significant.

The need for the first criterion is to insure that only statistically significant components are modelled. This is acomplished by insuring that the calculated coefficient is sufficiently far from zero. Criterion One is derived from consideration of the Tchebyshev's Inequality for unimodal distributions, from which the probability of a sample deviating from its mean by two standard deviations is calculated to be less than 11.1 percent.

EXHIBIT 2

SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Model: $X = a_o + a_1 t + a_2 t^2 + a_3 \sin(30t) + a_4 \cos(30t) + \sin(60t) + a_6 \cos(60t) + a_7 \varepsilon t$

Where t = 0 was at the data center (month 14.5)

Impact Area:	a_o	a_1	a_2	a_3	a_4	a_5	a_6	a_7
Total offenses:	46.33	.896 (.134)*	.080 (.018)	1.740 (1.609)	--	-4,480 (1.577)	5.787 (1.577)	0 (5.900)**
Assault:	7.130	.110 (.0784)	.017 (.0114)	2.362 (.941)	-1.824 (.999)	2.152 (.924)	2.152 (.924)	0 (7.130)
Burglary:	30.893	.619 (.176)	.075 (.023)	--	--	2.304 (2.083)	2.304 (2.083)	0 (7.817)
Robbery:	6.220	.128 (.07829)	--	-1.507 (.941)	--	1.1774 (.936)	1.1774 (.936)	0 (3.513)

Total Area:		a_1	a_2	a_3	a_4	a_5	a_6	a_7
Total offenses:	61.867	.914 (.180)	.099 (.024)	2.377 (2.165)	--	-4.575 (2.111)	6.687 (2.121	0 (7.937)
Assault:	9.135	--	.015 (.01291)	2.054 (1.07)	-2.013 (1.044)	-1.098 (1.044)	2.529 (1.058)	0 (3.961)
Burglary:	42,003	.677 (.251	.100 (.033)	--	--	--	--	0 (11.222)
Robbery:	8.069	.179 (.085)	--	-2.161 (1.017)	--	--	1.728 (1.012)	0 (3.799
Cases:	60.557	.667 (.180)	.073 (.024)	--	--	-5.178 (2.092)	6.219 (2.121)	0 (7.955)

( )* Numbers in parentheses indicate the standard error of the above coefficient

** The standard error under column a_7 indicates the standard deviation of the forecast error

"--" Indicates that the absolute value of the estimated coefficient was less than one standard error.

If normality can be assumed, the probability of a sample deviating from its mean by two standard deviations is 2.28 percent.

Criterion Two is derived from the fact that a sine-cosine pair actually models a single sine wave displaced from the origin by a shift angle. The signifiance of one implies the signifiance of its partner. The regressions were then rerun for models using only the selected model components. A summary of the output is provided in Exhibits 3 and 4. Appendix 3 contains graphs of the model versus the actual data for each offense type.

It was indicated earlier that estimates of seasonal components were calculated using an approach similar to that of Winter's adaptive smoothing. The resulting patterns for assaults and total offenses are shown in Appendix 4. Graphs in Appendix 5 present the seasonal patterns which were modelled (and tested to be statisticlly significant) in the multiple regression analysis for the same two data categories. The similarity of the two versions of seasonal estimation is very strong.

The emphasis of the analysis then shifted to model the non-Impact Area. Linear regression models were generated and the linear coefficient tested for significance as shown in Exhibit 5. In no case could the coefficient be assessed as being statisticaly significant. This indicates that from a statistical point of view, the non-Impact Area has not experienced any change over the period of the data sample. Exhibit 6 shows the comparable data for the Impact Area. Statistical significance occurs in the categories of total offenses and burglary. If one compares the percentage change per period estimates, one sees that the Impact area far exceeds the non-Impact Area in the categories of total-offenses, assault and burglary. In the robbery category, however, the non-Impact area seems to be growing faster than the Impact Area. However robbery comprises only 12% of the total

number of offenses. Thus, the conclusion is that the growth of target offenders residing in the Impact Area exceeds the growth in the non-Impact Area.

A final comment must be made concerning the data which was used in this study. Certain discrepancies were noted in the data as the analysis proceeded. For instance, the number of batteries occuring in September 1972 in the Impact Area is greater than the number of batteries reported for the total area. The Impact Area, being a subset of the total area, should never exceed the total area. Another instance of error in data was observed when the reported total of offenses did not equal the sum of the six component offense categories. These errors were manually corrected as best as one could estimate. The data errors were minute in nature; however, they should be noted.

EXHIBIT 3

SELECTED MODELS (t CENTERED AT MONTH 14.5)

Impact Area:

Total offenses: $X(t)=46.42 + .884\ t + .0777\ t^2 - 4.22 \sin(60t) + 5.91 \cos(60t)$ (S.E. = 5.92)*

Assault: $X(t)=8.16 + 2.12 \sin(30t) - 1.24 \cos(30t) - 1.64 \sin(60t) + 2.29 \cos(60t)$ (S.E. = 3.56)

Burglary: $X(t)=30.85 + .635t + .076\ t^2$ (S.E. = 7.85)

Robbery: $X(t)=6.24$ (S.E. = 3.77)

Total Area:

Total offenses: $X(t)=61.99 + 89.7\ t + .096\ t^2 - 4.22 \sin(60t) + 6.85 \cos(60t)$ (S.E. = 7.97)

Assault: $X(t)=10.08 + 1.92 \sin(30t) - 1.48 \cos(30t) - 1.15 \sin(60t) + 2.56 \cos(60t)$ (S.E. = 3.98)

Burglary: $X(t)=42.00 + .677\ t + .1\ t^2$ (S.E. = 11.22)

Robbery: $X(t)=8.11 + .190\ t - 2.05 \sin(30t) + .18 \cos(30t)$ (S.E. = 4.01)

Cases: $X(t)=60.56 + .667\ t + .073\ t^2 - 5.178 \sin(60t) + 6.219 \cos(60t)$ (S.E. = 7.96)

*S.E. = standard error of forecast

EXHIBIT 4

SELECTED MODELS (t=0 AT JANUARY 72)

Impact Area:

Total offenses: $X(t) = 49.93 - 1.37\ t + .078\ t^2 + 6.6 \sin(60t) - 3.01 \cos(60t)$

Assault: $X9t) = 8.16 - .649 \sin(30t) - 2.37 \cos(30t) + 2.57 \sin(60t) - 1.16 \cos(60t)$

Burglary: $X(t) = 37.67 - 1.58\ t + .076\ t^2$

Robbery: $X(t) = 6.24$

Total Area:

Total offenses: $X(t) = 69.14 - 1.88\ t + .096\ t^2 + 7.08 \sin(60t) - 3.82 \cos(60t)$

Assault: $X(t) = 10.08 - .93 \sin(30t) - 2.24 \cos(30t) + - 1.64 \cos(60t)$

Burglary: $X(t) = 53.21 - 2.2\ t + .1\ t^2$

Robbery: $X(t) = 5.36 + .19\ t - .357 \sin(30t) + 2.027 \cos(30t)$

Cases: $X(t) = 66.24 - 1.45\ t + .073\ t^2 + 7.50 \sin(60t) - 2.80 \cos(60t)$

EXHIBIT 5

LINEAR MODELS FOR THE NON-IMPACT AREA

(t=0 AT JANUARY 1972)

Total offenses:

$X(t) = 16.85 + .001\ t$ (S.E. = 5.26)

Mean = 16.86

(.117)*

% change/period = .005

Assault: $X(t) = 2.59 - .048\ t$ (S.E. = 1.33)

(.029)

Mean = 1.90

% change/period = -2.5

Burglary: $X(t) = 12.50 + .018\ t$ (S.E. = 5.71

(.237)

Mean = 12.76

% change/period = .14

Robbery: $X(t) = 1.06 + .056\ t$ (S.E. = 1.69)

(.037)

Mean = 1.86

% change/period = 3.01

* Numbers in parentheses represent the standard error of the linear coefficient.

