NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE TECHNOLOGY APPLICATIONS

Task 86, Phase III
September 8, 1970

EFFECTIVENESS ANALYSIS OF HELICOPTER PATROLS

VOL. II: EVALUATION

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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JPL DOCUMENT 650-89

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VOL. II: EVALUATION

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SECTION I

INTRODUCTION

Increases in crime and greater demands for police services have led the Los Angeles Police Department (LAPD) to look for new and better methods of controlling crime and serving the public more effectively. To this end, the LAPD decided early in 1968 to test the use of helicopters in a new role or phase of police work - specifically, as a patrol vehicle.

In the past, helicopters have been used in police work largely in support of the traffic control function, but experience has shown them to be very versatile, and they have also been used for rescue and emergency work, as observation posts during major riots, for dispersing disorderly crowds, and so on. Only recently have they been used in patrol work. Little documentation exists on how effective they are in this function. Much of what does exist is highly subjective, being concerned more with specific cases and examples than with overall effectiveness. In other words, the results have not been reported in a manner that relates to goal achievement. Consideration of the overall effectiveness has suffered because of a lack of qualified "control" data to which test results could be compared. This lack of information extends beyond repression of crime to support in the apprehension of offenders, maintaining the public order, and so on. Similarly, there is little information relating the effectiveness of the helicopter to the socioeconomic environment in which it is operated. In the past, helicopters were used in so-called bedroom communities, in which the requirements imposed on the police differ greatly from those in the central city and high-crime areas.

Subsequent to the decision by the LAPD to initiate helicopter patrol flights in the city, it became obvious that a concentrated effort must be made to clearly evaluate the new use of this system. Further helicopter procurements and their deployment will be strongly dependent on the effectiveness of helicopter patrols as determined in this evaluation. It was therefore important to examine helicopter patrols in more detail than had been done in the past, to attain a more quantitative expression of their effectiveness.

The Los Angeles Police Department and the California Institute of Technology's Jet Propulsion Laboratory, with the approval of the National Aeronautics and Space Administration, agreed that JPL would evaluate the effectiveness of helicopter patrols. This study was performed by the Space Technology Applications Office of JPL using evaluation techniques developed from space projects.

Planning and preparation for the patrol activities were conducted in the last half of calendar year 1968.

SECTION II

OBJECTIVES

This study* is being conducted to objectively evaluate the effectiveness of the helicopter patrols used by the Los Angeles Police Department (LAPD) in two of its divisions in 1969; to relate the resulting effects, if possible, to the demography of the areas in which the test program was conducted; and to determine what measures can be taken to increase the effectiveness of the helicopter units.

The present report describes progress toward these objectives to date.

*This report is in three volumes. Volume I summarizes the approach used and the results. Volume II presents the full study, and Volume III contains background material and some of the data too voluminous for Volume II.

SECTION III

DESCRIPTION OF HELICOPTER PATROL TEST PROGRAM

A. INTRODUCTION

A test program was conducted in which helicopters were used in patrol work in 2 of the LAPD's 17 divisions throughout calendar 1969 (Fig. 1). The University* and West Valley Divisions were selected as test divisions for this program because of their differences in crime characteristics and demography (Table 1). The patrols were initiated as day-watch flights, on January 2, 1969, and extended to the night watch on February 26, 1969. The period of activity for purposes of evaluation consists of the full calendar year 1969.

Table 2 summarizes the differences that existed between the two test divisions in factors relevant to the present study. Except for manpower changes, these factors remained constant during 1969 in all LAPD Divisions except Van Nuys, where the following changes occurred: (1) A control system known as LEMRAS (Law Enforcement Manpower Resources Allocation System) was instituted. This system uses weekly crime data to forecast where extra units should be deployed to counter expected crime. (2) Van Nuys Division received 15 additional black-and-white patrol units in 1969.

B. POLICE MANPOWER LEVELS DURING TEST PERIOD

Table 3 shows LAPD deployed manpower by divisions during 1969. Table 4 shows the amount of man-day effort expended by the Crime Task Force**(CTF) in all of the LAPD Divisions by quarter. Table 5 shows the percentage changes in operational man-days expended in LAPD divisions during 1968-1969.

*University Division contains a large university - the University of Southern California. It also contains the Colosseum, the Sports Arena and the Shrine Auditorium; all of these host large public events. West Valley Division is located in a largely residential area in the west end of the San Fernando Valley.

**The Crime Task Force, a special unit controlled by LAPD headquarters, is assigned when a high rate of crime occurs in a particular division. The unit's efforts are generally directed toward a specific crime. The force is also used for situations where violence is anticipated.

