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ATLANTA

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STREET LIGHT PROJECT

Final Evaluation Report,

NCJRS

SEP 17 1976

ACQUISITIONS

For the Period

December, 1973 - November, 1974

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I PROJECT SUMMARY

In an effort to discourage nighttime target crimes, high intensity lights were installed for streets in a selected area of Census Tract 27, Atlanta, Georgia. The goal of the project was to reduce nighttime robberies by 15% and the total of other nighttime target crimes by 5% in the lighted area. The other target crimes, consist of murder, rape, assault and burglary. In view of the fact the relative frequency of murder and rape were not significant, emphasis in this report is placed on the other three target crimes.

Data collected for one year (December,1973 through November,1974) of the project's operation indicates that none of the predefined goals of the project were accomplished. The most significant change in the crime trends was the extraodinary number of nighttime assaults that occurred in Census Tract 27, in both lighted and unlighted areas. In fact, this unusual crime rate in assaults accounts for the wide margin by which Goal 2 fails to be realized. It was believed that the pre-defined performance measures might ignore certain effects attributable to the street light program, therefore additional measures of performance were designed. This was done by comparing the difference in rate of increase of each crime before installation of the street lights with that rate after installation. This percent improvement per crime committed confirms that there has been a trend indicating a reduction in the rate of increase of nighttime burglaries.

In addition two measures of crime displacement were calculated. The first measure indicated the shift in nighttime target crimes from the lighted to un-lighted area of Census Tract 27. The second measure deals with the shifts of criminal activity from nighttime to daytime for target crimes occurring in the lighted area.

This report concludes that the first year of the street lighting project did not reduce target crimes in the areas of improved lighting. However there is an

indication that the project did reduce the rate of increase of nighttime burglaries. Regarding crime displacement, there was no indication that nighttime criminal activity shifted from the lighted to unlighted areas and only for robbery was there any supportable evidence that criminal activity in the lighted area shifted from day to night. For assault and burglary in the lighted area there were no shifts.

IX PROJECT DESCRIPTION

1. General

The project was designed to reduce night time robberies in the project area by 15% and reduce the total of other night time target crimes by 5% by the installation of high intensity lighting for 21 streets in a selected area of Census Tract 27, Atlanta, Georgia. This increased lighting was to be achieved by the installation of 137 400-watt high pressure sodium vapor lights and by converting 45 400-watt mercury lights to 45 400-watt high pressure sodium vapor lights. The immediate effect of this project was to produce a light level in the target areas of 8 average maintained foot-candles, which is four times the light level existing prior to the project.

2. Implementation

The grant award was made by the State Crime Commission to the City of Atlanta on March 15, 1973. The City's bidding and internal procedures were followed and a contract for the work was signed May 22, 1973 for the amount of $163,253. A change order later increased the amount to $3,557.55. The contractor began work July 25, 1973.

Implementation problems included (1) late delivery of new poles (2) having to reroute conduits due to difficult pole foundations and conduit runs in hollow sidewalk areas, and (3) deteriorated existing wiring conduit and foundations. Problems 2 and 3 were anticipated, but the degree to which they would occur could not be determined prior to implementation.

By the end of November, 1973 project implementation was complete- As usual, the final results differed somewhat from grant application projections- The grant application projected adding 137 four hundred watt high.preasure sodium vapor lights. Implementation resulted in 141 being added. The grant application also projected converting 45 of the old style 400 watt mercury lights to four hundred watt high preasure sodium vapor lights. Actually fifty conversions were made. Therefore while a total of 182 new high pressure sodium lights were projected by the application, a higher total of 191 was installed. The Total cost anticipated in the grant application for installations of 182 lights was $248,747.27.

3. Comparison Areas

The sample data prepared by ARC before the project was funded suggested that the nighttime commercial and open space robberies were the crimes that would be most affected by this project. Therefore, the choice was made to light appropriate streets in Census Tract 27 since Tract 27 ranked first in commercial robberies and first in open space robberies. (See ARC 1973 Master Plan-Statistical Abstracts for exact figures in TABLE A-l, Appendix A).

To provide a reasonable evaluation of project performance as compared to other unlighted areas, it was necessary to find comparable areas having the demographic similarity with the lighted area in Census Tract 27. Because the areas within Census Tract 27 surrounding the lighted area were similar in not only demographic but also in physical characteristics, it was believed that the most appropriate comparison should be made between the lighted and unlighted area of Census Tract 27. Therefore, the evaluation hypotheses were tested by comparing night robberies, assaults and burglaries rates in the lighted area with those in the unlighted area of Census Tract 27. The goals of the project focus on the rate of crime reduction during the period before the street lights were installed compared to the crime rate after installation. By compiling data concerning crimes committed in the same area before and after the lighting was installed, the success

of the project with regard to the goals of crime reduction were determined. Detailed descriptions of unlighted and lighted areas are shown in Figure 1 with street listings.

A. Evaluation

The purpose of this section is to evaluate the project performance with reference to the predefined goals associated with this project, and to develop additional insights into the effects of lighted area on criminal activity.

(i) Project Goals

In terms of frequency, robbery and burglary constitute the largest part of the crime problem in Census Tract 27. Therefore, murder and rape crimes were not the primary consideration for the street lighting project. Based on the results of previous street lighting programs undertaken by other cities, it was decided that project's greatest effect would be on robberies. Therefore, the primary goal was established to reduce the number of nighttime of robberies by 15 % in the lighted area.

GOAL I

Statement: Reduce the number of nighttime robberies by 15% within the lighted area.

Measurement:

Let

R_o » Number of nighttime robberies in the lighted area for 12 months *after* the lights are turned on,

R_1 «* Number-of nighttime robberies in the lighted area for comparable 12 months *before* lights installed.

Then, GOAL I will have been achieved if

$$-!\frac{a}{R_1} > .15 .$$

Figure 1. STREETLIGHTING PROJECT - CITY OF ATLANTA.

ATLANTA IMPACT PROGRAM

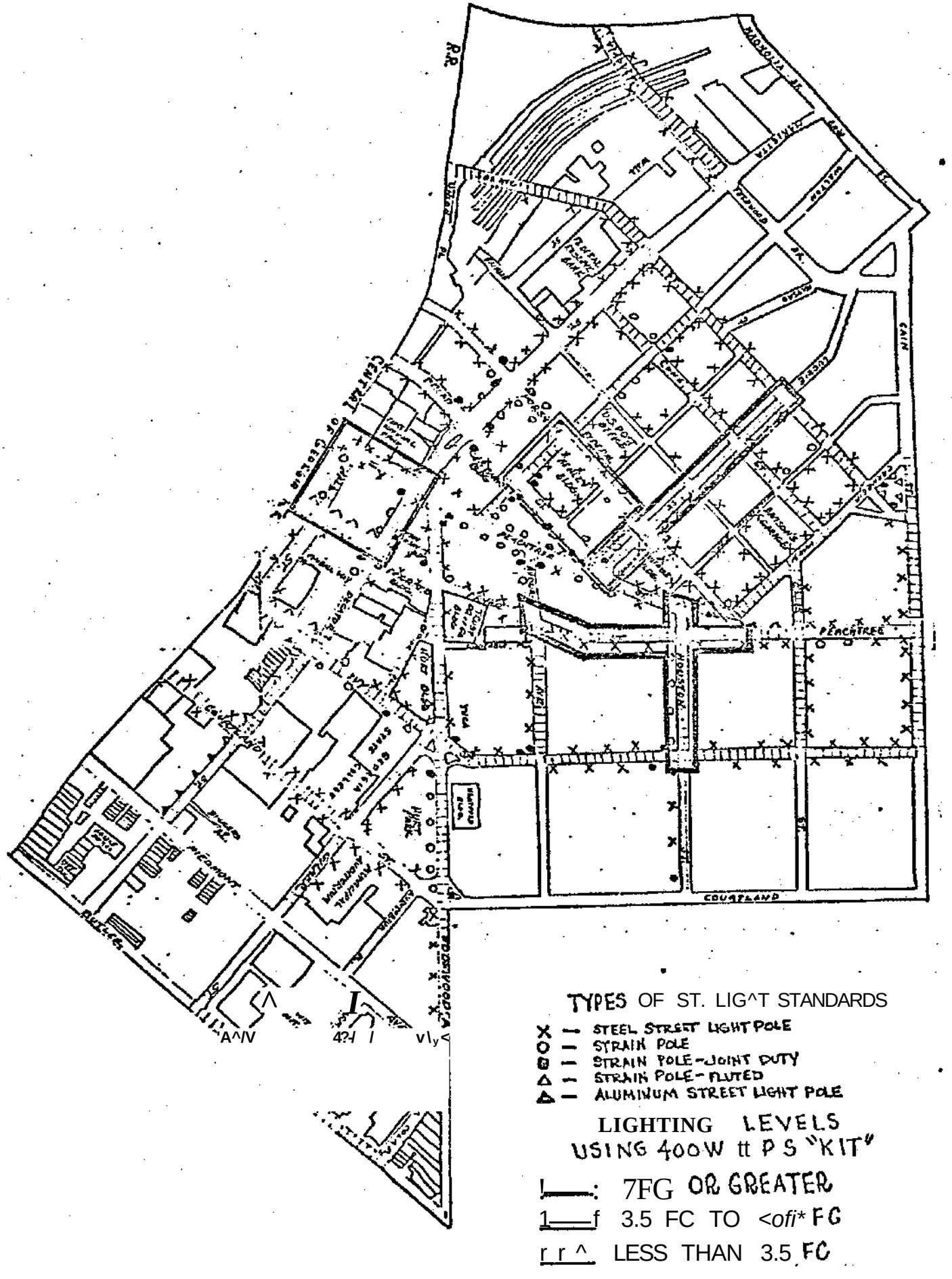


TABLE 1

Lighte'd Streets and Street Segments

Forsyth St.. from Luckie to Walton

Walton NW from Forwyth to Broad

•Broad St. from Walton to Luckie

Poplar St. NW from Forsyth to Peachtree

Fryor St. NE from Auburn to Peachtree

Houston NE from Peachtree to Ivy

Luckie NW from Peachtree To Spring

Peachtree St. NE from Plaza Park to Decatur

Pryor SW from Wall St. to Decatur

Wall SW from Peachtree to Pryor

Decatur NE from Pryor to Peachtree

Plaza Park

Pryor SW from Decatur to Auburn Ave.