EXHIBIT 6

LINEAR MODELS FOR THE IMPACT AREA

(t=0 AT JANUARY 1972)

Total offenses:

$X(t) = 40.52 + .80\ t$	(S.E. = 9.37)
$(.208)^{**}$	Mean = 51.69
	% change/period = 1.55
Assault: $X(t) = 6.89 + .8\ t$	(S.E. = 4.19)
$(.093)$	Mean = 8.03
	% change/period = 1.00
Burglary: $X(t) = 28.06 + .56\ t$	(S.E. = 9.15
$(.203)^{**}$	Mean = 35.9
	% change/period = 1.56
Robbery: $X(t) = 4.26 + .14\ t$	(S.E. = 3.63)
$(.081)$	Mean = 6.24
	% change/period = 2.24

**Indicates significance at the two sigma level

APPENDIX 1

DATA INPUTS:

OFFENSES AND CASES FOR IMPACT AREA

AND ALL OF ATLANTA

IMPACT AREA

	ASLT.	BAT.	BURG.	HOM.	RAPE	ROB.	TOTAL
J	1	0	46	0	0	6	53
F	8	1	31	1	2	6	49
M	11	0	20	0	0	10	41
A	11	0	38	0	0	4	53
M	3	0	41	0	2	1	47
J	8	0	25	0	0	1	34
J	5	0	35	1	0	4	45
A	14	1	29	1	3	7	55
S	20	0	35	1	0	1	57
O	5	0	30	1	2	8	46
N	5	1	31	0	0	3	40
D	3	0	17	0	0	5	25
J	8	0	25	1	0	6	40
F	3	0	43	0	1	5	52
M	8	0	38	0	0	8	54
A	3	0	45	0	0	8	56
M	8	0	24	3	0	5	40
J	8	0	27	0	0	13	48
J	8	0	31	1	3	3	46
A	10	0	38	1	2	2	53
S	13	2	36	1	0	8	60
O	10	1	25	1	1	12	50
N	6	0	44	2	0	9	61
D	3	0	42	0	0	5	50
J	11	0	35	1	1	7	55
F	7	0	50	0	0	16	73
M	9	0	58	0	3	6	76
A	10	0	47	1	0	11	69
M	14	0	55	0	1	1	71

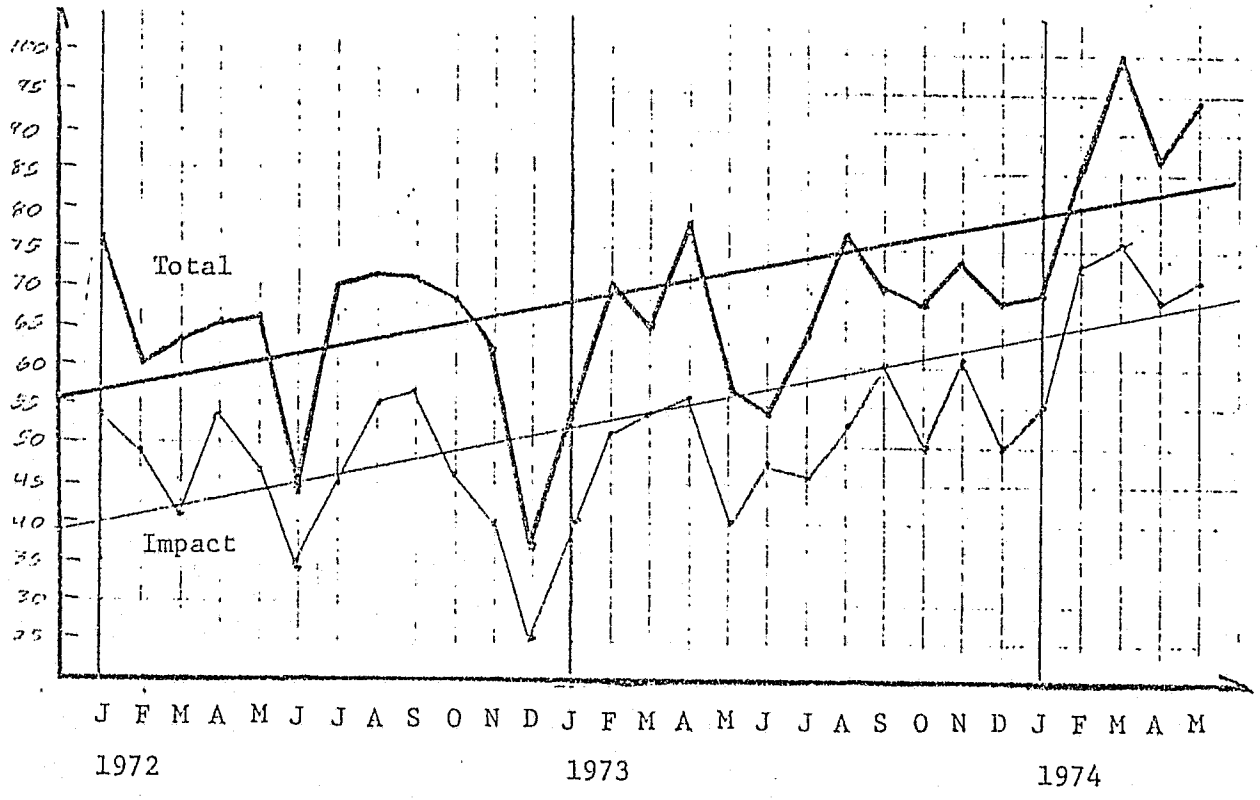
TOTAL ATLANTA AREA

	ASLT.	BAT.	BURG.	HOM.	RAPE	ROB.	TOTAL	CASES
J	2	0	66	1	1	6	76	74
F	9	0	42	1	2	7	61	59
M	15	0	37	0	0	11	63	63
A	13	0	44	1	1	6	65	64
M	6	0	55	1	2	2	66	66
J	11	0	31	0	0	2	44	43
J	6	0	59	1	0	4	70	68
A	15	1	42	1	4	9	72	70
S	24	0	40	1	2	4	71	69
O	9	0	48	2	1	8	68	66
N	9	0	48	0	0	5	62	59
D	6	0	19	0	0	12	37	36
J	12	0	34	1	0	6	53	51
F	3	0	57	0	2	8	70	68
M	10	0	47	0	0	8	65	62
A	3	0	63	0	0	12	78	76
M	10	0	37	4	0	6	57	53
J	9	0	32	0	0	13	54	53
J	10	0	46	1	3	4	64	63
A	12	0	59	2	2	2	77	75
S	12	1	44	1	0	12	70	69
O	12	1	34	2	2	17	68	61
N	8	0	52	2	0	11	73	71
D	4	0	56	0	0	8	68	67
J	11	0	47	1	1	9	69	67
F	8	0	60	0	0	18	86	81
M	12	0	77	0	3	8	100	96
A	12	0	59	1	0	15	87	77
M	15	1	76	0	0	2	94	77