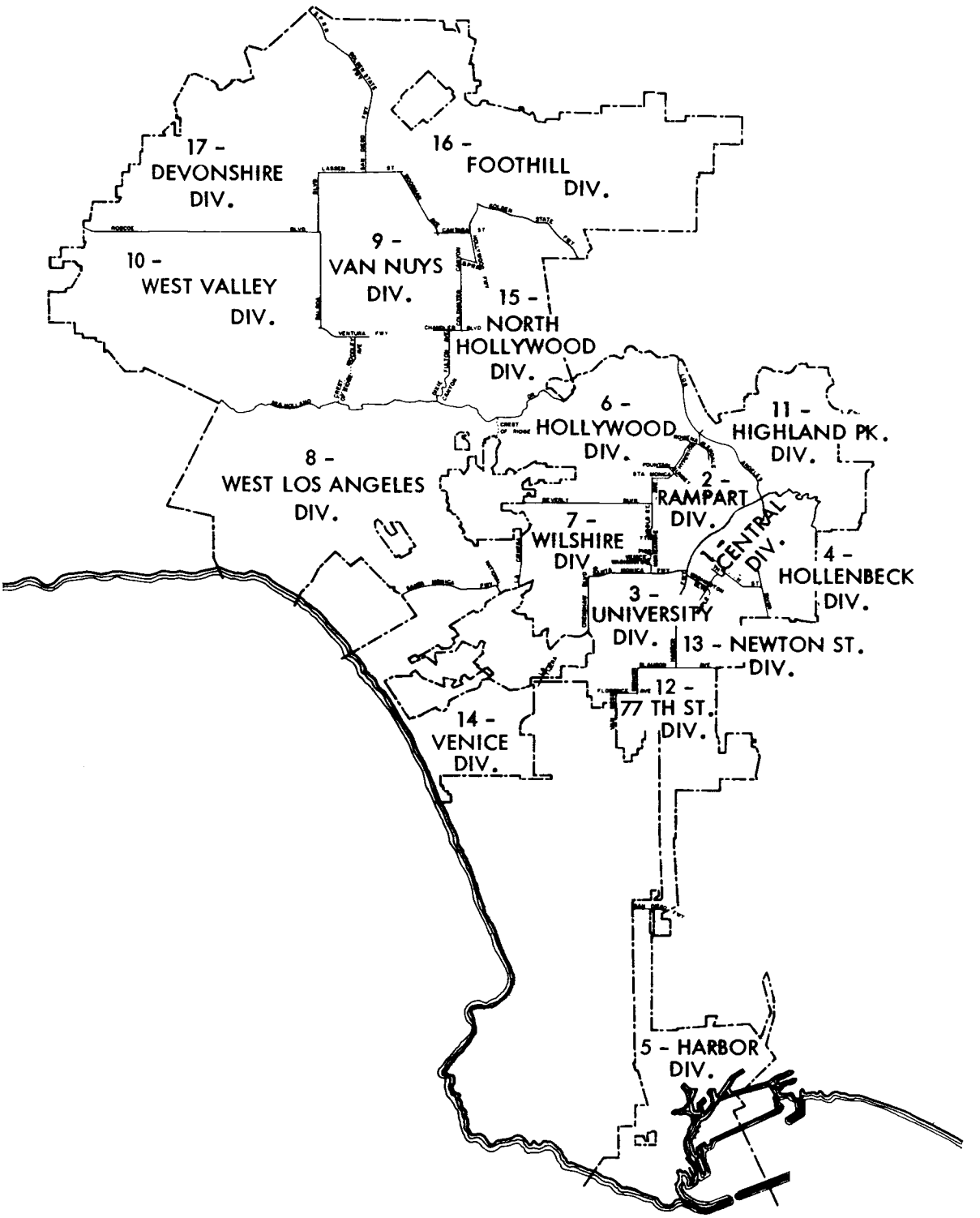

Fig. 1. Police division boundaries - Los Angeles, Calif. (Calendar Year 1969)

Table 1. Crime and demographic characteristics in the test divisions - 1968

Characteristics	West Valley	University
Crime*/square mile	231	1485
Crime*/street mile	19	66
Crime*/1,000 population	48	103
Area (sq. mi.)	55	13
Population/sq. mi.	4700	16,500
Business/sq. mi.	32	120
Race - % White	99	16
% Black	Nil	72
% Mex-Amer. & Oriental	1	12
% Single family dwellings	95	73
% Own dwelling	83	57
% Family income greater than $10,000	75	25
Male head of household - % greater than high school education	66	35
No male head of household - %	6	22

*Part I crime offenses, which includes murder, rape, aggravated assault, robbery, burglary, theft and auto theft.

Table 2. Differences between test divisions

University	West Valley
Deployed manpower per 1000 population: 0.7	Deployed manpower per 1000 population: 0.4
Patrol cars(1): 33	Patrol cars(1): 36
Single radio receiver per car except in supervisory vehicles	Extra radio receiver in every car
Two men per car	One man per car
Average service time(2) of personnel in division: Low	Average service time(2) of personnel in division: Average
Division commander changed during test period	Division commander was the same for test year
Division commander utilized a special operations squad	No special operations squad utilized
CTF(3) man-days expended in division during 1969: 4553	CTF(3) man-days expended in division during 1969: 621

(1)Marked patrol units.

(2)Compared to all divisions.

(3)As can be seen, CTF expended approximately seven times more man-days in University Division than in West Valley Division.

Table 3. Deployed manpower by division

Division	Start 1969	Calendar Quarters			
		End 1st	End 2nd	End 3rd	End 4th
Central	100	98	92	85	85
Rampart	124	125	120	116	120
University*	154	154	152	144	142
Hollenbeck	71	68	67	66	67
Harbor	79	80	78	78	78
Hollywood	130	130	125	126	132
Wilshire	131	136	128	125	130
West L. A.	85	86	87	83	78
Van Nuys	107	106	102	101	104
West Valley*	99	101	94	96	95
Highland Pk.	65	67	67	63	64
77th Street	203	204	200	198	201
Newton	98	99	93	96	94
Venice	83	89	97	94	96
No. Hollywood	77	76	77	76	76
Foothill	79	83	79	81	83
Devonshire	51	47	46	51	53
Total	1736	1749	1704	1679	1698

*Test divisions

Note: This table indicates only patrolman rank personnel whose assignment is street patrol. These data were obtained from the LAPD Officer Table of Organization and Deployment Reports for 1969.