Edgewood Ave. NE from Pryor to Peachtree

Auburn Ave. NE from Pryor to Peachtree

Peachtree St. NE from Decatur to Luckie

Peachtree St. NE from Luckie to Pryor

Poplar NW from Broad to Peachtree

Walton NW from Broad to Peachtree

William NW from Forsyth to Peachtree

Forsyth NW from Luckie to Carnegie Way

The other target crimes were grouped for COAL II- Because of the small number of murders end rapes GOAL II measures the reduction in burglaries and assaults in the lighted area.

GOAL II

Statement; Reduce the total of other nighttime target crimes by 5%. Within the lighted area.

Measurement:

Let

0_o = Number of other nighttime crimes in the lighted area for 12 months after the lights are installed.

0_1 " Number of other nighttime target crimes in the lighted area for comparable 12 months before lights installed.

The, GOAL II will have been achieved, if

$$\frac{0_1 - 0_o}{0_1} \geq .05.$$

(ii) Alternative Performance Measures

It was believed that the previously discussed performance measures ignored certain effects attributable to the street light program, and therefore other measures of performance were designed. One of these measures is the change in the rate of increase in crime before the installation of the lights when compared to the rate of increase after installation. This rate of change in the rate of crime increase was computed for burglary, assualt and robbery-. To do this, it is necessary to define a base rate at which crime is'increasing to develop some measure of crime per crime committed.

Two cases are to be considered in this study. The first case is to compute the percent improvement per crime committed for each target crime classification by using the total nighttime annual crime rate within Census Tract 27 as a base rate. The second case uses the total city, nighttime annual crime rate as a base rate.

Let

r_o - The number of crimes per year committed at night in the lighted area before installation divided by the base rate at which crime is increasing for that year.

r_R The number of crimes per year committed at night in the lighted area after installation divided by the base rate at which crime is increasing for that year.

IF,

$$\frac{r_R - r_o}{r_o} > 0$$

then, there has been a decrease in the rate of increase of criminal activity from one year to the next.

(Hi) Crime Displacement

In addition to the evaluation of the project goals, an attempt was made to determine if displacement is occurring as a result of the street lighting project. This displacement is investigated in terms of shifts of crime from nighttime hours to daytime hours, and the displacement of target crimes from the lighted area to the unlighted area of the census tract. These additional measures provide some indication of the effects of street lighting on criminal activity. First, it was hypothesized that by installation of street lights, criminals would choose to leave the lighted area and commit their crimes in the unlighted area during the nighttime hours. Secondly, it was hypothesized that there should be crime displacement from nighttime to daytime hours in the project area. To present this, each crime category is shown separately and analysed with regard to the following premises.

(1) : Whether or not target crimes are displaced into adjacent areas where lighting has not been improved.

(2) : Whether or not there is a shift of target crime activity from nighttime to daytime hours after the lights were installed.

Statistical tests have been devised to test the validity of conclusions drawn from the project data. This allows for more meaningful statements about the crime trends observed.

(iv) Statistical Tests

To prove whether the hypotheses in Section (iii) are valid a series of statistical tests were applied. Since there is always some element of each crime rate which is due to chance occurrences, it is necessary to distinguish between chance variations and those changes that may be attributable to the cause and effect of the street lighting project. To do this, tests of statistical significance were adopted. Tests of statistical significance determine the probability that observed changes are part of this chance variation. If a hypothesis test is performed at a 0.05 level of significance (Type I error), it indicates that the probability is 0.95 of accepting the hypothesis when it is true.

In this report most of the hypotheses are concerned with whether the amount of change observed in various statistical measures is due to chance variation or changes in cause and effect relationships. At a 0,05 level of significance the change in some statistical measure is considered to be other than chance if the probability of that change is less than 0.05. In this study all hypotheses were tested at 0.05 level of significance.

(v) Data Base

The data utilized in this report was based on information provided from the records of the Atlanta Police Department. To determine criminal activity in Census Tract 27 for a year preceding the installation of the street lights requires that a time span from December 1972 through November 1973 be considered. This report covers data from December 1972 through November 1974.

Basic data for target crimes committed on Census Tract 27 was classified by

the type of crime, hour and date of occurrance, location, weapon used and goods stolens. The target crimes are murder, rape, burglary, assault and robbery as-defined by FBI crime classification. These data elements are tabulated monthly for the project area classified by street address, type of crime and time of day.

To prepare a monthly listing of the known nighttime occurrence of each of the crime classes for the entire 24-month period, each crime was classified by lighted and unlighted categories depending on where the crime was committed. The nighttime crimes were identified by the time of occurrence and then each month they were tabulated as to whether they occurred in the lighted or unlighted areas- In this tabulation, nighttine crimes were defined as those crimes that were committed between 6 p.m. and 6 a.m. To illustrate how. this data format was developed the sample computer print-out supplied by the Atlanta Police Department is attached in Appendix A, Table A3. Tor example, to determine the nighttime robbery statistics in the lighted area during November 1974 (See the sample data Table A-2, Appendix A), it is necessary to identify whether or not the crime committed is in Census Tract 27. This is accomplished by checking the street address where the crime has occurred. (It is marked (/) if the crime has been committed within the census tract.) The next step is to classify each crime committed within the census tract by lighted and unlighted areas depending on where the crime has occurred. (It was double marked (//) if the crime was committed in the lighted area in the sample format.) The last step is to count and tabulate the number of nighttime crimes from each area. Therefore, it is seen that the robbery statistics for November 1974 is tabulated as $\begin{bmatrix} 19, & 11 \\ 7, & 3 \end{bmatrix}$. This indicates that the total number of robberies committed within census tract were 19 and 11 of them were committed during the nighttime hours. It also shows that a total of 7 robberies were committed in the lighted area and 3 of them occurred during the nighttine hours. Therefore, it was possible to classify those that were known to have been committed during the day, those known to have been committed at night and those for which the time of commission was unknown.

III RESULTS

1- Crime Statistics - Trends Analysis

The crimes committed during the first full year operation since the installation of high intensity street lights within Census Tract 27 are shown in Table 2, These crimes are classified by the type of crime, when they were occurred, i.e., day or night, and whether they were committed in the lighted or unlighted area of the census tract. Table 2 covers the data from December of 1973 through November of 1974.

Table 2. Crime Statistics in Census Tract 27 (Dec. 1973 - Nobember 1974)

Crime	Lighted Area Only			Unlighted Area Only			Census Tract 27		
	Night	Day	Total	Night	Day	Total	Night	Day	Total
Murder	1	0	1	1	0	1	2	1	2
Rape	1	0	1	3	1	4	4	1	5
Robbery	41.	16.	57	106	51	157	147	67	214
Assault	33	24	57	132	61	193	165	85	250
Burglary	26	11	37 *	61	20	81	87	31	118
Total	102	51	153	303	127	*430	405	184	589

Prior data for December 1972 through November 1973 has been collected and analysed by type of crime and time of day for Census Tract 27 in the same format as Table 2. This crime statistic is illustrated in Table 3.

Table 3. Crime Statistics in Census Tract 27 (Dec. 1972 - Nov. 1973) before the lights installed

Crir.e	Lighted Area Only			Unlighted Area Only			Census> Tract 27		
	Might	Day	Total	Night	Bay	Total"	Kight	Day	Grand Total
Murder	0	0	0	2	2	4	2	2	4
Rape	0	0	0	7	2	9	7	2	9
Robbery	26,	36.	62	30	4?	127	105	83	189
Assault	5	6	11	24	22	46	29	28	57
Burglary	22	19	41	31	30	61	53	49	102
Total	53	61	114	144	103	247	197	L64	351

Figure 2 compares criminal activity in the lighted area of Census Tract 27 for the year preceding the installation of the street lights with year following installation. This figure was developed on the basis of nighttime crimes in the project area. For similar data regarding total crime trends in Census Tract 27 see Figure A-l, Appendix A.

»

As indicated by the figure, there has been a significant increase in assault crimes in 1974 as compared to other crimes rates. All types of crimes increased when considered in terms of the absolute number of crimes. Daytime crimes in both lighted and unlighted areas in Census Tract 27 also shows the same general trends as seen for nighttime crime.