APPENDIX 2

GRAPHS OF OFFENSE DATA BY CATEGORY

INCLUDING A COMPARISON OF TOTAL AREA TO IMPACT AREA



Total Offenses Data

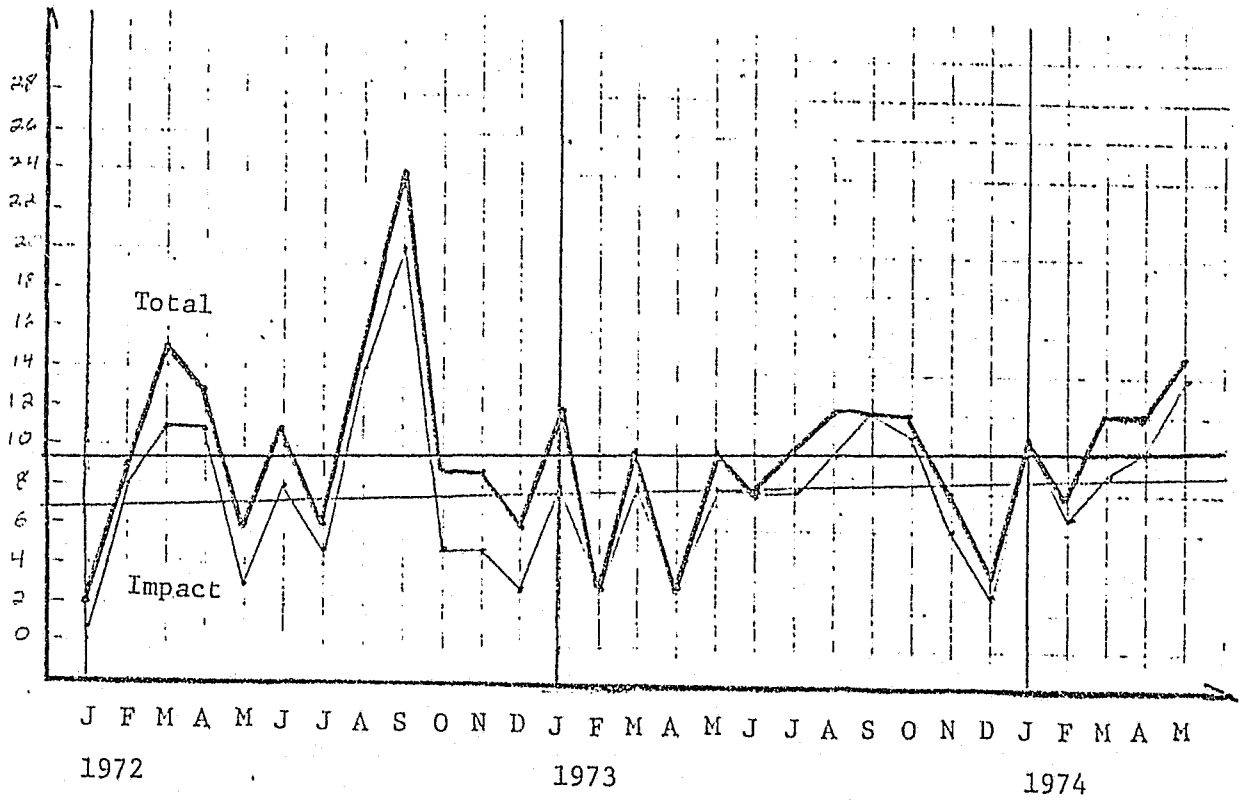
Regression Line Data:

	intercept	slope	mean	%change/period
Total	56.6	.80	68.6	1.2%
Impact area	39.7	.80	51.7	1.6%

Adjustments for seasonal pattern [(Σ actual data)/(Σ forecasted data)].

month	J	F	M	A	M	J	J	A	S	O	N	D
Total	1.02	1.08	1.11	1.12	1.04	.75	1.02	1.12	1.05	1.00	.97	.74
Impact area	1.02	1.16	1.10	1.15	1.00	.84	.93	1.09	1.16	.93	.95	.69

quarter	JFM	AMJ	JAS	OND
Total	1.07	.97	1.06	.90
Impact Area	1.10	1.00	1.06	.85



ASSAULT DATA

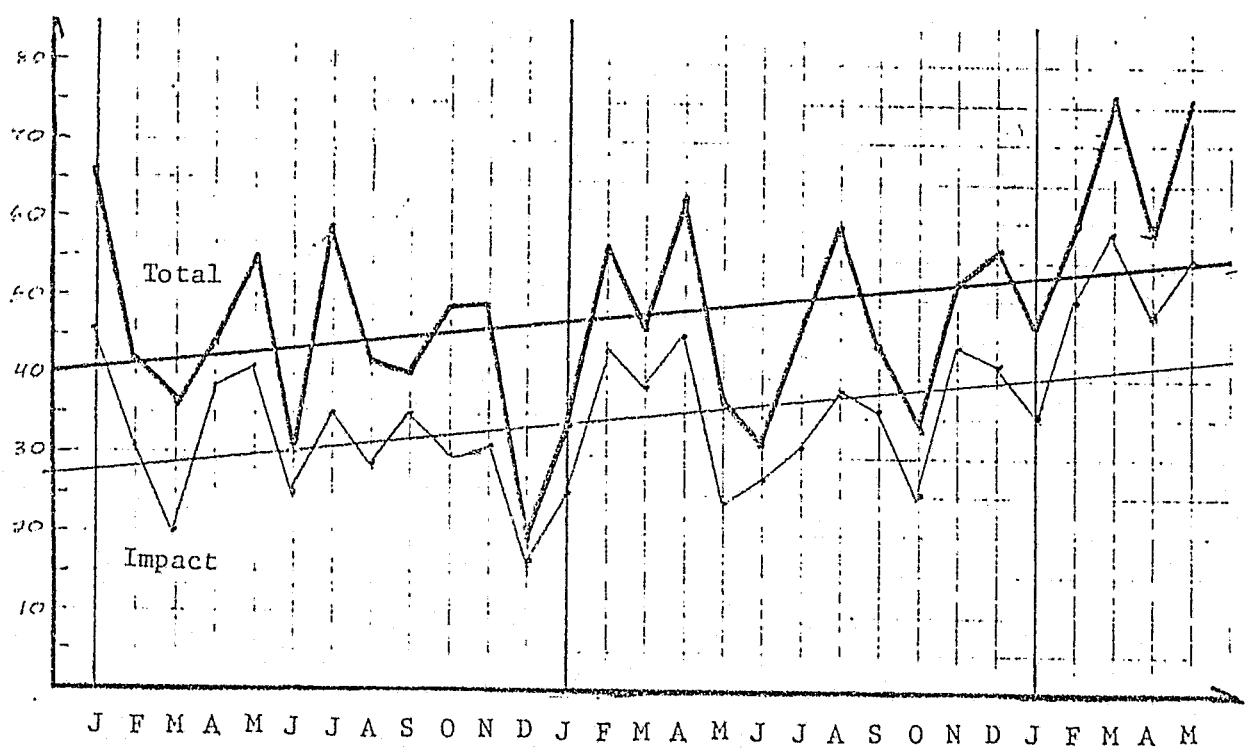
Regression Line Data

	intercept	slope	mean	%change/period
Total	9.46	.03	9.93	0.3%
Impact area	6.82	.08	8.03	1.0%

Adjustments for seasonal pattern:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	.84	.68	1.25	.94	1.03	1.02	.81	1.37	1.83	1.05	.85	.50
Impact Area	.81	.78	1.20	1.01	.98	1.04	.83	1.55	2.11	.92	.68	.37

quarter	JFM	AMJ	JAS	OND
Total	.92	1.00	1.34	.80
Impact area	.93	1.01	1.49	.65



BURGLARY DATA

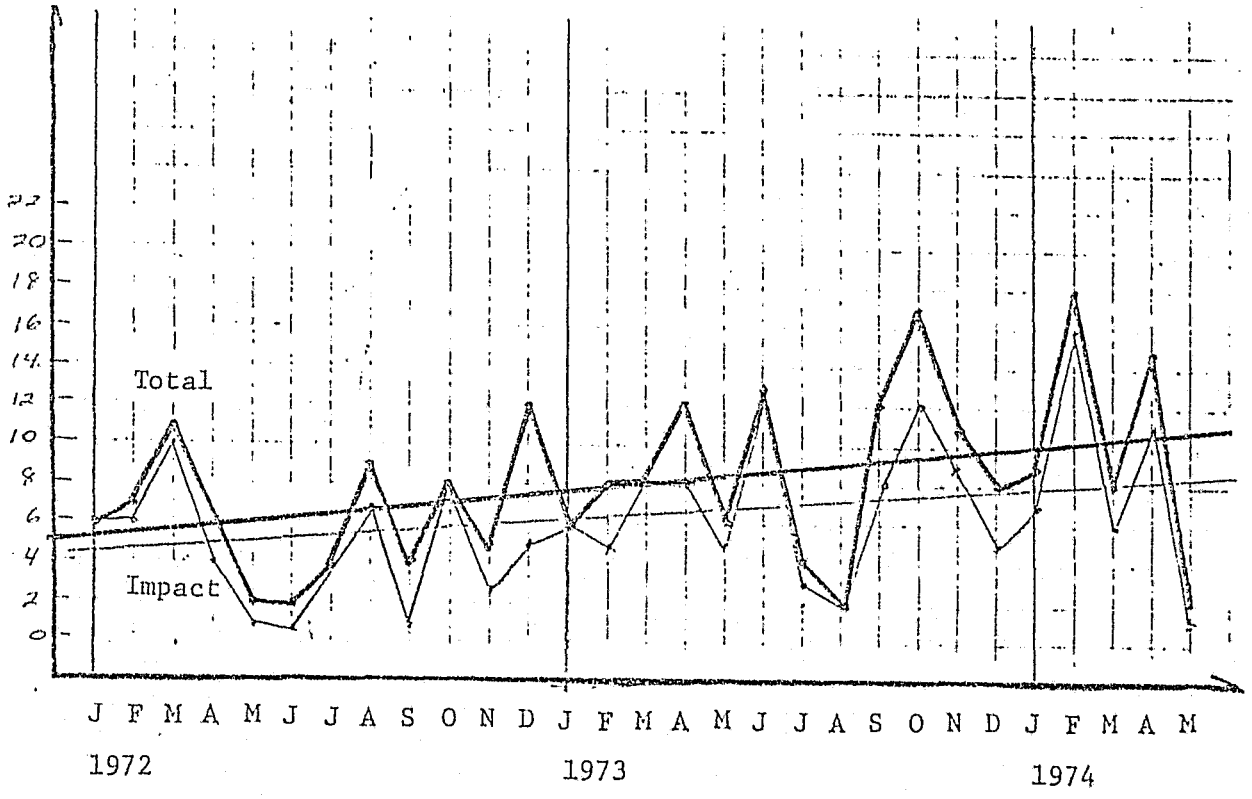
Regression Line Data:

	intercept	slope	mean	%change/period
Total	40.0	.58	48.7	1.19%
Impact Area	27.5	.56	35.7	1.57%

Adjustments for seasonal pattern [(Σ actual data)/(Σ forecasted)]:

Month	J	F	M	A	M	J	J	A	S	O	N	D
Total	1.08	1.11	1.09	1.14	1.14	.68	1.14	1.06	.88	.86	1.02	.73
Impact Area	1.09	1.18	1.05	1.22	1.10	.78	.98	.96	1.01	.78	1.02	.77

quarter	JFM	AMJ	JAS	OND
Total	1.10	.98	1.02	.87
Impact area	1.11	1.03	.98	.86



ROBBERY DATA

Regression Line Data:

	intercept	slope	mean	%change/period
Total	5.14	.20	8.10	2.5%
Impact area	4.12	.14	6.24	2.2%

Adjustments for seasonal pattern [(Σ actual data)/(Σ forecasted data)]

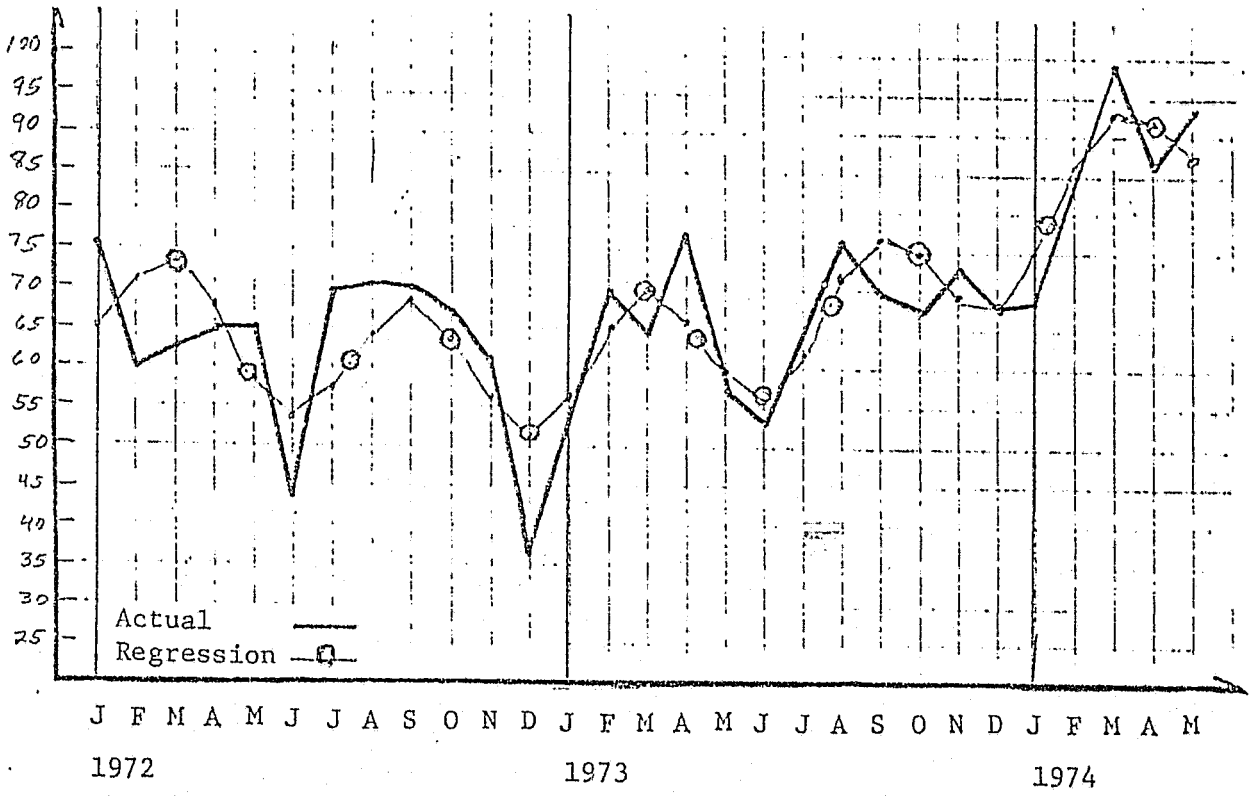
Month	J	F	M	A	M	J	J	A	S	O	N	D
Total	.96	1.38	1.26	1.32	.42	.93	.55	.80	.96	1.49	.93	1.23
Impact area	1.13	1.45	1.45	1.18	.37	1.10	.63	.83	.67	1.59	.89	.78

quarter	JFM	AMJ	JAS	OND
Total	1.20	.89	.77	1.22
Impact area	1.35	.89	.71	1.09

APPENDIX 3

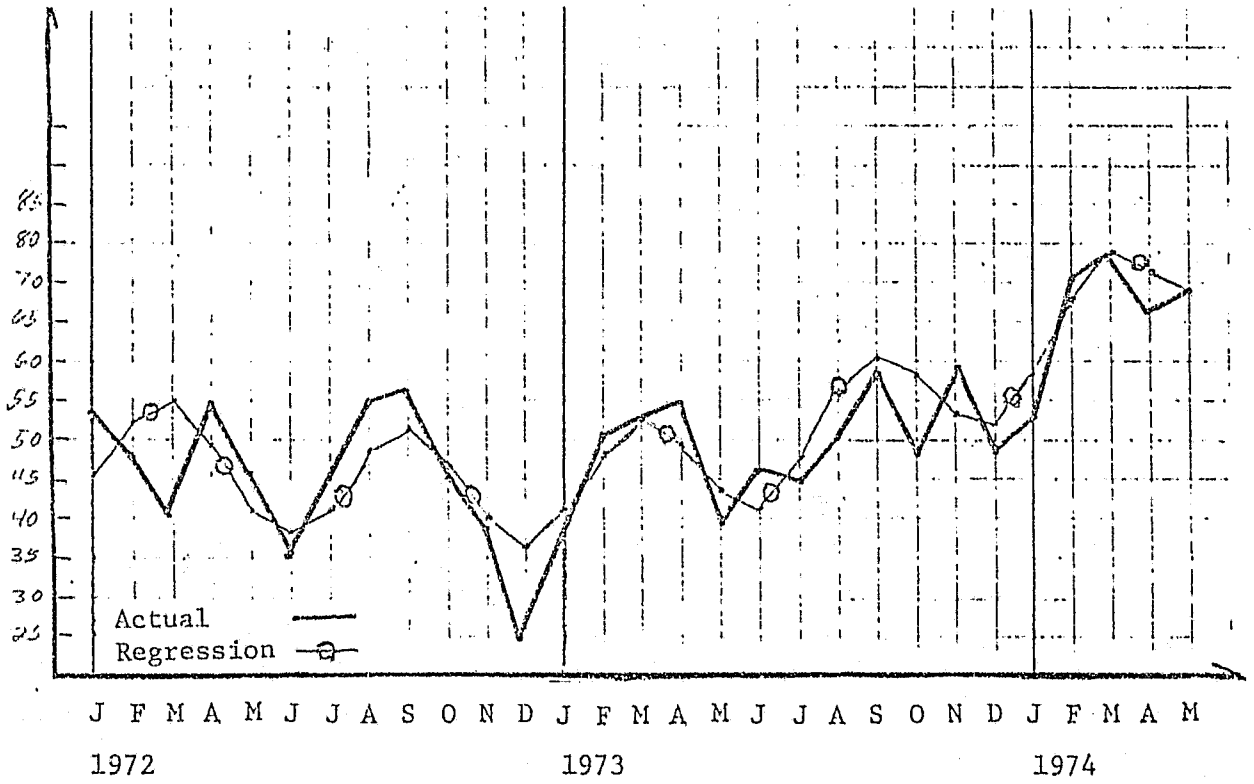
GRAPHS OF ACTUAL DATA AND SELECTED MODEL