Table 4. CTF man-days* expended in 1969

Division	Quarter				
	First	Second	Third	Fourth	Total
Central	90	191	265	65	611
Rampart	423	1015	747	813	2998
University	1841	910	836	966	4553
Hollenbeck	592	175	0	0	767
Harbor	87	36	0	40	163
Hollywood	559	933	473	1800	3765
Wilshire	746	306	240	1477	2769
West L. A.	197	96	430	441	1164
Van Nuys	356	147	568	256	1327
West Valley	560	11	32	18	621
Highland Park	0	0	163	84	247
77th Street	608	943	1782	1624	4957
Newton	266	605	295	439	1605
Venice	54	493	544	233	1324
North Hollywood	476	419	303	68	1266
Foothill	19	435	235	408	1097
Devonshire	653	237	0	169	1059

*One man for one 8-hour day.

Table 5. Change in operational man-days expended* - 1969 from 1968

Division	Percent Change
Central	-15
Rampart	+4
University	+2
Hollenbeck	-7
Harbor	-7
Hollywood	+7
Wilshire	+4
West L.A.	+3
Van Nuys	-8
West Valley	-6
Highland Park	-9
77th Street	+4
Newton	-1
Venice	+15
North Hollywood	+2
Foothill	+1
Devonshire	-6

*Operational man-days expended is defined as the sum of divisional man-days and CTF man-days.

As shown in Table 2, the Crime Task Force expended a considerable amount of effort in University Division.

C. HELICOPTER PATROL OPERATIONS

The helicopter patrol operated within the police system as a tool at the disposal of the division commander, and was subject to all of the constraints imposed by the police system. The helicopter patrol was therefore dependent upon the present communications system, the present chain of command and the special instructions of the divisional commanders (Fig. 2).

The helicopter patrol, an extension of the patrol car concept to aerial observation, was dependent on the present ground patrol units to complete any call for service, since the helicopter itself was not permitted to land. In reality, therefore, it was the effectiveness of the helicopter-car patrol team that produced the measurable results for analysis in this study. (The term "patrol" is somewhat of a misnomer for this work; very little time was spent in random patrol activity. The helicopter patrol was complementary to the patrol car effort and was not used as a replacement for the patrol car. The car and the helicopter units acted as a team, for maximum utilization of their capabilities.)

The basic helicopter patrol system consisted of a Bell 47G-5 helicopter, pilot, observer, auxiliary helicopter support equipment and auxiliary police support equipment. These items were the new elements introduced into the total police patrol system to implement the helicopter patrol (Fig. 3).

The pilot was responsible for operating the helicopter in flight. He ensured that all flight movements were coordinated with and were conducted in accordance with all safety and FAA flight regulations. The pilot received flight directions from the observer through the intercom system. All FAA control coordination was performed with the VHF radio. Pilots were administratively responsible to the Lieutenant-in-Charge of the ASTRO Section.

The observer directed the helicopter patrol operation and was responsible for deciding which calls to respond to and the operating tactics to be used. He provided flight direction to the pilot for the tactical procedures to be used.