Define that 1973 will refer to Dec. 1972 - Nov. 1973
1974 Dec. 1973 - Nov. 1974

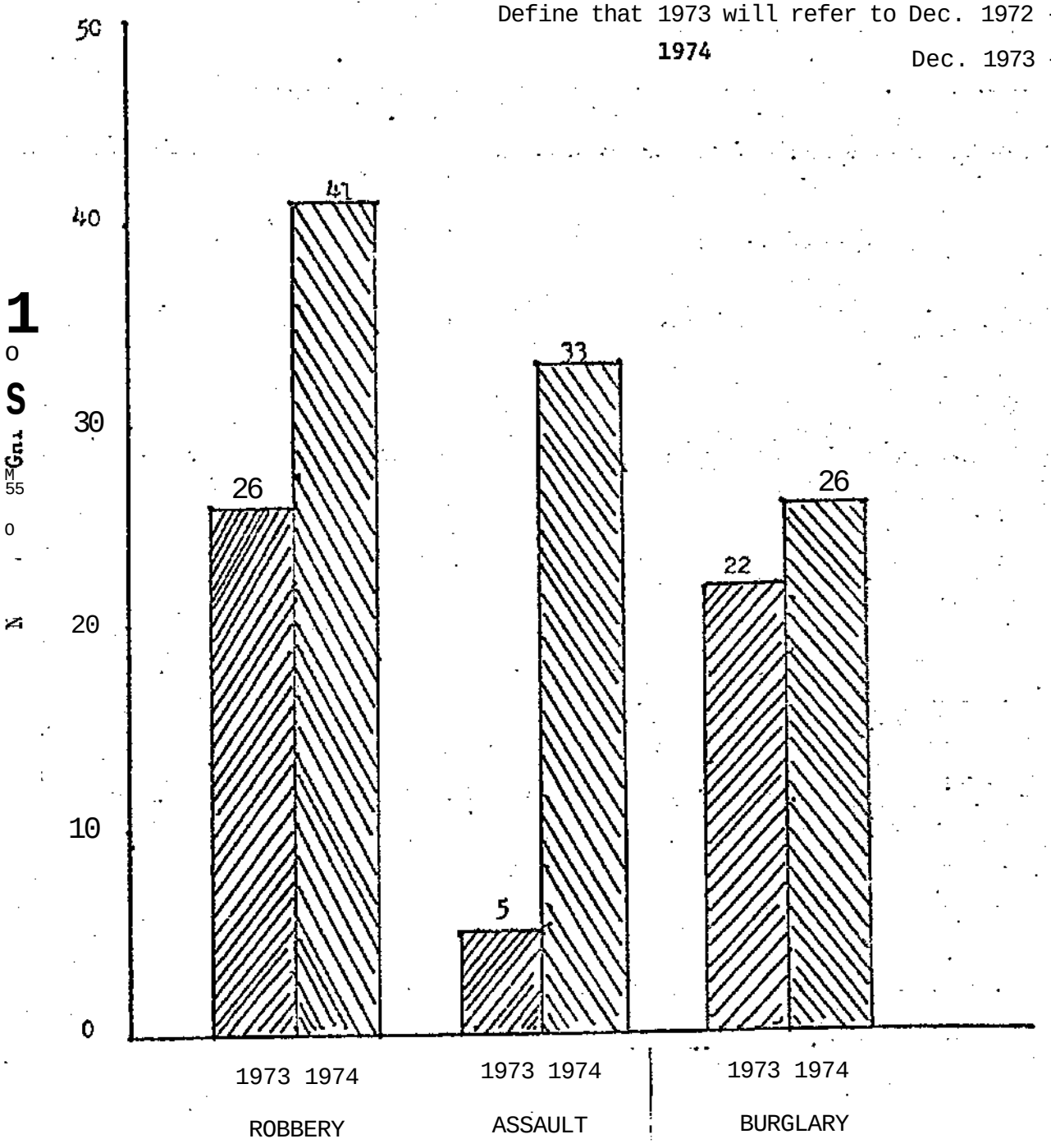


FIGURE 2 Nighttime Crime Statistics in Lighted Area of Census Tract 27 (December 1972 - November 1974)

2. Nighttime Target Crimes - Trends Analysis

It is of interest to study the rate of crime before and after the installation of the lights. To facilitate the presentation, the crime statistics in Table 4 are based on the rate of crime per month rather than yearly totals,

Table 4. Crirae per Month Statistics after the Installation of the Lights Based on one full year's data (Dec. 1973 - Nov. 1974)

;n»»	Lighted Area Only			Unlighted J\rea Only		
	Night	Day	Total	Night	Day	Total
Murder	,08	0	.03	.03	0	.03
-Hape	.03	0	.03	.25	.08	.33
Bobbery	3.42	1.33	4.75	3.33	4.25	13.03
Assault	2.75	2.00	4.75	11.00	5.03	16.03
Burglary	2.17	.91	3.03	5.03	1.67.	6.75
Total	8.50	4.24	12.74	25.29	11.08	36.32

The above measure of the rate of crime can then be compared with crime rate per month for the year preceding the installation of the lights. To illustrate the true relative changes in level of the three target crimes within Census Tract 27, each type crime was depicted in Figure 3,4, and 5, respecetxvely. An examination of the data and figures shows that the additions of lights in the target area has not affected levels of the crimes in accordance with the pre-determined goals of the project. The crimes per committed month for the previous year (1973) of the installation of the lights is shown in Table 5.

Table 5 Crime per konth Statistics before installation of the Lights
(Dec. 1972 - Nov. 1973)

Crime	Lighted Area Only			Unlighted Area Only		
	Night	Day	Total	Night	Day	Total
tturder	0	0	0	• 16	.16	• 32
. Rape	0	0	0	.58	.17	•75
Robbery	2.17	5.0	5.17	6.67	3.92	IQ..59
Assault	.42	.5	-92	2.0	1.83	5.83
Burglary	1.83	1.53	5-41	2.58	2.5	.5-08
Total	4.42	5.08	9-5	11.99	8.58	!0.57

(i) Robbery

For the census tract as a whole, nighttime robberies increased 38.6% as compared to the preceding year of installation of the lights. For the lighted area only, the rate of increase was 64% and for the unlighted area only, that rate accounted for 32%. The level of change in the rate of crime occurrence for each area is shown in Figure 3,

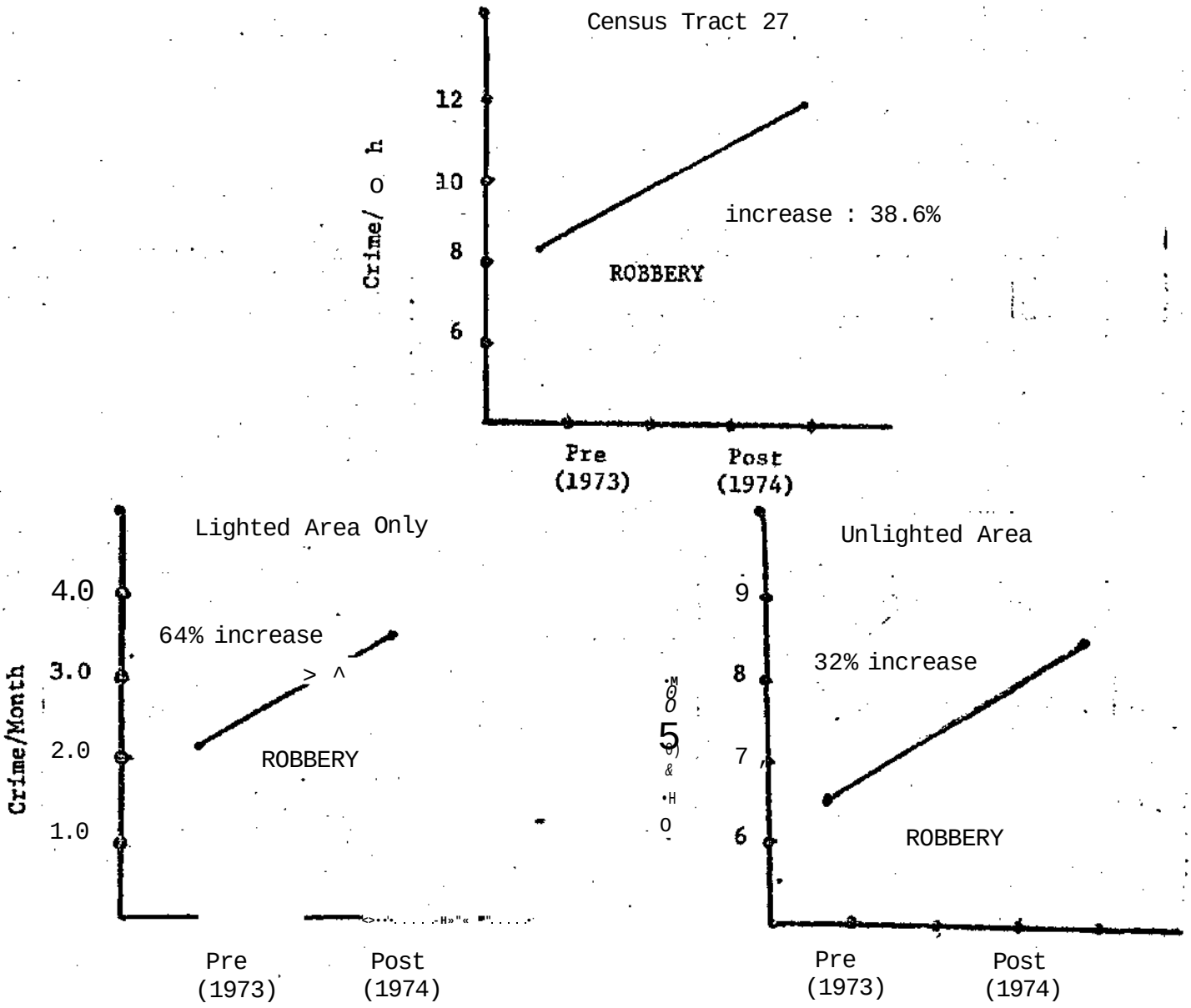


Figure 3. Nighttime Robberies per month in Census Tract 27 (before and after the installation of the lights)

(ii) Assault

Figure 4 illustrates the assault crime trend in Census Tract 27. For the census tract as a whole, the rate of increase in assaults after the installation of the street lights amounted to 415.6% furthermore, for the lighted area the number of nighttime assaults during 1974 have increased almost 6 times the corresponding amount for the year of 1973. For the unlighted area, the increase is 450% over the year preceding the installation.