BY OFFENSES TYPE AND AREA



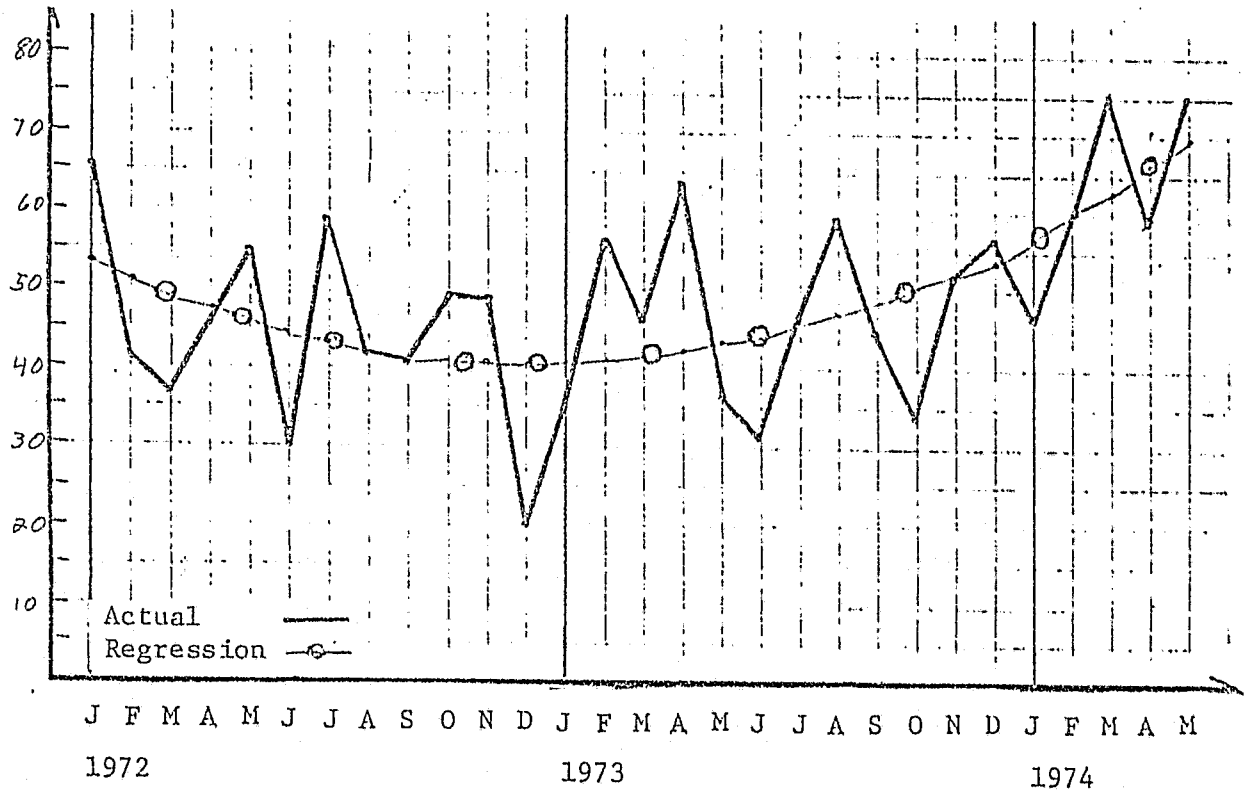
$X(t) = 69.14 - 1.88 t + .096 t*t + 7.08 \sin(60t) - 3.82 \cos(60t)$

Total: Total offense data vs model



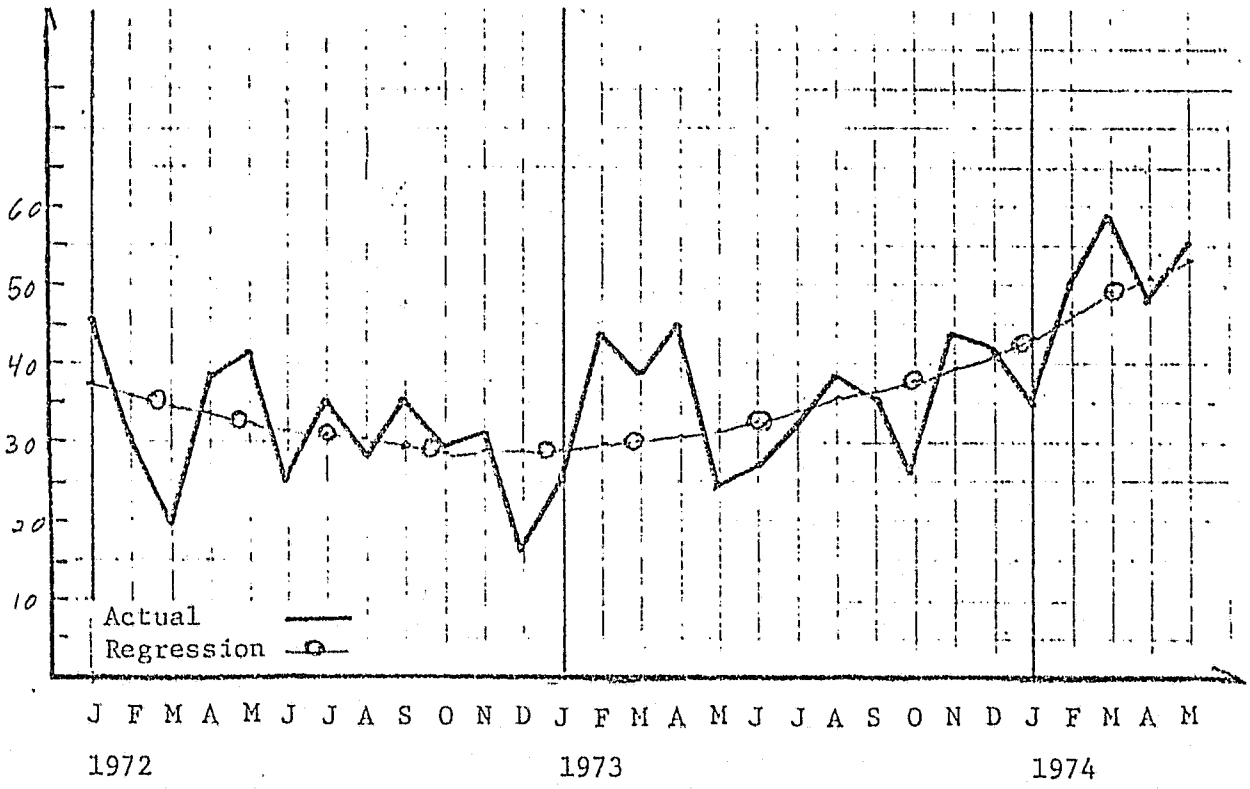
$$X(t) = 49.93 - 1.37\,t + .078\,t*t + 6.61 \sin(60t) - 3.01 \cos(60t)$$