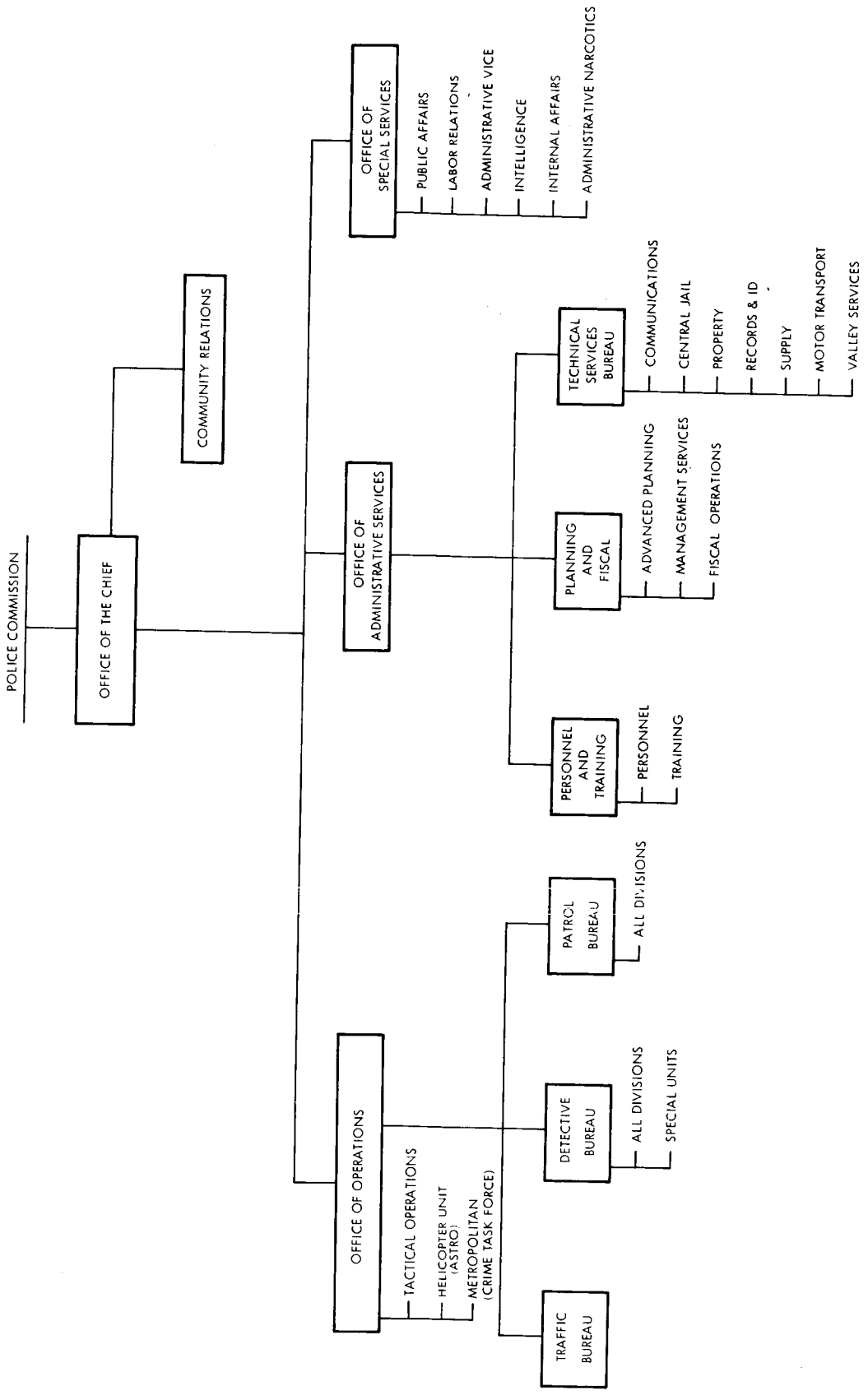

Fig. 2. LAPD organization chart

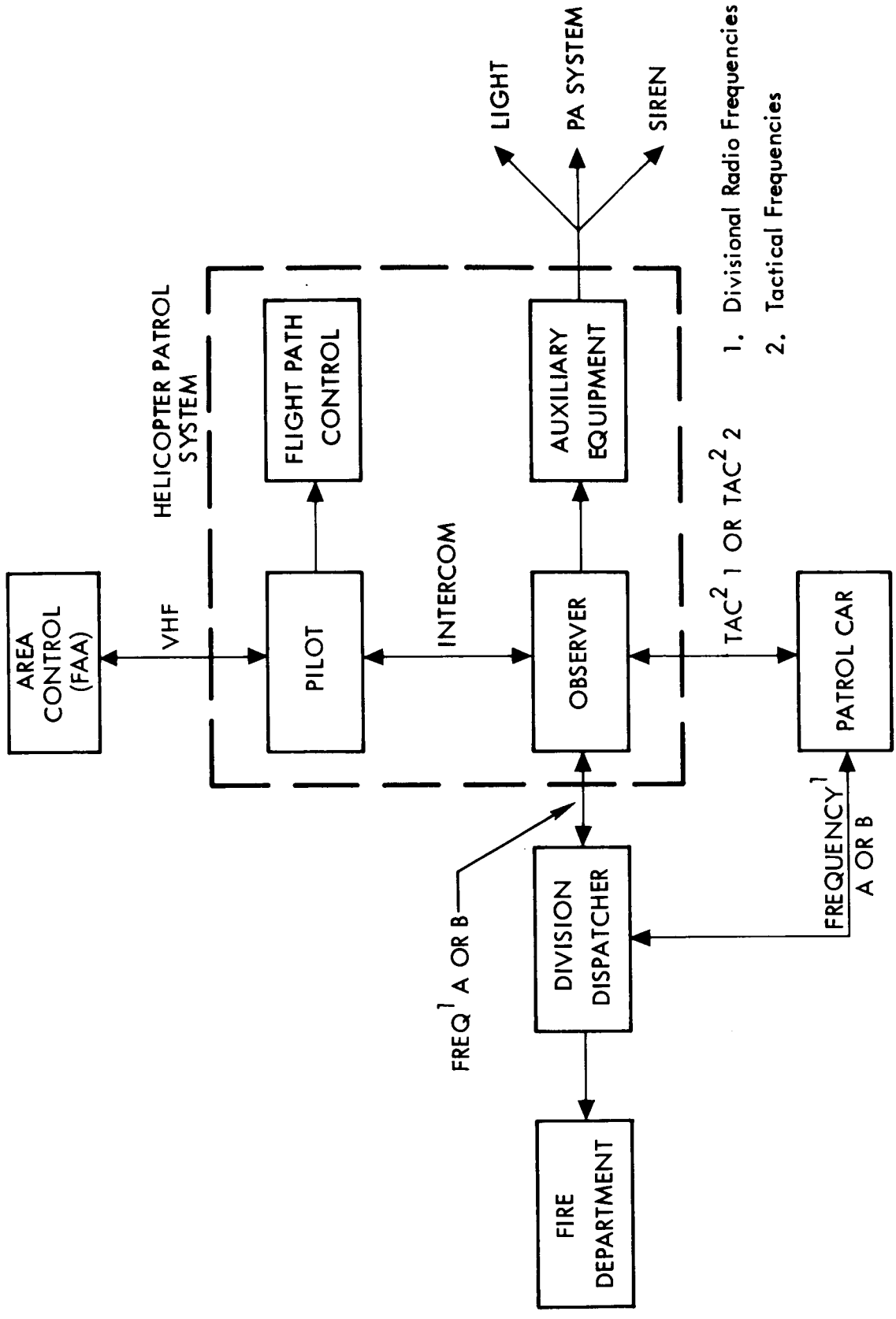

Fig. 3. Helicopter patrol interfaces

Helicopter actions were based on "problem" areas in the division, radio calls received and observations made. Flight time not related to specific radio calls was utilized for the investigation of problem areas of the division. The division dispatcher sent out all calls that required a service response. The observer monitored these calls and selected those in which he felt helicopter assistance could increase the chance of apprehending an offender or could provide additional safety for the responding ground units. The helicopter was seldom assigned by the dispatcher to respond to a specific call. The helicopters were not used to replace patrol cars; the calls answered by helicopters were also responded to by patrol cars. The observers were administratively responsible to the Division Commanders and were drawn from the Division's patrol force.

The auxiliary police equipment (Fig. 3) provides the observer with additional air-to-ground visibility and communication. The searchlight enables observation in remote or poorly lighted areas. The siren and loudspeaker can be used to inform people on the ground of emergency situations. This equipment is used at the discretion of the observer, and its application varies with the particular circumstances of each event. The helicopter also contains auxiliary equipment for increased performance for this particular application. Examples of these items are the rotor brake, dynamic flap, synchronized elevators, and dual controls.

Heliports and maintenance/hangar support facilities are closely related to aerial patrol. Although not directly involved during patrol flight, these facilities greatly affect the amount of flight time available during each shift. The maintenance facility is needed to keep the helicopters in operating condition and provide hangar space when they are not in use. Local heliports are required for coordination with the division station and for intermediate fueling stops during a shift. Current conditions require fueling stops at locations other than the division station and this reduces the available flight time.

The introduction of helicopter patrol system constitutes a change to the police division system. The helicopter system, however, is dependent on the present car patrol, communications and other police support systems for

effective operation, and it is within these constraints that the helicopter patrol must be evaluated.

D. TYPES OF DATA GATHERED

In addition to information on effective police manpower levels, three types of data were gathered for analysis in this study:

1) Crime statistics for all divisions were obtained, so as to determine the performance of the test divisions relative to the other divisions, and to validate the crime prediction technique.
2) Information was obtained on the helicopter patrols responses to calls for service or observations of suspicious actions, in order that the extent of the helicopter patrol's participation in the full range of police functions could be determined. This information was obtained from the flight logs maintained on each flight. (Only the results of the first six months of flight log data are presented in this report.)
3) Two opinion polls were conducted in the test divisions to measure the public and police attitudes toward the helicopter patrols. The first was a poll of the policemen that patrol the divisions in ground units and the second was a poll of the residents and businessmen living and working there.