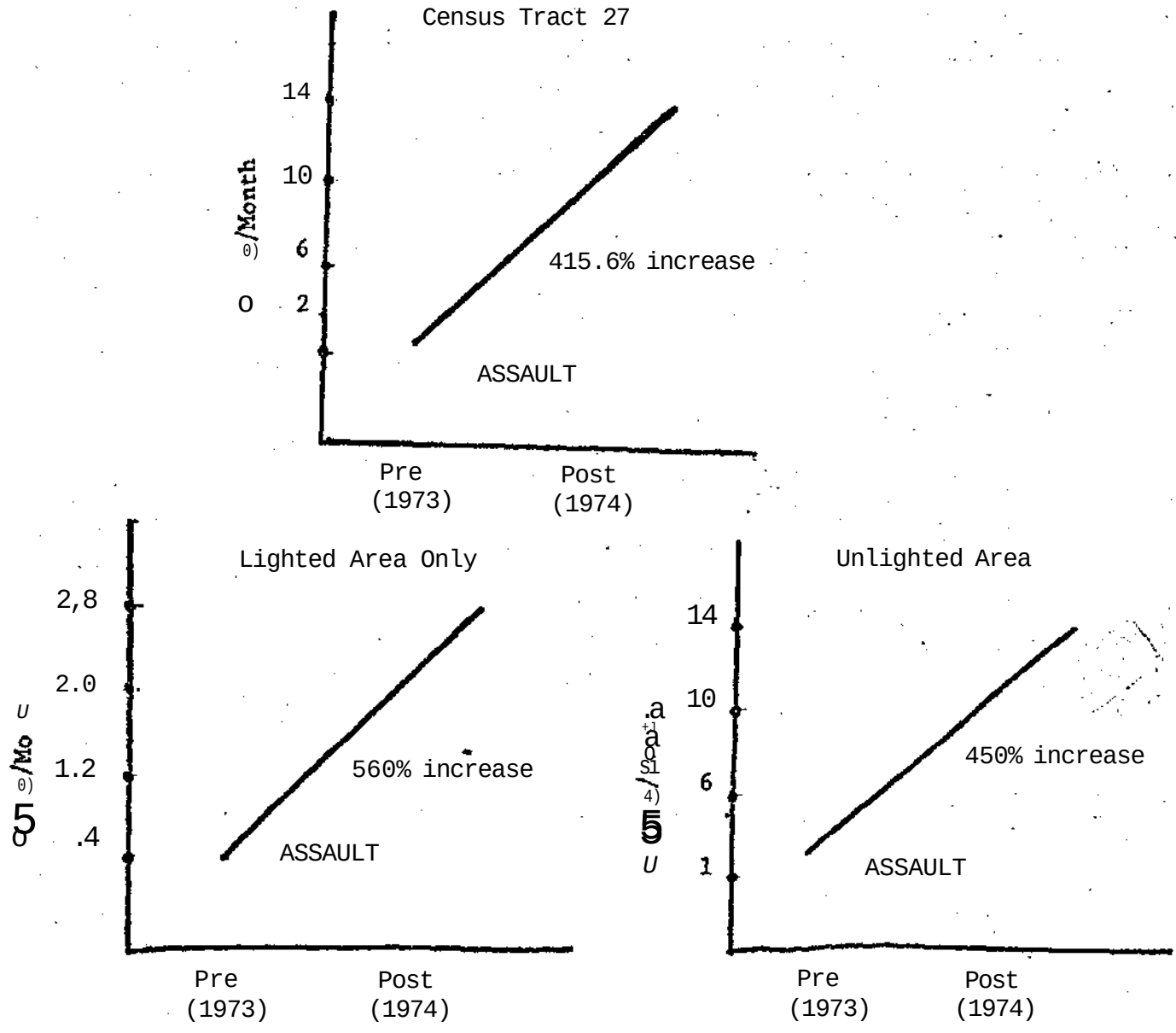


Figure 4. Nighttime Assaults per Month in Census Tract 27

(iii) Burglary

The nighttime burglaries also increased at a rate of 63.8% for the census tract as a whole. However, the year to year rate of increase in the lighted area is far less than the rate of increase in the unlighted area. These crime trends are shown in Figure 5.

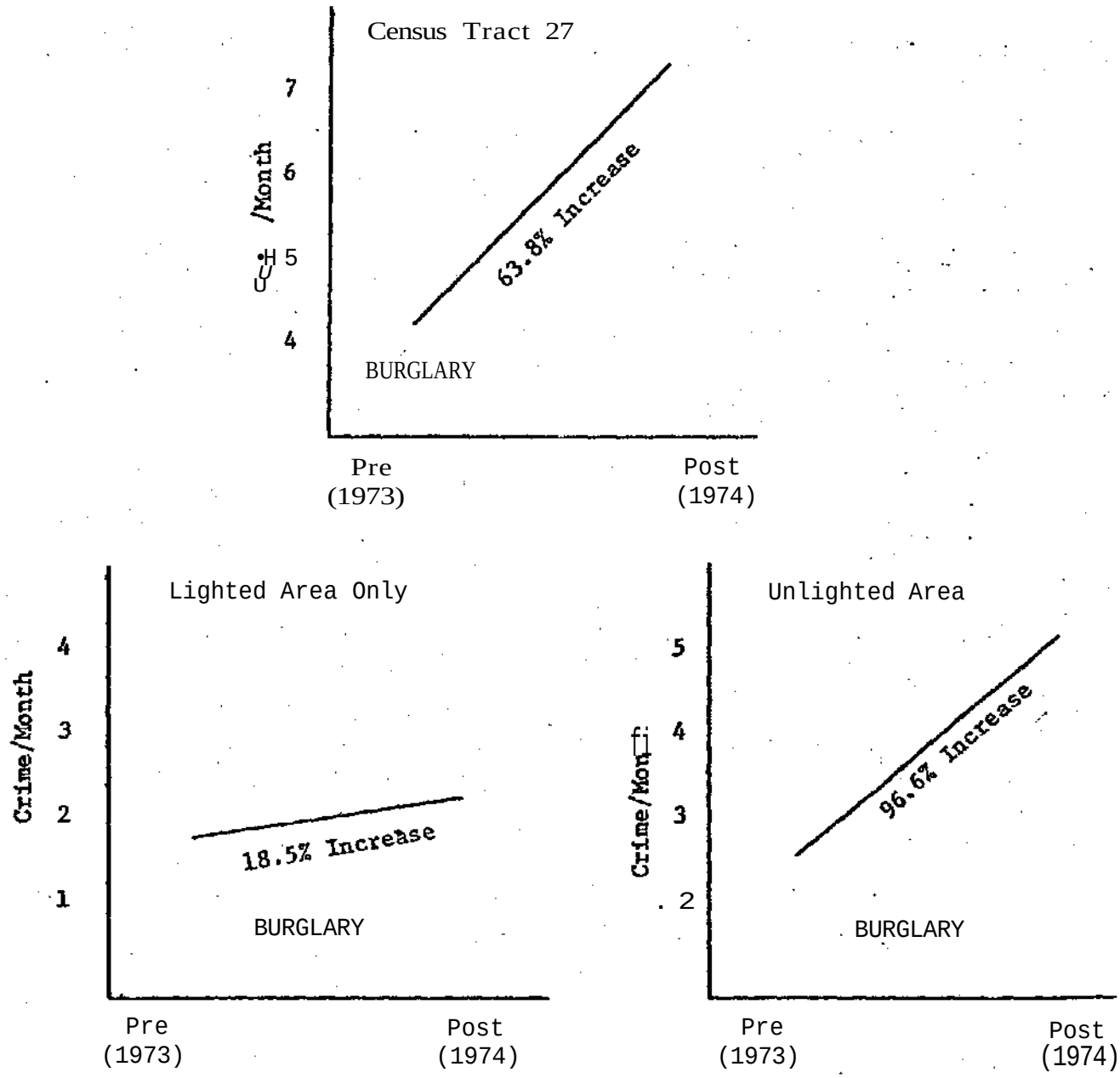


Figura 5, Nighttime Burglaries per Month in Census Tract 27

3. Performance Measures

To compute the performance measures defined in Section III, the first full year's nighttime crimes for the year previous to installation are compared to similar data for the first year after installation. Table 6 summarized the nighttime crimes for one year before and one year after Installation of the lights.

Table 6. Nighttime Target Crimes Summary - One year before and one year after installation of the street lights in Census Tract 27 .

Crime	Lighted Area Only		Census Tract" 27	
	Dec. 1973 - Nov. 197^	Dec. 1972 - Nov. 1973	Dec. 1973 - liov. 197^	Dsc. 1972 - Kov. 1973
Murder	1	0	2	2
Rape	1	0	k	6
HoVoary	I*	25	Xk?	106
Assault -	33	•5	165	32
Burglary.	- 26 -	• 22	87	52
Total .	- 102 .	54	405	193

As indicated in the table above none of the crime categories were reduced in terms of absolute figures. To evaluate the crime reductipn goals that were predefined for the project the following computations were carried out.

(i) Goal I

The achievement of this goal requires a reduction in the number of nighttime robberies by 15% in the lighted area. Then, from Table 6, it is found that

$R_o = 41$

$R_i = 25$

$$\frac{R_1 - R_0}{R_1} = \frac{25 - 41}{25} = -.64$$

Since $(R_i - R_0)/R_1 \leq .15$. GOAL I has not been

Based upon the previous year's statistics (1973), attainment of the project GOAL I was expected to result in a reduction of 4 (actually 3.7) nighttime robberies. The figure of -.64 means that there has been 64% increase in nighttime crimes in the lighted area, rather than a reduction in the nighttime robberies.

(ii) GOAL II

The achievement of this goal requires a reduction in the number of other nighttime target crimes by *5%* in the lighted area. From the table,

0_o » 61

$0_1 = 27$

$$\frac{0_1 - 0_o}{0_1} = \frac{27 - 61}{27} = -1.26$$

Since $\frac{0_1 - 0_o}{0_1} = \wedge -05$, GOAL II has not been achieved.

According to the predefined goals, attainment of GOAL II was expected to result in a reduction of 1 (actually 1.35) other nighttime crimes in the target area based on the 1973 data. (This computation figure evolves from 0.05 multiplied by 0_1 (= 27).) However, the total other nighttime crimes have increased at a rate of 126% as compared to the previous year's level in the number of nighttime burglaries. The unusual increase in assaults account for the wide margin by which GOAL II fails to be realized.

4. Alternative Performance Measures

Because performance measures in the previous section do not give complete information on the effects produced by the street lights, other measures of performance were designed and analyzed in this section. The result is shown in Table 7 which was prepared to illustrate the percent improvements in target crimes when compared to the annual rate of crimes for the previous year. See the detail crimes statistics for the City of Atlanta in Table B-2. Appendix B.

Table 7. Percent Improvement of one year after compared to one year before installation of the street lights

	Census Tract 27					
	Lighted Area Only		Unlighted Area Only		City of Atlanta	
CRIME	Night	Day	Night	Day	Night	Day
Murder	—	—	—	100%	15.3%	7.95%
Rape	—	—	—	50%	11.6%	-24.65%
Robbery	-64.0%	55.56%	-32.0%	-8.5%	-11.4%	8.27%
Assault	-560.0%	-300.QQ	-450.0Q	-177.3%	-27.4%	-38.01%
Burglary	-18.6%	36.84%	-96.6%	33*33%	-39.0%	10.48%
TOTAL	-93.2%	6.56%	-110.4%	-23.3%	-27.4%	7.03%

As reflected in the Table 7, it is seen that the total nighttime crimes in the lighted area increased 93.2% between one year before and one year after installation of the street lights. For the unlighted area in the Census tract, these target-crimes- increased 110.4%. For the city as a whole, the increase was only 27.4%. These figures might be expected because Census Tract 27 is one of the high crime census tracts in the City 6£ Atlanta. Thus, the city'as a whole/ did not experience a crime rate as high as that of Census Tract 27. It is encouraging that the rate of increase in the total nighttime crimes for the lighted area is somehow less than that rate of increase for the unlighted area. However, statistical tests (see Appendix C) indicate that the first year since installation are statistically significant from the previous year only for assaults. Thus, even though these figures seem to indicate that target crimes are increasing in the lighted area whan compared to the previous year's data, statistically that trend can only be confirmed for assaults.

(i) Crime Trends Comparison (The lighted area vs. the unlighted area and the city as a whole)

ROBBERY

The nighttime robbery in the lighted area has increased at a rapid rate as compared to the rate increase in the unlighted area. On the other hand, for daytime robbery, the situation is reversed. This reversal indicates that there may be a displacement of crime occurring from daytime hours to nighttime hours. However, as shown in Appendix C, this conclusion cannot be justified at a .05 signficance level. When it is compared to the city as a whole, this rate of increase in the nighttime crime appears far more serious.