Impact: Total offense data vs model



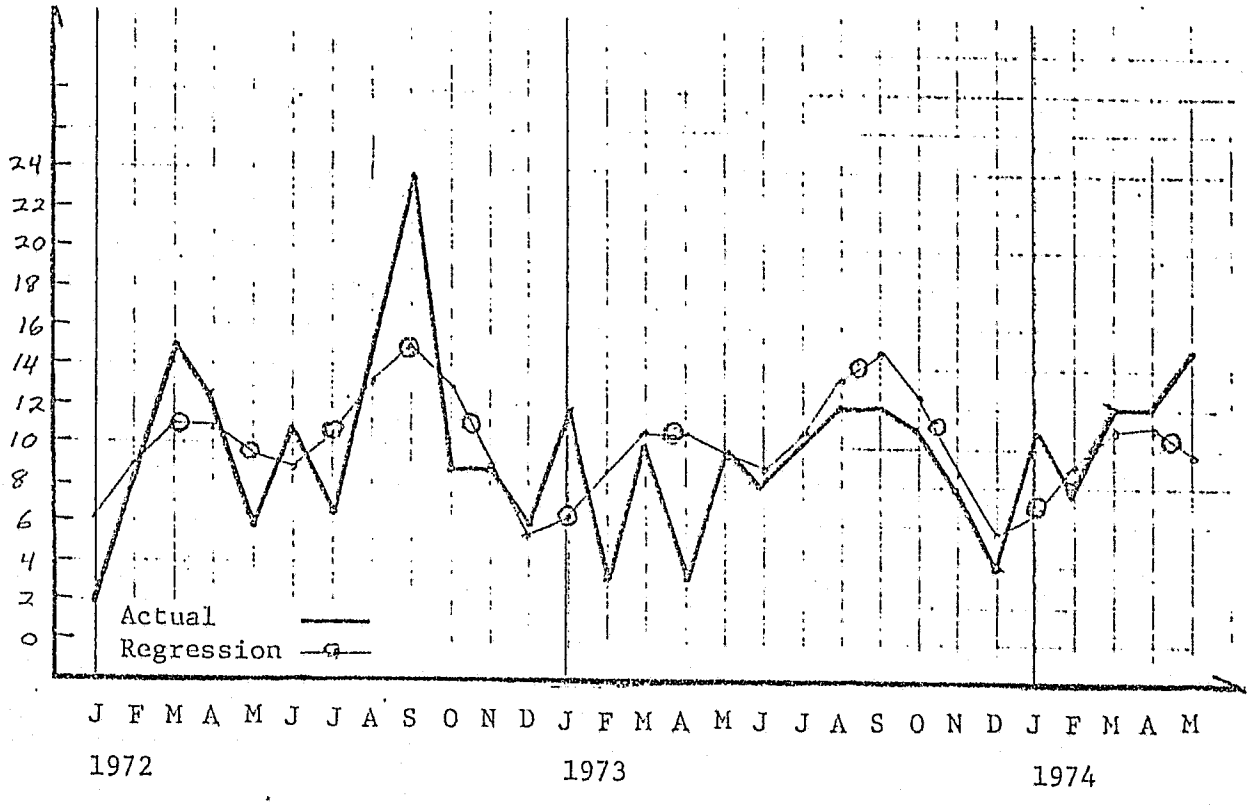
$X(t) = 53.21 - 2.22\ t + .01\ t*t$

Total: Burglary data vs model



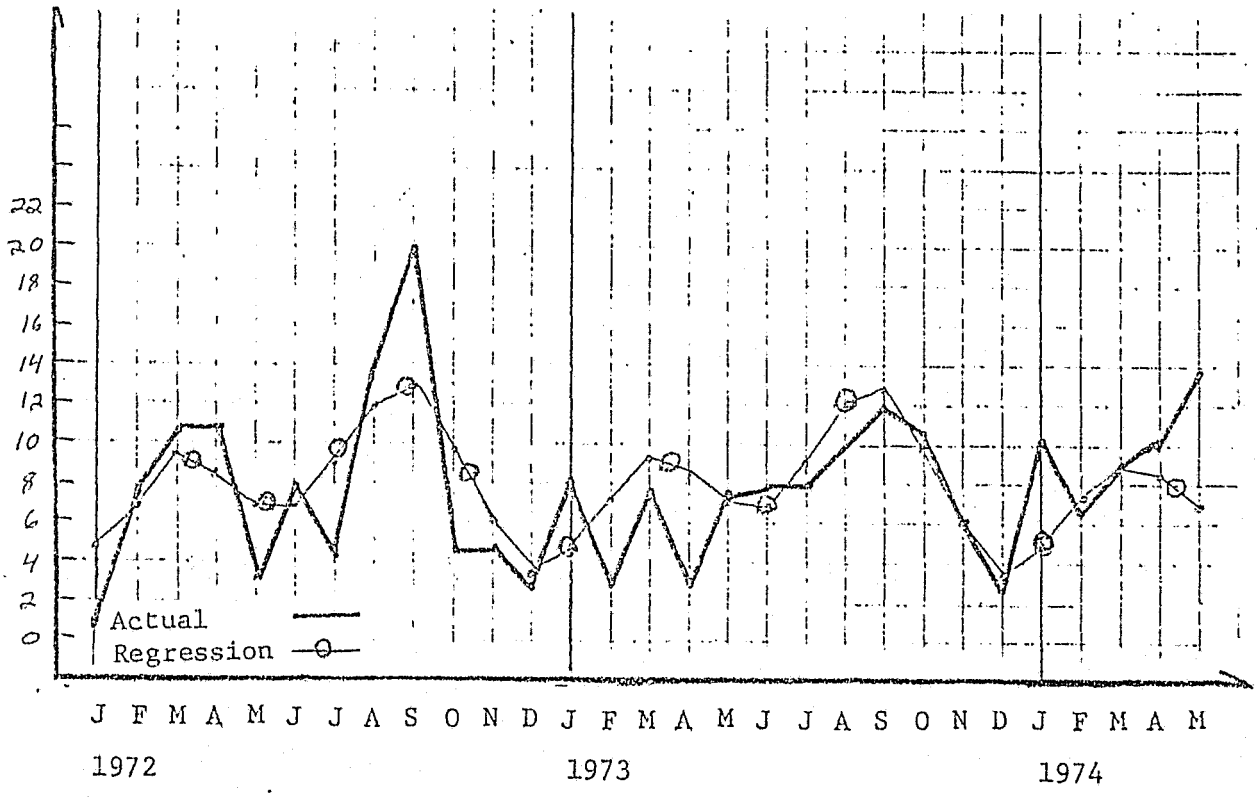
$X(t) = 37.67 - 1.58\ t + .076\ t*t$

Impact: Burglary data vs model



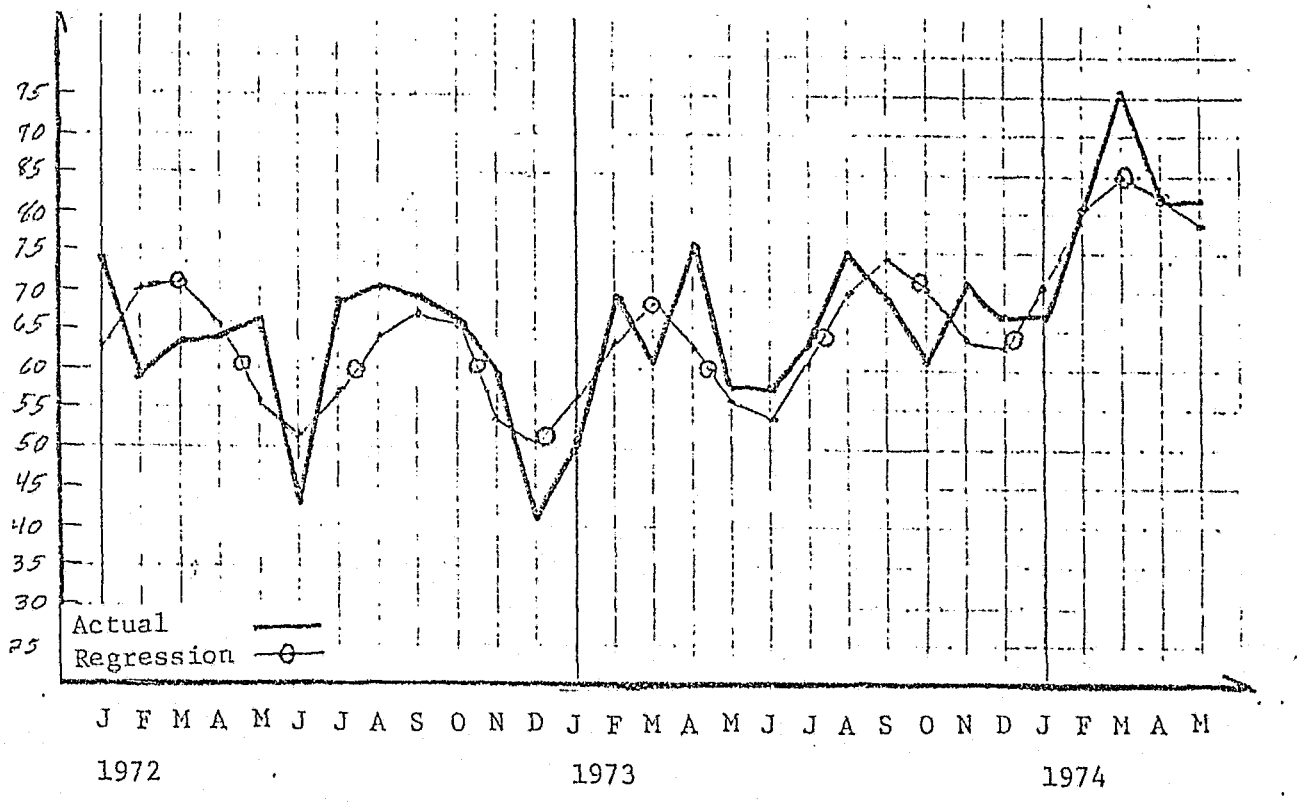
$$X(t) = 10.08 - .93 \sin(30t) - 2.24 \cos(30t) + 2.28 \sin(60t) - 1.64 \cos(60t)$$