SECTION IV

THEORY AND METHOD OF ANALYSIS

A. INTRODUCTION

To be meaningful, the "effectiveness" of helicopter patrols must be evaluated in terms of (1) the accomplishment of basic police system objectives and (2) the benefits or deficits that may accrue to the community and police from such patrols. The basic police system objectives are:

1) Control and reduction of crime:

   a) Prevention of criminality. Determination of the factors in community life which create criminal tendencies and lead the criminal to delinquency in social behavior, with the objective of eradicating these causes (Ref. 1).
   b) Crime repression. Making crime more hazardous to the criminal by increasing the probability of arrest and successful prosecution, and reducing or eliminating opportunities to commit crime.
   c) Apprehension of offenders. That process initiated by the occurrence of a crime which through the investigation of the crime and gathering of evidence leads to the arrest and booking of the offenders.
   d) Recovery of stolen property. Self-explanatory.

2) Movement and control of traffic:

   a) Traffic movement. Those activities consisting of direction of traffic, enforcement of traffic-oriented parking rules, emergency road services, weather emergency procedures, and identification and reporting of congestion points.
   b) Traffic safety. Those activities consisting of the enforcement of regulations by patrol/apprehension of moving violations or

enforcement of safety-oriented parking rules, driver training, eductional programs, and vehicle inspections.

c) Accident investigation. Self-explanatory.

3) Maintenance of public order:

a) Public events. Provision for the public safety at legally constituted public activities; e.g., sporting events and public ceremonies.

b) Minor disturbances. Prevention and control of relatively small disruptions of the peace, e.g., private quarrels, parties, drunkenness, derelicts, and miscellaneous nuisances.

c) Civil disorder. Prevention and control of relatively major disruptions of the peace.

4) Provision of public services:

a) Emergency services. Provision of support in, for example, fire, medical, power failure, flood, civil defense, and miscellaneous emergency situations.

b) Missing persons. Search for and rescue of lost persons, location of missing persons.

c) Lost property. Locating, recovery, and return of lost property to the rightful owner.

d) Miscellaneous. Any other non-criminal services to or for the public.

Table 6 contains a partial listing of subjects for benefit/deficit consideration.

Table 6. Subjects for benefit/deficit consideration in evaluating helicopter patrol effectiveness

Community	Police
Personal and property safety	Officer safety
Taxes	Economy
Insurance rates	Retention of personnel
Police/community relations	Morale
Civil rights	Recruitment

B. STATISTICAL ANALYSIS TECHNIQUES

The subjective nature of many of the determinations involved in evaluating helicopter patrol effectiveness precludes seeking a purely statistical or numerical overall result. Accordingly, a three fold analytical approach was taken: (1) development and application of a statistical procedure for evaluating selected, quantifiable aspects of helicopter patrol work (the statistical method is described in paragraph IV-B-1), (2) determination of the extent of the helicopter patrol's participation in total divisional law enforcement activities (this information to be derived from flight log data), and (3) an assessment of the results of public/police opinion polls concerning helicopter patrols.