ASSAULT

It is significant to note that there has been a tremendous rate of increase in both nighttime and daytime assaults within the lighted and unlighted areas. It also can be seen that both rates of increase in nighttime and daytime in the lighted area is far greater than the increase in the unlighted area and city wide. This unusual circumstance might be explained by improvement in record keeping, or more seriously, the street lights may in some way be encouraging nighttime assaults. However, there is no solid evidence for accepting either of these conclusions but they must be considered as possible explanations.

BURGLARY

For burglaries, the street lighting project seemed to have affected a substantial reduction in the rate of increase for nighttime burglaries within the lighted area. As compared to the unlighted area, this rate of increase in the nighttime burglaries is far less than that rate of increase in the unlighted area. However, in the case of daytime burglaries, there was improvement in both lighted and unlighted areas. This improvement might be explained by the increased daytime police activity in the Census tract.

When the lighted area rate is compared to the rate of increase in this nighttime crime for the City of Atlanta, supprisingly the rate for the city is higher than for the lighted area. For daytime burglaries, there has been some improvement made in burglaries* for the lighted and unlighted areas and the city as a whole.

(ii) Percent Improvement per Crime Committed

Because the rate of criminal activity is increasing it: is of interest to see if the street lights are having any effect per target crime committed. As illustrated in Section II-3(ii), two cases are presented to measure the percent improvement per crime committed for each crime.

Case I

By using the total nighttime annual crime rate within Census Tract 27 as a base rate, Table 8 is developed. The number of each type of crime in Table 8 represents the crimes per year committed at night in the lighted area divided by the per year nighttime crimes for all crimes committed within Census Tract 27. As an example, in order to determine r_o for robbery, from Table 3 the nighttime robberies for the lighted area and the total nighttime crimes within Census Tract 27 are found as 26 and 197 respectively. Then by definition, the value of r_o for robbery is obtained by:

$$r_o = \frac{26}{197} = .1262$$

To determine r_1 for robbery, the same procedure is followed using data from Table 2.

$$r_1 = \frac{41}{405} = .1012$$

Table 8. Crimes per year in the lighted area per Total Census Tract crimes per year

CRIME	NIGHTTIME ONLY (LIGHTED AREA)	
	$r_{n_x i}$ (Dec. 1973 - Nov. 1974)	r_{o_i} (Dec. 1972 - Nov. 1973)
Robbery	.1012	1262
Assault	.0815	•0253
Burglary	.0643	1111.

Therefore, the percent (%) improvement per crime committed $\frac{r_o - r_1}{r_o}$ for each target crime is presented in Table 9-

Table 9. % Improvement per nighttime crime committed

CRIME	PERCENT IMPROVEMENT $(\frac{r_o - r_1}{r_o}) \times 100$
Robbery	19.8%
Assault	-220.8%
Burglary	42.2%

Table 9 indicates that the nighttime robbery and burglary crimes have improved on a per crime basis in the lighted area.

Case II

By using the total city nighttime annual crime rate as a crude estimate of the rate at which crime is increasing, the percent improvement per crime committed for each target crime can be computed in the same way as Case I.

For example, from Tables 2,3 and Table B-3 in Appendix B, the values of r_o and r_1 for robbery are determined as follows.

$$r_o = \frac{26}{9873} = .002532$$

$$r_1 = \frac{Al}{12577} = .00326$$

Table 10 summarizes these r_o and r_1 values for each type of crime.

Table 10. Nighttime Crimes per year in the lighted area per total nighttime crimes per year in the City of Atlanta.

CRIME	Night Only Lighted Area	
	Dec. 1973 - Nov. 1974	Dec. 1972 - Nov. 1973
Robbery	.00326 *.	.002532
Assault	.002624	.000506
Burglary	.002067	* .002228

The percent improvement per crime committed is present in TAble 11 for each type of crime.

Table 11. Percent Improvement per crime connnitteed

CRIME	Percent Improvement $\left(\frac{r_0 - r_i}{r_0}\right) \times 100$
Robbery	$\frac{.002532-.00326}{.002532} = -28.75\%$
Assault	$\frac{.000506-.002624}{.000506} - -418.5\%$
Burglary	$\frac{.002228-.002067}{.002228} = 7.23\%$

Froo the analysis of Case I and Case II, it is not clear which base is the correct measure of this project's performance. However, in both cases, it is evident that there has been a positive improvement made in reduction of burglary crimes in the lighted area. This measure was considered because although there is an absolute increase in the various crimes committed, there may be a reduction in the relative proportion of crimes when compared to the overall increase in crimes.

5. Crime Displacement Analysis

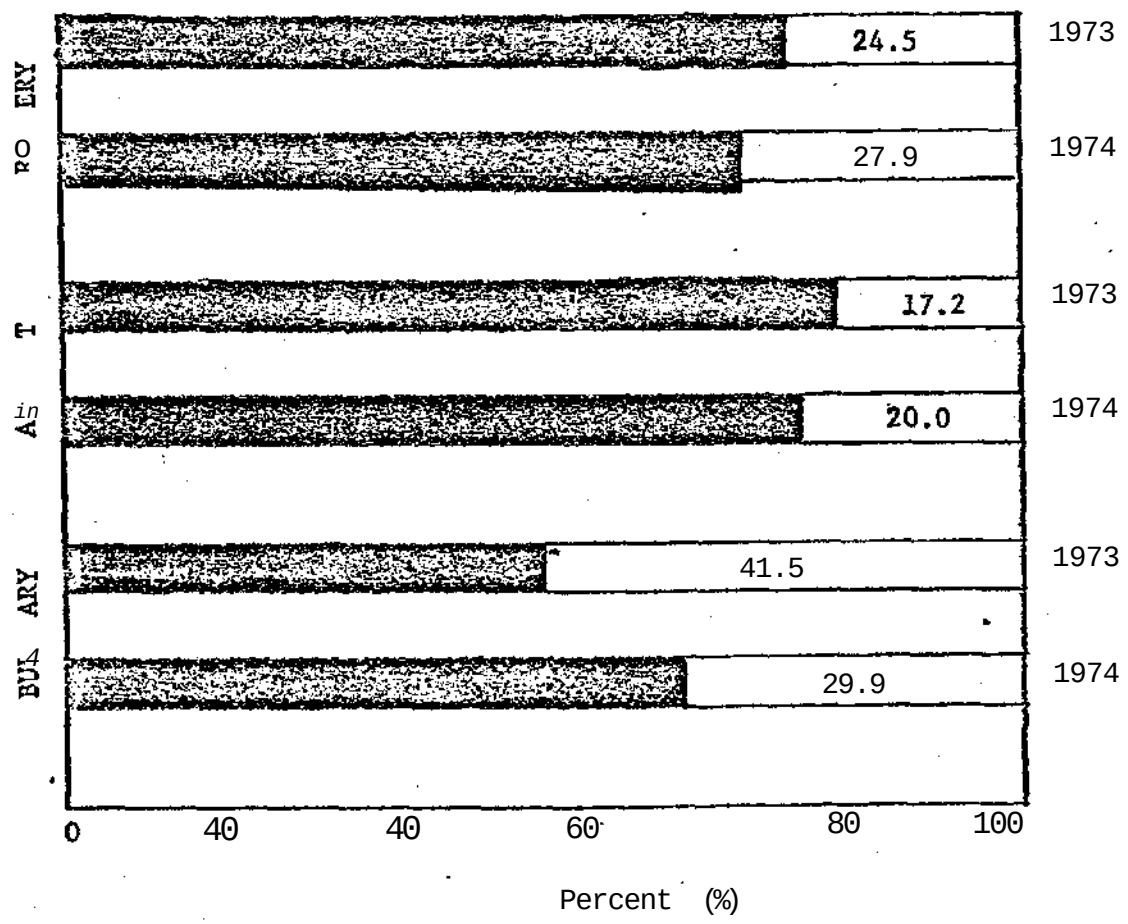
It is of interest to find out if there has been a displacement of crime to unlighted areas of Census Tract 27 and to see if there has been a shift of crime from nighttime to daytime hours.

(i) Hypothesis I: Target crimes are displaced into adjacent areas where lighting has not been improved.

This analysis is illustrated in Figure 6. which represents the distribution of nighttime crime between the lighted and unlighted areas.

Figure 6. Percent of Night time crimes within lighted & unlighted unlighted areas of Census Tract 27

(1973 - 1974)



By comparing the before and after percentage it is seen that little change has taken place with the exception of burglary. Although it does appear that the percent of nighttime burglaries committed in the lighted area has been reduced from 41.5% to 29.9%, this conclusion can not be substantiated at a 0.05 significance level. This conclusion is confirmed by a contingency table test which indicates that the differences shown are not statistically significant. Therefore, the hypothesis is rejected. See the detail test statistics in Appendix C.

(ii) Hypothesis II: There should be a shift of target crime activity from nighttime to daytime hours after the lights were installed.

Table 11 presents the percent of nighttime target crimes committed in the area of Census Tract 27 and Figures 7 and 8 shows graphical comparison of changes in the nighttime crirae percentage in the lighted and unlighted areas. A series of statistical tests were performed on Hypothesxs II. But at a .05 significance level this hypothesis was rejected except robbery. See the detail test statistics in Appendix C - II. Although it is not possible to make statistically significant statements about this data for the other type of crimes it does appear that a greater percentage of crimes are being committed at night than during the day. This trend seems to be continuing in both the lighted and unlighted areas of Census Tract 27.

Table 11. % of total crime committed at night within Census Tract 27

Area / Crime	Lighted Area Only		Unlighted Area Only		Census Tract 27 As A Whole	
	Dec. 1973 Nov. 1974	Dec. 1972 Nov. 1973	Dec. 1973 Nov. 1974	Dec. 1972 Nov. 1973	Dec. 1973 Nov. 1974	Dec. 1972 Nov. 1973
Robbery	71.9%	42.0%	64%	63%	68.7%	56%
Assault	57.9%	45.4%	65.5%	52%	66%	51%
Burglary	70.3%	53.6%	75.2%	50.8%	73.7%	52%

IV. CONCLUSIONS

Ttie goal of the street lighting project was to reduce nighttime robberies by 15% and the total of other nighttime target crimes by 5% for the lighted area in Census Tract 27. Data collected and analyzed for one year after installation of the street lights indicates that there has been *a* 64% increase in nighttime robberies while there was a 126% increase in the total of other nighttime target crimes in the project area. In terms of the predefined goals of of the project, neither was accomplished during the first year of operation.