Total: Assault data vs model



$$X(t) = 8.16 - .649 \sin(30t) - 2.37 \cos(30t) + 2.57 \sin(60t) - 1.16 \cos(60t)$$

Impact: Assault data vs model



$$X(t) = 60.56 + .667\,t + .073\,t*t - 5.178 \sin(60t) + 6.219 \cos(60t)$$

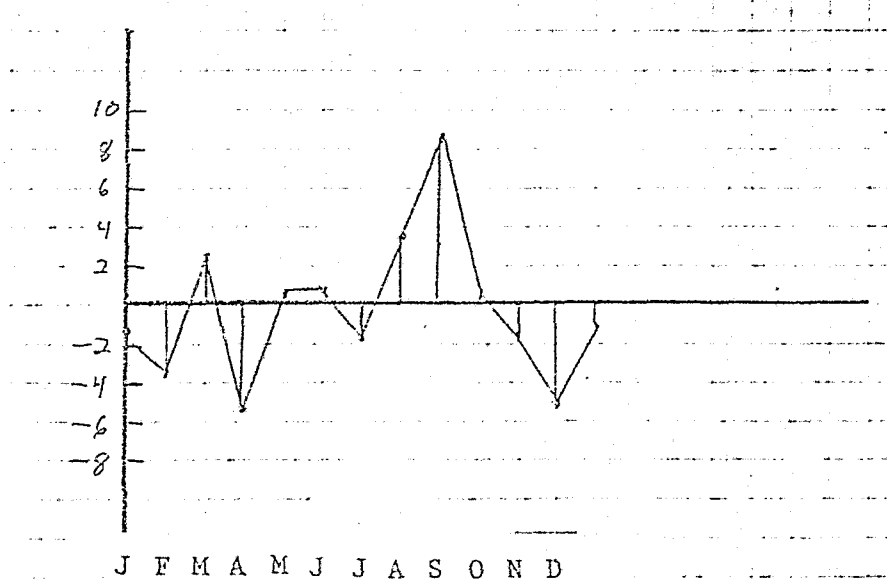
Total cases vs Model

APPENDIX 4

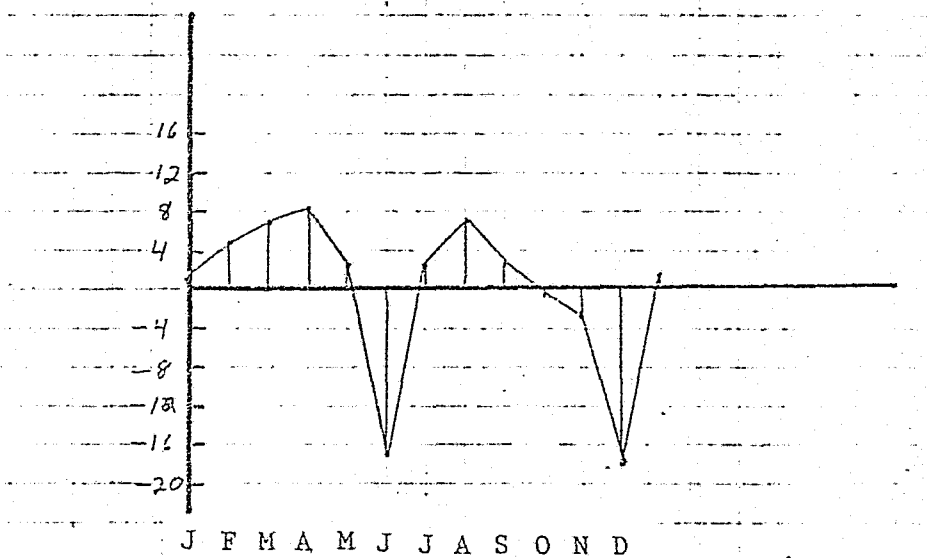
SEASONAL DEVIATION ESTIMATES

GENERATED BY WINTER'S METHOD

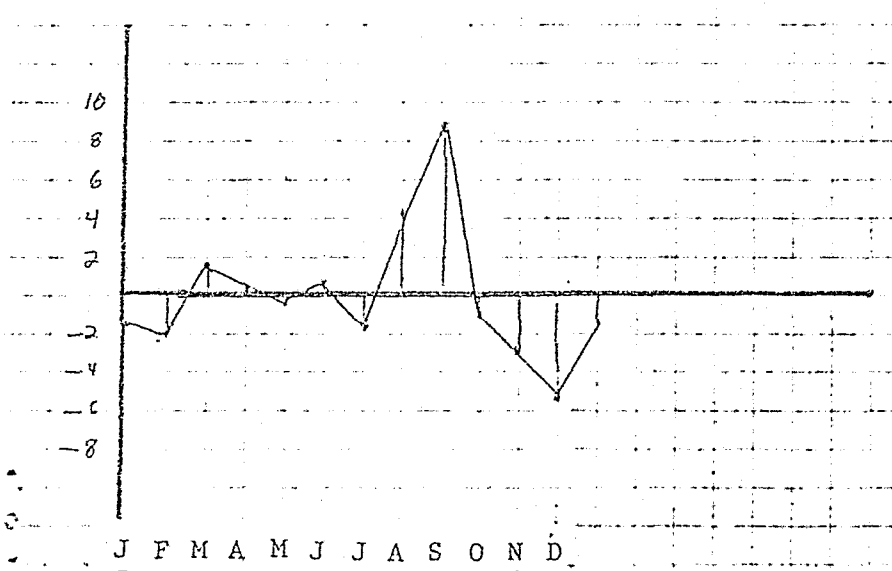
Total Area: Assault



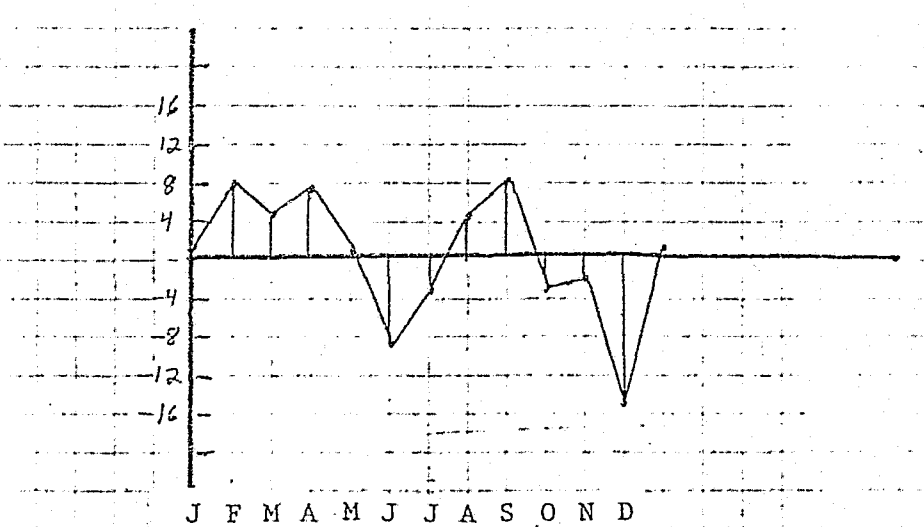
Total Area: Total - Offenses



Impact Area: Assault



Impact Area: Total - Offenses

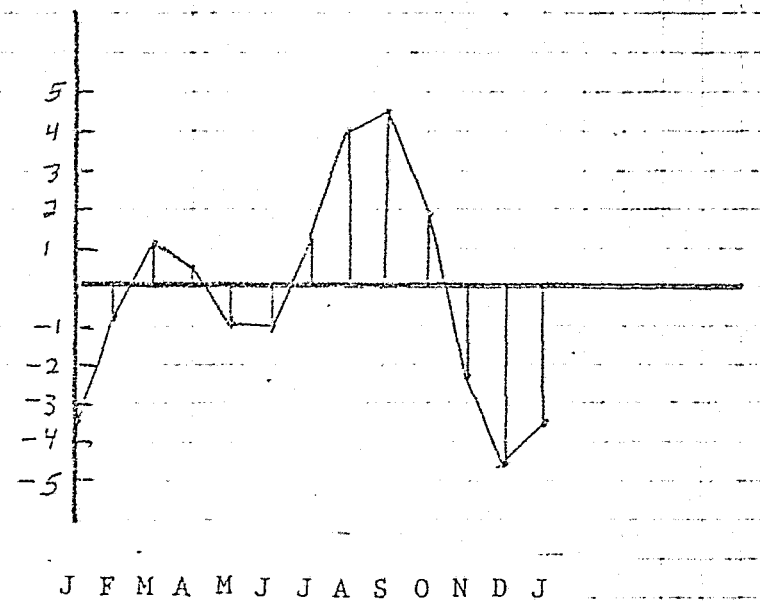


APPENDIX 5

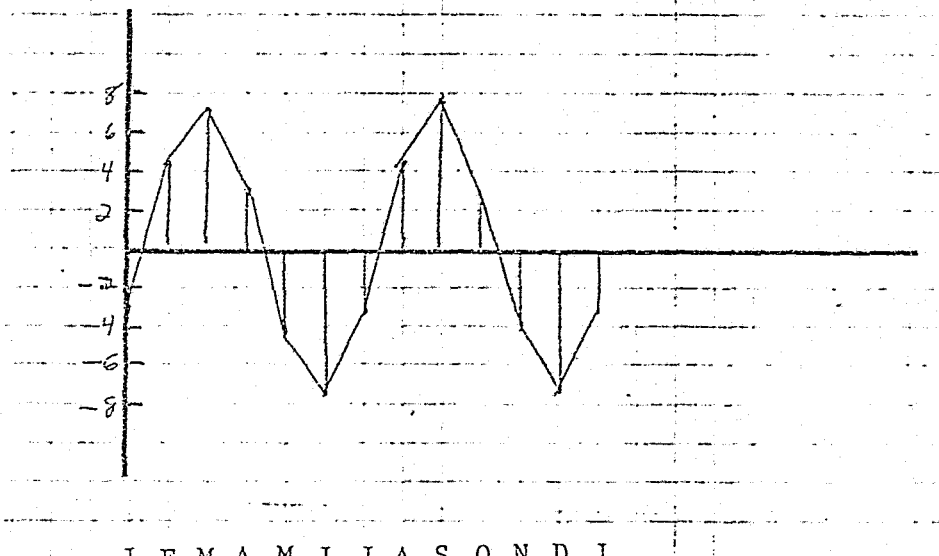
SEASONAL DEVIATION ESTIMATES

GENERATED BY MULTIPLE REGRESSION