Of the police system objectives and the benefit/deficit considerations, only the "control and reduction of crime" objective was analyzed statistically. It was selected because (1) most of the results are readily quantifiable and (2) it was the objective toward which the helicopter patrol program was directed.

Using these results and defining the changes to the police system, a comparison can be made to determine what effect all changes have on crime results. The evaluation process is shown in Fig. 4. The data* used were the number of offenses and number of arrests involving Part I property crimes of robbery, burglary, theft and auto theft. The analytical problem was how to determine whether changes had occurred in crime data of the test divisions that were attributable to the introduction of the helicopter patrols.

1. Crime Prediction Technique

To determine the effect of the helicopter patrols on crime repression and the apprehension of offenders in the test divisions, a set of comparisons or

*A study was performed to determine whether data on the dollar value of property stolen and recovered could be utilized. Based on past history, dollars reported stolen per offense and dollars reported recovered per arrest were calculated. Applying these to the offense/arrest calculations described earlier provided dollar numbers. It was found, however, that when the uncertainties associated with the predictions are combined with the uncertainties in the dollar conversion parameters, the answers were inconclusive, and are therefore not presented in this report.

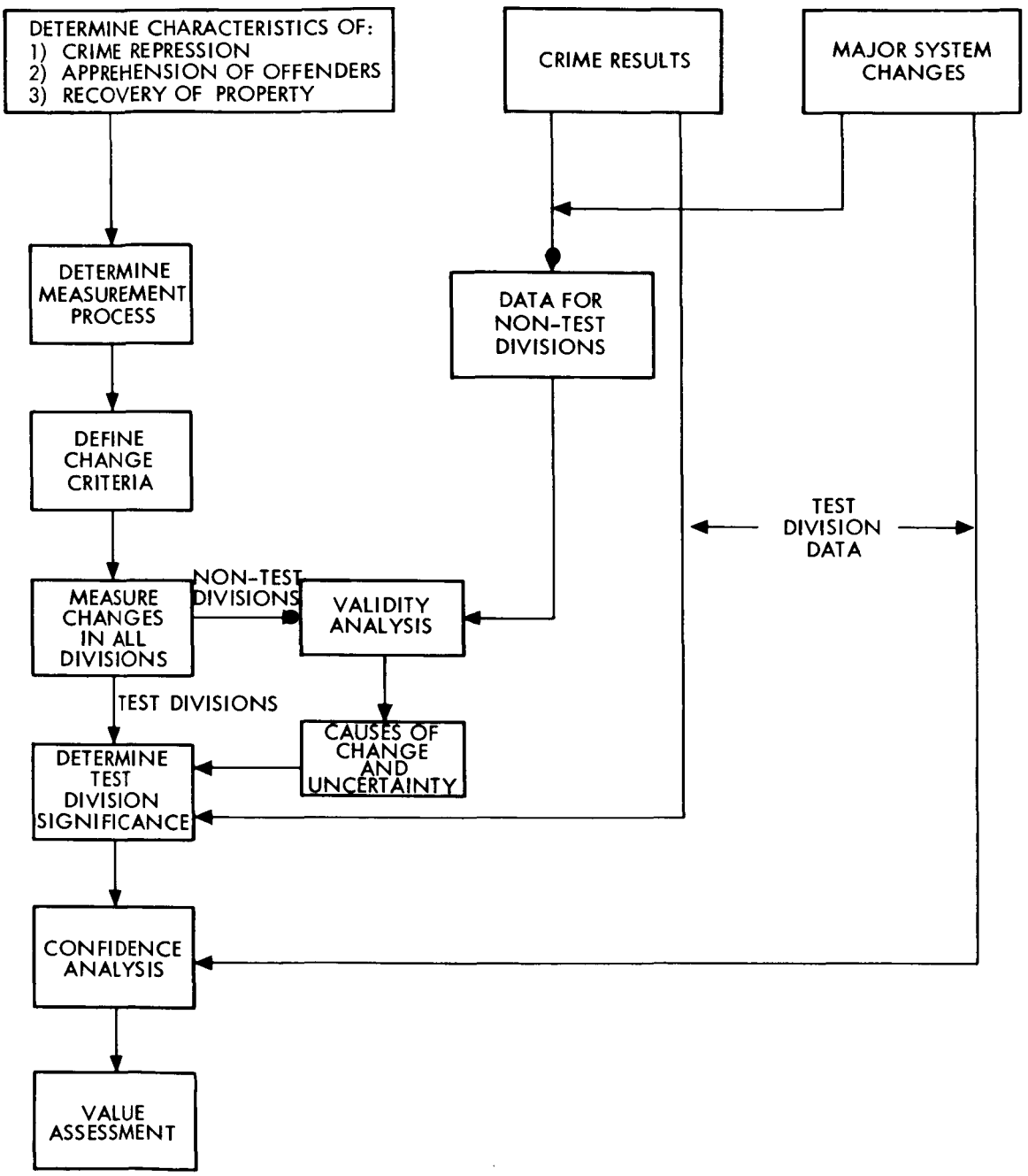

Fig. 4. Evaluation process

"control" data was needed. In many situations of this type the method would be to select a control area and a test area. The situations in the two areas would be identical except for changes in one variable in the test area. Any difference in results between the two areas would then be attributable to the changed variable. In the real world, it is often impossible to find two identical areas and/or assure that only one variable will differ. This was the situation here.