Tp consider other effects of the street light program additional measures were designed to give more complete information about project performance. Two cases are utilized to analyze whether the project discouraged criminal activity by comparing the difference in rate of increase of each crime before installation of the street lights with that rate after installation. This change in the rate of increase which can be thought of as the percent improvement per crime committed was computed for each of the three target crimes being considered. Case I, which used the total nighttime annual crime rate in Census Tract 27 as a base rate, indicates that the improvement per crime was 19.8% and 42.2% for nighttime robberies and burglary. For assaults there was a 220.8% increase in the rate of occurance. This statistic indicates a worsening situation with regard to assaults in this area of the city.

Case II, which used the total nighttime annual crime rate in the City of Atlanta as a base rate, shows that a percent decrease on a per crime basis of 7.23% for only burglary while there was a 28.75% and 418.5% increase for robberies and assaults, respectively.

The analyses for Case I and Case II were undertaken because the rate selected to represent the year-to-year growth rate of nighttime crime in the lighted area can be selected for different assumptions. In this study, the

Case I comparisons were made assuming the nighttime crime rate was increasing at the rate experienced for all of Census Tract 27. The same comparisons were made for Case II which assumed the rate of growth of nighttime crime in the lighted area was increasing at the rate experienced by the city as a whole. Using either assumption leads to the conclusion that there was some decrease in the rate of increase experience for burglaries. Robberies showed some improvement for the Case I assumption while showing a decrease for the Case II assumption. For assaults the rate of increase actually increased for both cases, It is not possible to say with any statistical certainty that burglaries were affected by streetlights while robberies and assaults were not. However, there are trends in the data which indicate that there might have been such an effect.

The most significant change in the crimp, trends was the extraordinary number of nighttime assaults that occurred in the lighted area of Census Tract 27. The increase in assaults was more than 5 tines the number of assaults expierienced during the year previous to the installation of the street lights. However, the rate of daytime assaults in Census Tract 27 has also risen at an extraordinary rate and therefore it cannot be concluded that the streetlights have in any way encouraged assaults. It does appear that control of assaults in this area is not good and that the streetlights have had little or no effect in reducing this type of crime. It should be noted that the actual number of assaults were 33 in 1974 and only 5 for 1973 in the lighted area. Therefore any conclusions based on such a small number of occurrences have little statistical validity.

The data presented in Table II does indicate an increase in the percentage of robberies, assaults, and burglaries occurring at night in the lighted area compared to the situation that existed for the year preceding the project. Robberies at night comprised *kVA* of the robberies in 1973 compared to 72% for

1974, For assaults the nighttime occurrences were 45% in 1973 while they were 50% in 1974. The greatest increase in nighttime percentages occurred for burglaries where they were 54% in 1973 increasing to 70% in 1974.

Statistical tests for each of these three target crimes indicate that robbery is the only crime for which the change in the percentage of crimes committed at night was statistically significant.. Thus there was a higher percentage of robberies committed in the lighted area at night in 1974 than in 1973. This trend is due to factors other than chance variations. No explanation for this situation has been developed as present data is not detailed enough to define cause-effect relationships.

For assaults and burglaries the percentages of nighttime crimes are not statistically different for 1973 and 1974. Therefore, for these two type crime it is concluded that the lights did not shift criminal activity from night to day.

Regarding the possibility that the lights would shift nighttime crimes from the lighted area to the unlighted area, comparisons were made between the 1973 and 1973 percentages of crimes committed in the lighted and unlighted areas. For robbery, 24.5% of the nighttime crimes in C&nsus Tract 27 were committed in the lighted area. In 1974, this percentage was 27.9%. Nighttime assaults in the lighted area provided 17.2% of the assaults recorded in Census Tract 27 while this percentage in 1974 was 20%. Burglaries showed the only significant change with the 1973 percent of 41.5% changing to 29,9% in 1974. Thus there is a trend indicating that for burglaries the lights did shift some nighttime activity from the lighted to unlighted areas. The lights seemed to have had little effect in shifting assaults and robberies to the unlighted area of the census tract.

V. RECOMMENDATIONS

Based on the experience developed during the Atlanta Streelight Program there .are some suggestions that might assist in the further evaluation of . of streetlighting programs. These suggestions can be divided into those dealing with the improvement of data analysis of the crime statistics and those dealing with the measurement of effects directly concerned with the reduction of criminal acts.

Because of expense the area that is lighted is relatively small and therefore the absolute number of criminal acts is small. This makes it difficult to develop meaningful statistical tests. To overcome this problem a longer time span can be used or a larger area can be lighted. These parameters should be selected so that at least 50 crimes of the type being studied will have occurred. A similar requirement should be utilized when defining the unlighted or control area.

As it appears that streetlighting affects different type crime in different ways it is important that studies analyzing categories of crime other than target crimes should be undertaken. Based on the results of this report emphasis should be placed on the evaluation of burglary and assault to determine how the lighting affects these type[6] crimes.

In addition to the direct affect of streetlights on crime it is important to understand the influence of exogeneous factors on the commission of various types of crimes. That is, how does a change in the unemployment rate or changes in police deployment affect the level of particular type crimes? Some knowledge of those effects would enable the evaluation to account for such factors and a more realistic assessment would result.

Another important effect that should be investigated further is the change in public attitude that may result from a streetlighting program. Consideration

should also be given to how long lasting any detected changes are. Measuring these changes can be accomplished both directly and indirectly. Direct measurement would include questionnaires and interviews of various classes of citizens that are affected by the area of concern.

Indirect measurement consists of investigating changes in habits by studying various business indexes and other statistical data. If business revenues in the lighted area showed significant changes this would provide an indication that shoppers[1] habits had changed. Determining the change in the number of people in the area who work past dark might reflect the feeling of security of those who work there. Such indirect measures can often provide meaningful .insights. " regarding people's true feelings and their associated behavior.

V. Comparison with Portland in Streetlighting Project

The source of information of Portland's streetlighting project was "A Preliminary Evaluation of the Portland Lighting Project" prepared by the Oregon Law Enforcement Council and dated August 1974. This information was compared with information obtained from evaluations and programs reports on Atlanta's Impact Program streetlighting project.

The common denominator between the two projects is addition of streetlighting to a selected geographical area. Thereafter, the differences outnumber the similarities between the projects. Portland installed in two phases 330, 175 watt mercury lights while Atlanta installed 191, 400 watt high pressure sodium vapor lights. On the average the footcandle level in Portland was increased from 1/2 to 1. Atlanta, on the other hand, increased the footcandle level from approximately 2 footcandles to 8 average maintained footcandles. Portland selected three police patrol districts in which to install the lights in contrast to Atlanta's choice of 21 selected streets and street segments in the downtown area in census tract 27. The target crimes were also different. While both cities expected reductions in nighttime robberies, assaults, and burglaries, Atlanta included homicide and rape as well. Therefore, the types of lights, the number of lights, the wattage, the degree of increase in illumination, the size of the areas in which the lights were installed, and to some degree the crimes upon which the project focused were all different. However, preliminary conclusions suggest the same result—streetlights alone do not reduce the occurrence of nighttime crimes.

APPENDIX

A. Crime Statistics

B. Supplementary Tables

C. Statistical Tests

APPEKDIX A
Table A-l

1972 ROBBERIES
CITV or *rtJv;.TA NSES

LOCATION OP O?fE

TOTAL 3,074

TRACT	COMMERCIAL	RESIDENTIAL	OPEN SPACE	UNKNOWN	TOTAL
1	5	1			6
2	14	1	2		17
4	13		17		30
5	10		7		17
6	•5	1	3		9
7	6		2		3
e	11	2	4		17
9	2	1	6		9
10	9		7	1	17
11	8	4.	35		37
12	la	7	63	1	83
13	17	2	20		39
14	10	1	7		13
IS	12	1	3		1&
IS	4		4		8
17	14	2	IS		32
IB	4	3	e	1	IS
19	21	1	30	1	53
20			2		2
21	12	1	34		37
32	9	1	B	1	19
23	5	5	32	1	33
24	7	5	10	1	23
35	14	6	18		39
25	9		13		22
17	si	I	9\	5	1:5
23	IV	•i	^j		6-i
19	21	4	16		41
30	9	4	6		19
31	IS		5		20
32	7	1	7		15
33	IS	2	ia		35
35	37	2	70		103
35	15	1	5		21
37	4	1	3		8
3a	8	1	13		27
33	6	1	22		29
40	17	1	6		25
41	23	7	11	4	45
42	9	1	12		32
43	10		10		20
44	6	3	12	1	22
45	3	1	6		10
46	11	3	11		25
47	3	2	14		19
43	2	3	7		12
<9	7	1	10		13
50	10	1	7		13
52	22		3		25
53	6	1	9		1$
55.01	17	5	34	1	57
55.02	9	4	15		23
55	14	5	30	1	50
57	2		6		B
58	17	1	3		21
59	10		14		24
60	13	2	12		27
61	5	2	5		13
62	a	1	6	1	16
63	13	5	6	1	25
fit	10		1		41
65	6	1	6		13
66.01	6		4		10
66.02	4		3		7

TRACT	COMMERCIAL	RESIDENTIAL	OPEN SPACE	UNKNOWN	TOTAL
67	35	9	16	2	52
63	1				1
CO	20	1			2L
70	11	1	9	1	22
71	e	3	£		IS
72	3		10		13
73	B		1		9
7C	17	3	2		21
73	19		5		23
75.01	17	1	2		2O
75.0?	21	3	5		23
77,01	13	2	4		2>
77.02	11	2	1		17
73.01	42	2	17	1	63
78.02	2		2		•I
79	1		1		2
SO	10	1	3		14
81.01			1		1
61. C?	21	2	B		31
62.01	8	2	4	1	IS
62.02	1	1	10		12
83,01	9	2	14	a	27
83.02	6	3	9	i.	19
84	14	3	15		31
85	30	3	11		44
fa.01	21	1	17	i	42
65.03	2-;		13		37
87.01	5	4	2a		3B
87.02	7		13	2	22
93	2}		6		31
69	35	1	7		43
9a	4		2		6
si	12		e		20
92	X'i		6		2?
93	6		I		7
94	6		4		12
95	2		5		7
95	25	1	4		3O
97			2		2
93	2	2	3		7
99	3	1	2		6
100	7	2	1		10
103	3		-		3
103	2				*
203	8		2		10
304	3	1	5		*
205	32	4	13		39
205	10		10		20
207	B	X	13		23
303	32	1	13		51
209	42		12		54
TOTAL	1.377	177	1.211	32	2.817
TOKN'COT	134	11	75	37	257
CITYWIDE TOTAL	1,511	188	i.396	69	3,074