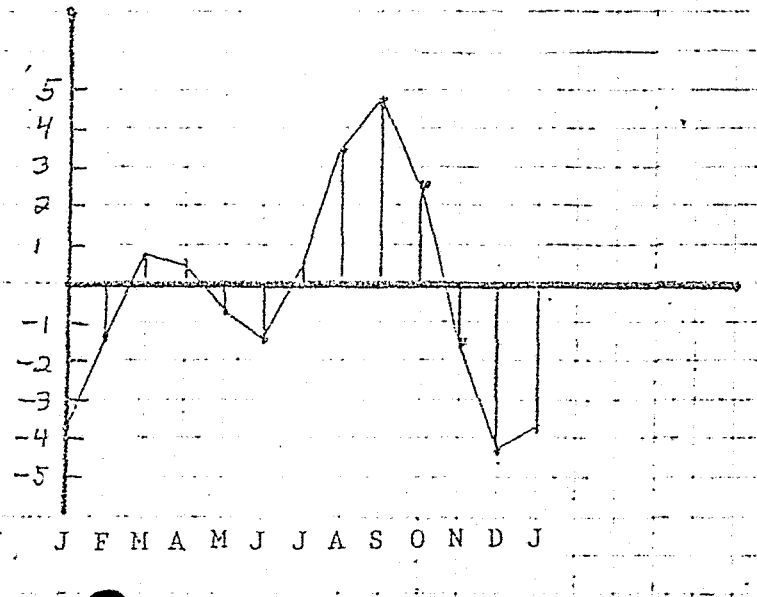
Impact : Assault



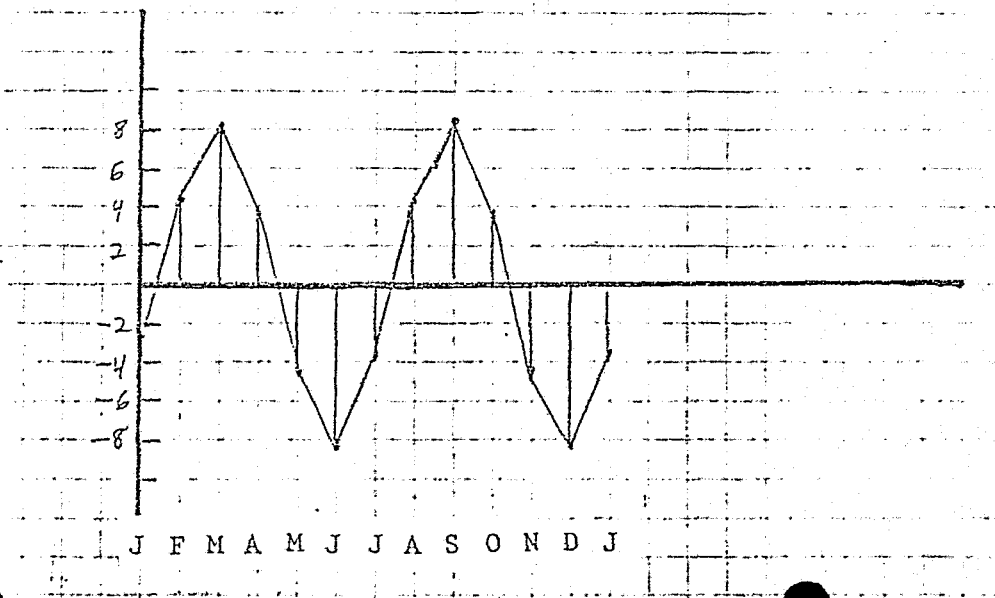
Impact : Total-Offenses



Total Area : Assault



Total Area : Total-Offenses



APPENDIX 6

DEFINITION OF IMPACT AREA BY CENSUS TRACTS

BREAKDOWN OF IMPACT AREAS BY CENTERS AND CENSUS TRACTS[1/]

WHEAT STREET CENTER	LEILA VALLEY	BANKHEAD
10	52	6
11	53	7
12*	55.01*	8
13	55.02*	9
14	56*	22
15	63	23
16	64	24*
17	65	25*
18	66.01	26
19	67*	40*
20	68	60*
21	69	61*
26*	70	62
27	71*	66.02
28	72*	76.02
29	73	77.01*
30	74*	78.01
31	75*	78.02
32*		79
33		80
35		81.01
36		81.02
37		82.01*
38		82.02
39		83.01*
41		83.02
42		84*
43		85*
44		86.01*
45		86.02
46		87.01
47		87.02
48*		88
49		
50		
57		
58		
59		

*Identified by ARC as high crime census

[1/] Source: Fulton County Juvenile Court

END