Divisions adjacent to the test divisions, although being most like the test divisions in many respects, could not be selected as control areas, since either or both of two effects could be present in them:

1) The presence of helicopters might cause criminals to shift to surrounding areas that were not to be patrolled, thus causing an increase in crime there and a greater apparent difference between it and the test division.
2) In many instances, the helicopter patrols cross the test division boundaries – going to and from the main heliport, refueling, meal and rest stops, special assignments, and exceptional circumstances. This may create an impression that the area of helicopter coverage is broader than publicly acknowledged, again with consequent effect on the crime data.

Elimination of these adjacent divisions, which included those adjacent to areas where the L.A. County Sheriff was operating helicopters, left four possible divisions for use as "controls". As these divisions in no way resembled either of the test divisions, an alternative method of providing "control" data was selected: It was decided to use the two test divisions as their own controls. To do this, it was necessary to predict the number of offenses and arrests that would have occurred in the test divisions, had the helicopters not been introduced. Differences between the actual and predicted occurrences would then be used in assessing the effectiveness of the patrols.

To test the validity of the prediction technique, predictions were made for all 17 LAPD divisions, and for selected combinations of the divisions, for the Part I crimes of robbery, burglary, theft and auto theft, both offenses and arrests. The accuracy of these predictions, when made for the non-test divisions, provides a measure of confidence for those for the test divisions.

Since a true causal model for predicting crime does not exist, the following approach, using solely time-series of data, was taken. This approach can be made clearer by describing the steps:

1) Establish a data base. Data was obtained for the years 1961-1968 for each type of crime, both offenses and arrests, by reporting district, * and by quarter-year. The data was then recombined, taking into account all boundary changes, into data for the police divisions as they were constituted in 1969. This provided an accurate time-series for each division and crime type.
2) Define the prediction models. Three baseline models were selected: linear, quadratic, and logarithmic. Two parameter estimation techniques were used: multiple regression analysis and exponential smoothing. Using these basic combinations, a total of 54 different models were defined.
3) Model selection. The 54 models were applied to each of the time-series. Only data from 1961 to 1966 was used, and predictions were then made for 1967 and 1968. Variances were determined and a "best" model was selected for each time-series.
4) Generate predictions for 1969. The selected best-fit model for each combination of crime-type and police division was then applied to the full 8-year data base for that same crime type and division to generate a set of predictions by quarters, for 1969.

Associated with any mathematical prediction is some degree of uncertainty in the final predicted value. When the final predictions were made, a probable uncertainty (one standard deviation, σ) was also calculated. When the actual data was compared to the predicted values, only those differences which exceed the one standard deviation were considered important to the evaluation. The greater the difference was in terms of, or in numbers of standard deviations the more significant is that difference. A significance level, in number of σ's was chosen that gave 90% confidence that the difference between the actual and

*Police divisions are subdivided into smaller geographical elements called reporting districts. These are, in general, identical with census tracts.

predicted number of occurrences could not have occurred by random chance. Only the deviations from the predicted number of occurrences that exceeded this level of significance were considered in the evaluation. (For a statistical explanation, see Appendix A.)

Using the resulting predictions and their associated uncertainties, a comparison to actual data was made. The deviations from the predictions were then used to determine the helicopter effectiveness in the test divisions. This comparison was also made in the non-test divisions, so as to assess the validity of the prediction technique.

When a significant difference was detected during the comparison of the predicted occurrences versus actual occurrences, a search through the system was made to determine what caused the deviation. This procedure was not limited to the test divisions; the other divisions and combinations thereof were being used as prediction validity evaluators. If a deviation in a non-test division could be explained by a parametric change in that division, it must be determined if that parameter was also changed in the test divisions.

NOTE

In the LAPD quarterly reports the Part I crimes of robbery, burglary and theft are broken down into subcategories as follows:

1) Robbery
   a) Street
   b) Other
2) Burglary
   a) Residence
   b) Business
   c) Phone booth
   d) Other
3) Theft
   a) Theft and burglary from auto
   b) Theft from person
   c) Bicycle and other theft
4) Auto Theft

This evaluation considers only the total occurrences in each category. In Volume III, the predicted and actual occurrences for each subcategory are presented as well as the total for the category. Also shown in the Volume III are the crimes of murder, rape, aggravated assault, narcotics and the total number of offenses and arrests.

The results in the non-test divisions were investigated to determine if the prediction techniques were valid. This entailed determining whether the deviations found in the non-test divisions could be explained as resulting from system changes (e.g., manpower changes) known to have taken place in those divisions. The results for the test divisions were then examined to see if they were influenced by similar changes. Where possible the results in the test divisions were explained in light of the other changes that were measured in the test divisions. Using these techniques, the changes in crime due to the helicopter patrol were determined.

The number of significant deviations in the non-test divisions indicates the confidence level that can be attributed to the prediction technique used.

2. Crime Trend Analysis

Since the number of occurrences predicted by the model was a function of the actual occurrences, a comparison of 1969 data with that for 1968 or earlier is redundant. There is, however, another technique that indicates effectiveness and that is the rate of change of occurrences. This value is determined by finding the increase (or decrease) of occurrences in percent of the previous year's occurrences. A comparison of several years of these data indicates the general trend in that crime.