Appendix A

Table A-2

1 = No. in census tract
2 * No. in lighted area

Crime \ Month		Bee 72	Jan 73	Feb 73	Mar 73	April 73	May 73	June 73	July 73
Murder	1	0,0	0,0	0,0	0,0	2,1.	0,0	1.0	0,0
	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rape	1	0,0	0,0	0,0	0,0	1,0	2,1	2,2	0
	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0
Robbery	1	18,7	18,10	10,8	15,8	17,9	12,5	21,10	17,9
	2	7,3	9,3	1,0	2,1	5,3	A,2	6,2	10,5
Assault	1	3,2	6,3	5,3	5,3	4.2	5,4	3,0	4,1
	2	0,0	1,0	1,1	2,0	0*0	3,2	0,0	0,0
Burglary	1	13,9	14,8	8,7	12,5	10,6	2,1	5,1	5,1
	2	4>4	7.3	4,3	4,2	6,3	1.1	1,0	1.1

Crime \ Month		Aug 73	Sept 73	Oct 73	Nov 73	Dec 73	Jan 74	Feb 74	Mar 74
Murder	1	0,0	0,0	0,0	1.1	0,0	0,0	0,0	0,0
	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rape	1	0,0	1,1	1.1	2,1	0,0	1,1	0,0	1,1
	2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Robbery	1	19,10	15,11	19,8	18,11	10,5	30,19	22,17	11,8
	2	4,1	4,1	5,1	5.4	5,2	6,5	6,5	4,3
Assault	1	7,A	6,3	4,3	5,4	3,0	29,20	28,18	25,14
	2	2,1	0,0	1,1	1,0	1,0	8,4	8,4	3,2
Burglary	1	10,5	6,1	11,3	6,5	9,6	13,8	18,13	6,6
	2	3,2	2,0	5,1	3,2	5,4	5.3	6,2	2,2

Cr ime \ Month		Apr: 74	May 74	June J74	July 74	Aug 74	Sept 74	Oct 74	Nov 74
Murder	1	0,0	1,1	0,0	0,0	0,0	0,0	1,1	0,0
	2	0,0	0,0	0,0	0,0	0,0	0,0	1,1	0,0
Rape	1	0,0	1.1	1,0	0,0	0,0	0,0	1,1	0,0
	2	0,0	0,0	0,0	0,0	0,0	0>0	1,1	0,0
Robbery	1	18,13	13,8	19,11	22,13	19,17	16,14	15,11	19,11
	2	7,5	2,1	2,2	5,3	3,2	3,3	7,7	7,3
Assault	1	13,7	16,10	31,20	23,15	23,17	13,9	18,15	28,20
	2	3,1	2,1	8,7	7,3	3,3	1,1	2,2	11,5
Burglary	1	15,10	6,5	7,5	7,5	6,5	13,8	5,5	13,11
	2	**4,2**	1,1	1,1	0,0	1,1	4,2	3,3	5,5

Appendix A

Table A8

tar XXX FORDERT STfifcET LIGHT CRIME LOCATION KGPOKT fIONTH 11 YEAH 74 PAtE 2

STREET NUMBER	STREET HAKE		TIME Of fit	OA	YR	CftIf HOU	UAY	fiEI'ORT NU«t)f;ft	UEAP OR FCRC t	IIOU GNTtR	S-TC-5	RES OA COM	AMOUNT UQItN	INTERSECTION	DISPOSITION
			11	11	74	02	THU	942)3	IIODILY		S		$ 35. Od		ftB. KOL'13. M6ht
CLEG			11								$				PE6. ftCiC. MGhT
toe			11	25	74	12	(ION	V7;i(i1	U001LY				4 10.00		
CCVI,			11	21	74	07	THU	961/.9	PISTCL		S		$ 22.00		
L1M			11	1"	74	£2	MOM	95467	pisrcL		S		t AC.00		NIGHT
	ARMSTRONG	srsu	11	24	74	14	hUH	97171	PISTOL				S 4'J.GO		PED. ROBB.
	ARMSTRONG	Sf!,t	11	16	74		SAT	9501 rt	Pli IOL		S		1 68.JO		PUD. MC-HT
	AULUNA	AVIIf.	11	id	M	23	TUt	97793	Uiili IL Y		S		$ 25.00		PED. KCI't. NIGHT
Ct>3	LARKIN	SI NC	11	04	74	2e	HOM	91a 19	UJ1KN0WK		S		t 150.00		NIGHT
C?',>'.	i.ft>w:I,I.AU	AV1-W	11	zi	74	20	SAT	96951	PISTOL		S		$ 60.00		HlohT
C'.T.		S.TSW	11	01	74	U	fni	9C929	OODILY				i 63.CO		NtGhT
C'.I-.		Lt LJ	11	1	74	17	FKI	>1(J33	UOUILY				i 65.CC		
C	;..rc u	STbW	11	14	74	13	TtIU	94369	BODILY		S		S 20.00		
		STiiJ	11	(.5	74	11	TUt	01'/1 £	01HtR		S				
CL....		STSW	11	23	f4	17	SAT	96V07	.10D1LY		S		$ 30.CO		P£0. KOtli.
CUr		STSVi	11	20	i-4	00	kiLb	9P19	PISTOL		S				
v C1'.	C G.\tl		11		74						S		4 15.00		PtO. fior-2.
t' 1'.	Li.'.,* TL A'.*	UTI.f-	11	2j	74	'JC	SAt	9tI26	PISTOL		S		1		
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i"C-.'t		STiii.	11	•>!	74	C'J	THU	9ti59	PUTOL		S		$ 25.00		MCkT
	'L i.I r.	Sf.'Jt	11	25	74	2C	KON	974U3	PISTOL		S		$ 32'u.JO		hiiJHT
		5T Nlj	11	02	74	15	SAT	91U5	HCDILY		S		$ 20.00		
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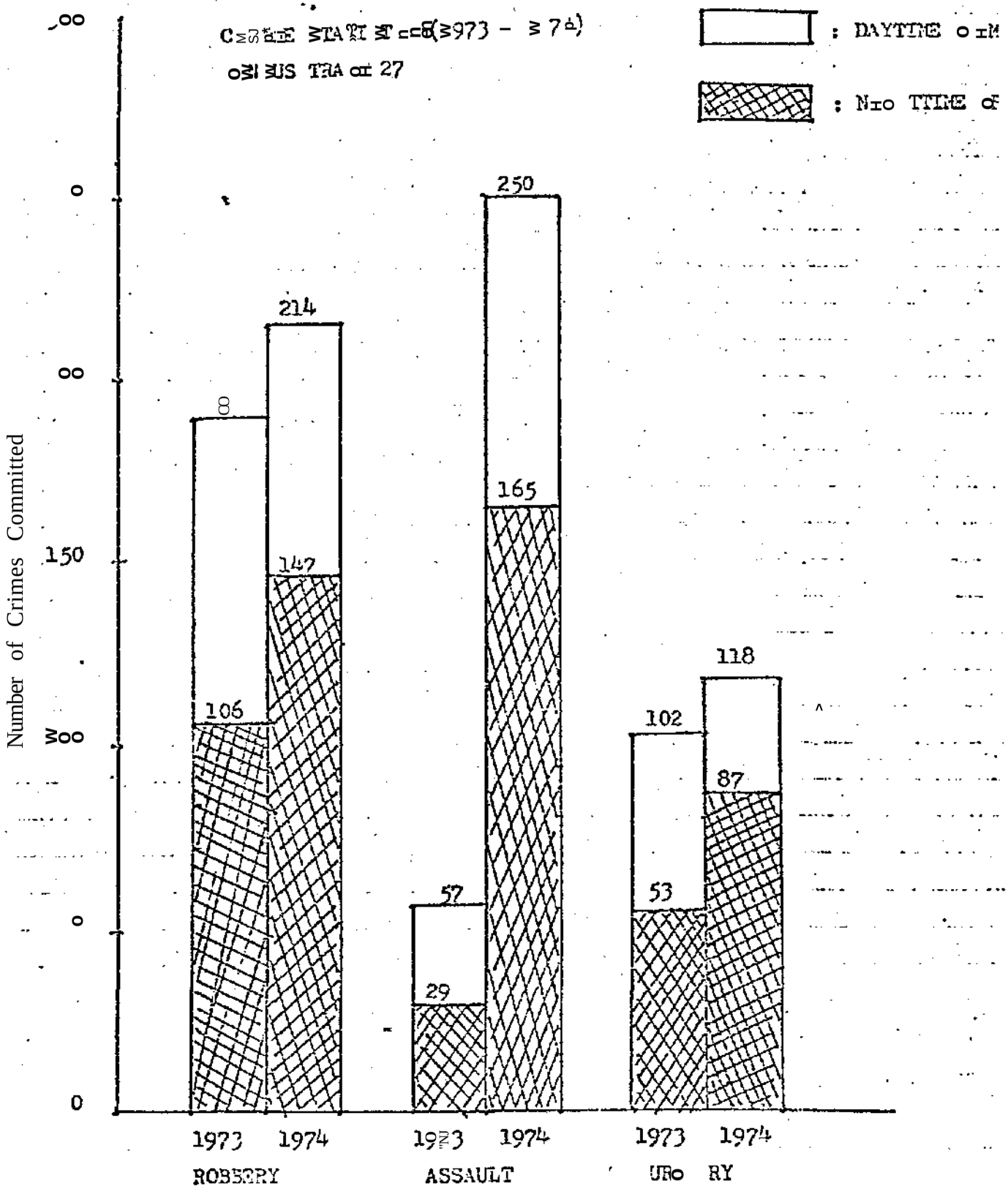
t'. 'i.			11	11	74	UV	MCN	93459	U001LY		S		$ 4.CO		PLD. hCcf..
/ - CM',	v;. LL		11	02	74	23	SAI	V13u9	I'ISTOL				a 60.UO		PIO. ;;CCG. MC.HT
	•^IL	;;i.:i	11	10	74	1 il	SAt	9^731	COOJLY		S		i 3.00		i'tD. KC^G. MCHT
/"Cli.4		J! HM	11	04	74	12	HCN	91628	PISTCL		S		$ 2.CO		
.' f f'.	kt.It I!;.VLL	SI Sw	11	iO	74	11	UbD	95916	PISTCL		S				
CO*	-lil I Li.ML	LT GU	11	16	7'.	21	SA1	VV//6	1JCCILY		S		t ICC.00		PCD. ROBB. MthT
- C1.v	IK IT 4I'I'IIL	ST5U	11	07	74	1C	THU	52411	PISTCL		5		X VO.JO		
C*7V	-rirCi'ALL	5T3W	11	25	7A	IS	KCK	97429	SHOTül/N		S		i 27.00		
.C/.4j		STSW	11	01	74	14	FR1	5CR£7	cisrcL		S		i 15.30		P£D. ROf-P.
^Clio	* ULI*i'.»	STr.rf	11	£S	74	21	SAI	V7004	IICDILY		S-		i 26.00		MChT
	V.H1.1AP3	STSU	11	30	74	21	SAT	VC7t5	BODILY		S		j 47.00		PCD. KSi-b. MChT
			44				Tun				K		$ Su.OC		,\I6hT

Appendix A



Note: 1973 will refer to Dec. 1972 - Nov. 1973
1974 Dec. 1973 - Nov. 1974

APPENDIX B. SUPPLEMENTARY TABLES

Table B-l. % of Night Crimes Within Lighted and Unlighted Areas of Census Tract 27

Crime^^^ / Area	DEC 1973 - NOV 1974		PREVIOUS YEAR DEC 1972 - NOV 1973	
	Lighted Area	Unlighted Area	Lighted Area	Unlighted Area
Robbery	27.89%	72.11%	24.5%	75.5%
Assault	20.0%	80.0%	17.2%	82.8%
Burglary	29.9%	70.1%	41.5%	58.5%

Appendix B

Table B-2. Total City Crime Statistics (1973-1974)

Crime	DEC 1973 - NOV 1974			DEC 1972 - NOV 1973		
	Night	Day	TOTAL	Night	Day	TOTAL
Murder	161	81	242	190	88	278
Rape	275	182	457	310	146	456
Robbery	2759	1465	4224	.2483	1597	4080
Assault	2140	1211	3351	1679	946	2625
Burglary	7242	9281	16,523	5211	10,367	15,578
TOTAL	12,577	12,220	24,797	9873	13,144	23,017

APPENDIX C STATISTICAL TESTS

TESTS OF STATISTICAL SIGNIFICANCE

I. Is the change in crime since project initiation statistically significant?

1. Robbery

1973				1974			
1st	2nd	3rd	4th	1st	2nd	3rd	4th
6	6	8	6	12	9	7	13

Total = 67.

$\bar{c} = 8.375$

$$Z = \frac{(c_i - \bar{c})^2}{\bar{c}} = \frac{1}{8.375}\left((6 - 8.375)^2 + (6 - 8.375)^2 + (8 - 8.375)^2 + (6 - 8.375)^2 + (12 - 8.375)^2 + (9 - 8.375)^2 + (7 - 8.375)^2 + (13 - 8.375)^2\right)$$

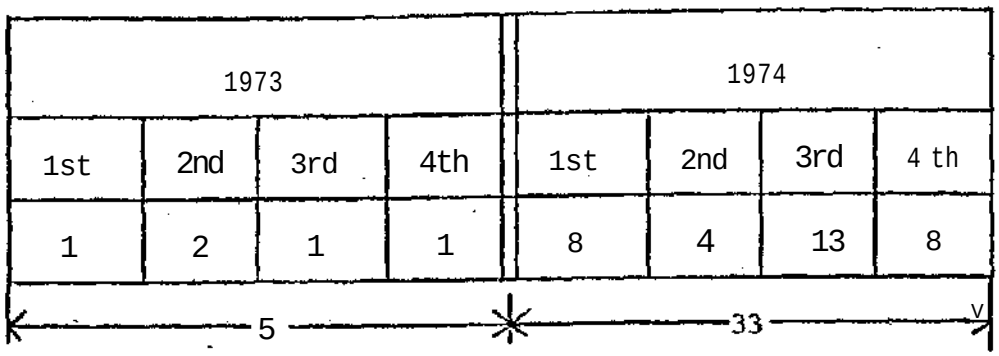
$= 53.875/8.375$

$= 6.433$

$\chi^2_{7,0.05} = 14.06$

Therefore the changes in robberies from 1973 to 1974 are not statistically significant.

2. Assault



Total = 38

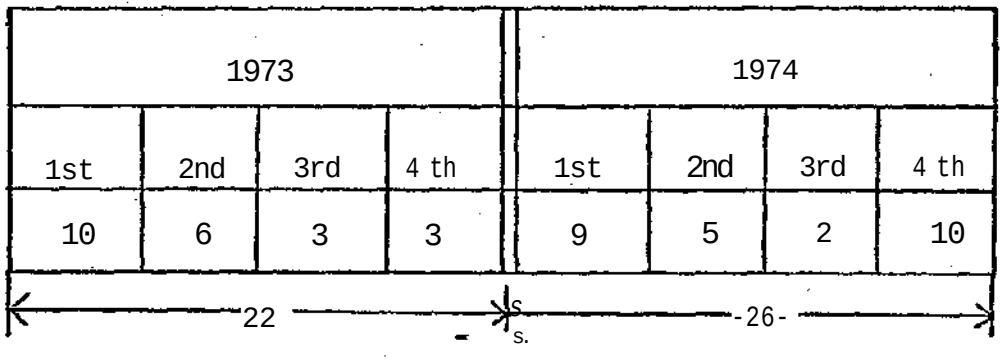
$\bar{c}$ - 19

$$\Sigma \frac{(c_i - \bar{c})^2}{\bar{c}} = \frac{(5-19)^2}{19} + \frac{(33-19)^2}{19} = 20.62$$

$x^2_{1,.05} = 3.48$ Since $\frac{\bar{i}}{\bar{c}} > x^2_{1,.05}$

Statistically Significant

3. Burglary



Total =-- 48

$\bar{c}$ = 24

$$\frac{\Sigma(c_i - \bar{c})^2}{\bar{c}} = \frac{(22-24)^2}{24} + \frac{(26-24)^2}{24} \quad x^2_{1,.05} - 3.48$$

= .33

Not statistically significant

Appendix C

Displacement Study

II. Contingency Table Test to Determine if Crime Has Shifted from Lighted to Unlighted Area.

1. Robbery

	Lighted Area	Unlighted Area	
Dec. 1972 - Nov. 1973	26 (28)	80 (78)	106
Dec. 1973 - Nov. 1974	41 (39)	106 (108)	147
	67	186	253

$$\Sigma \frac{(F_i - f_i)^2}{f_i} = \frac{(26-28)^2}{28} + \frac{(80-78)^2}{78} + \frac{(41-39)^2}{39} + \frac{(106-108)^2}{108}$$

$$= .143 + .0513 + .103 + .037$$

$$= .3343$$

$$x^2_{1,0.05} - 3.84$$

Not significant

2. Assault

	Lighted Area	Unlighted Area	
Dec. 1972 - Nov. 1973	5 (5.68)	24 (23.3)	29
Dec. 1973 - Nov. 1974	33 (32.3)	132 (132.68)	165
	38	156	194

$$\Sigma \frac{(F_i - f_i)^2}{f_i} = \frac{(5-5.68)^2}{5.68} + \frac{(24-23.3)^2}{23.3} + \frac{(33-32.3)^2}{32.3} + \frac{(132-132.68)^2}{32.3}$$

$$= .0814 + .021 + .015 + .0035$$

$$= .1209$$

$$x^2_{i,0.05} \ll 3.84$$

Not significant

3. Burglary

	Lighted Area	Unlighted Area	
Dec. 1972 - Nov. 1973	22 (18.17)	31 (34.83)	53
Dec. 1973 - Nov. 1974	26 (29.82)	61 (57.17)	87
	48	92	140

$$\Sigma \frac{(F_i - f_i)^2}{f_i} = \frac{(22-18.17)^2}{18.17} + \frac{(31-34.83)^2}{34.83} + \frac{(26-29.82)^2}{29.82} + \frac{(61-57.17)^2}{57.17}$$

$$\approx .807 + .421 + .489 + .256$$

$$\approx 1.973$$

$$\chi^2_{1,0.05} = 3.84.$$

Thus, not statistically significant.

III. Contingency table test to determine if crime has shifted from nighttime to daytime hours in the lighted area.

1. Robbery

	Lighted Area		
	Nighttime	Daytime	
Dec. 1972 - Nov. 1973	26 (34.9)	36 (27.1)	62
Dec. 1973 - Nov. 1974	41 (32.9)	16 (29.9)	57
	67	52	119

$$\Sigma \frac{(F_i - f_i)^2}{f_i} = \frac{(26-34.9)^2}{34.9} + \frac{(36-27.1)^2}{27.1} + \frac{(41-32.9)^2}{32.9} + \frac{(16-24.9)^2}{24.1}$$

$$= 7.146$$

$4.0.05$ " 3,84

Thus, statistically significant.

2, Assault

	Lighted Area		
	Night Time	Day time	
Dec. 1972 - Nov. 1973	5 (6.14)	6 (4.85)	11
Dec. 1973 - Nov. 1974	33 (31.85)	24 (25.14)	57
	38	30	68

$$\Sigma \frac{(F_i - f_i)^2}{f_i} = \frac{(5-6.14)^2}{6.14} + \frac{(6-4.85)^*}{4.85} + \frac{(33-31.85)^2}{31.85} + \frac{(24-25.14)^2}{30}$$

$$= .6262$$

$$\chi^2_{1,0.05} = 3.04$$

Thus, statistically not significant

3. Burglary

	Lighted Area		
	Nighttime	Daytime	
Dec. 1972 - Nov. 1973	22 (25.23)	19 (15.76)	41
Dec. 1973 - Nov. 1974	26 (22.27).	11 (14.23)	37
	48	30	78

$$\frac{(F_i - f_i)^2}{f_i} \quad \frac{(22-25.23)^2}{25.23} + \frac{(19-15.76)^2}{15.76} + \frac{(26-22.27)^2}{22.27} + \frac{(11-14.23)^2}{14.23}$$

$$= 2.436$$

$$\chi^2_{1,0.05} = 3.84$$

Thus statistically not significant.

PART I: The procedure based on a test for random variables with, a Poisson distribution
Duncan, A. J., Quality Control and Industrial Statistics, Revised Ed., pp. 511-512.

PART II & III: The Test is a 2 x 2 contingency table test from
Duncan, A. J., Quality Control and Industrial Statistics, Revised Ed.» pp. 503-504.