SECTION V

RESULTS

A. COMPARISON-PREDICTED VS. ACTUAL OCCURRENCES

The results of the comparison of actual and predicted occurrences are shown in Figs. 5 through 14. These figures are a block representation of the police division map of the city of Los Angeles drawn in such a manner that each division is shown in contact with all of its adjoining divisions. This allows the reader to see what went on in the adjoining divisions. A complete set of comparison data in tabular form is presented in Volume III of this report.

The data shown in Figs. 5 through 14 are presented in two columns, one headed "%", the other "σ's". The % column represents the percentage value of the difference between the actual and predicted occurrences for that crime in that division. In mathematical terms,

$$\% = \frac{\text{Actual - Predicted}}{\text{Predicted}} \times 100$$

The column headed σ's represents the number of standard deviations (probable uncertainties) that the actual number of occurrences deviated from the predicted number. As an example:

Predicted = 112
Standard Deviation = 9
Actual = 84

Therefore:

$$\% = \frac{84 - 112}{112} \times 100 = -25.0$$

$$\sigma\text{'s} = \frac{84 - 112}{9} = -3.1$$

As stated earlier, only the deviations that exceed one standard deviation are presented.

The data in each block also has four rows. Each row is a calendar quarter. The top row is the first quarter, next row is the second, etc.

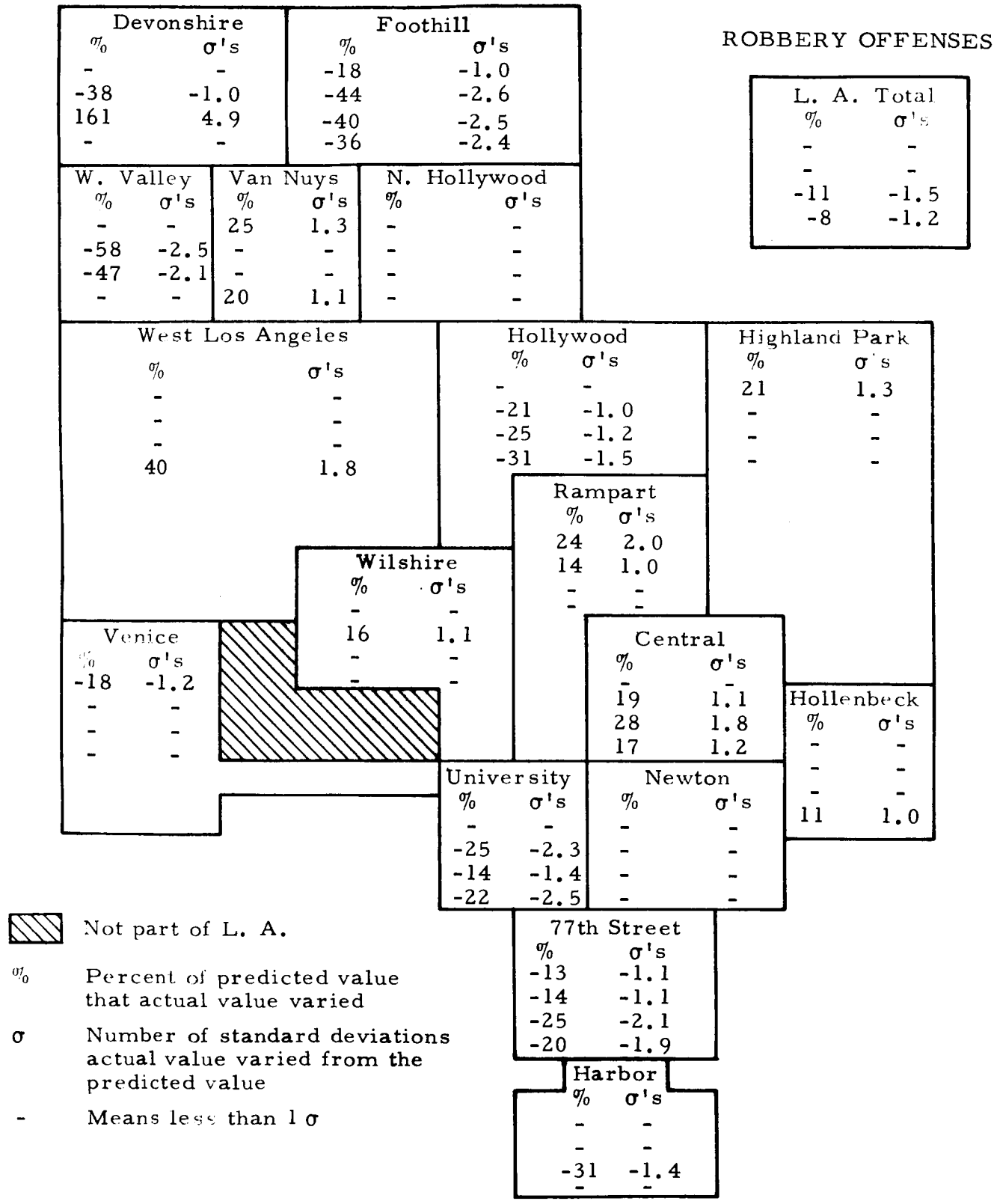

Fig. 5. Comparisons - actual vs. predicted occurrences: Robbery offenses

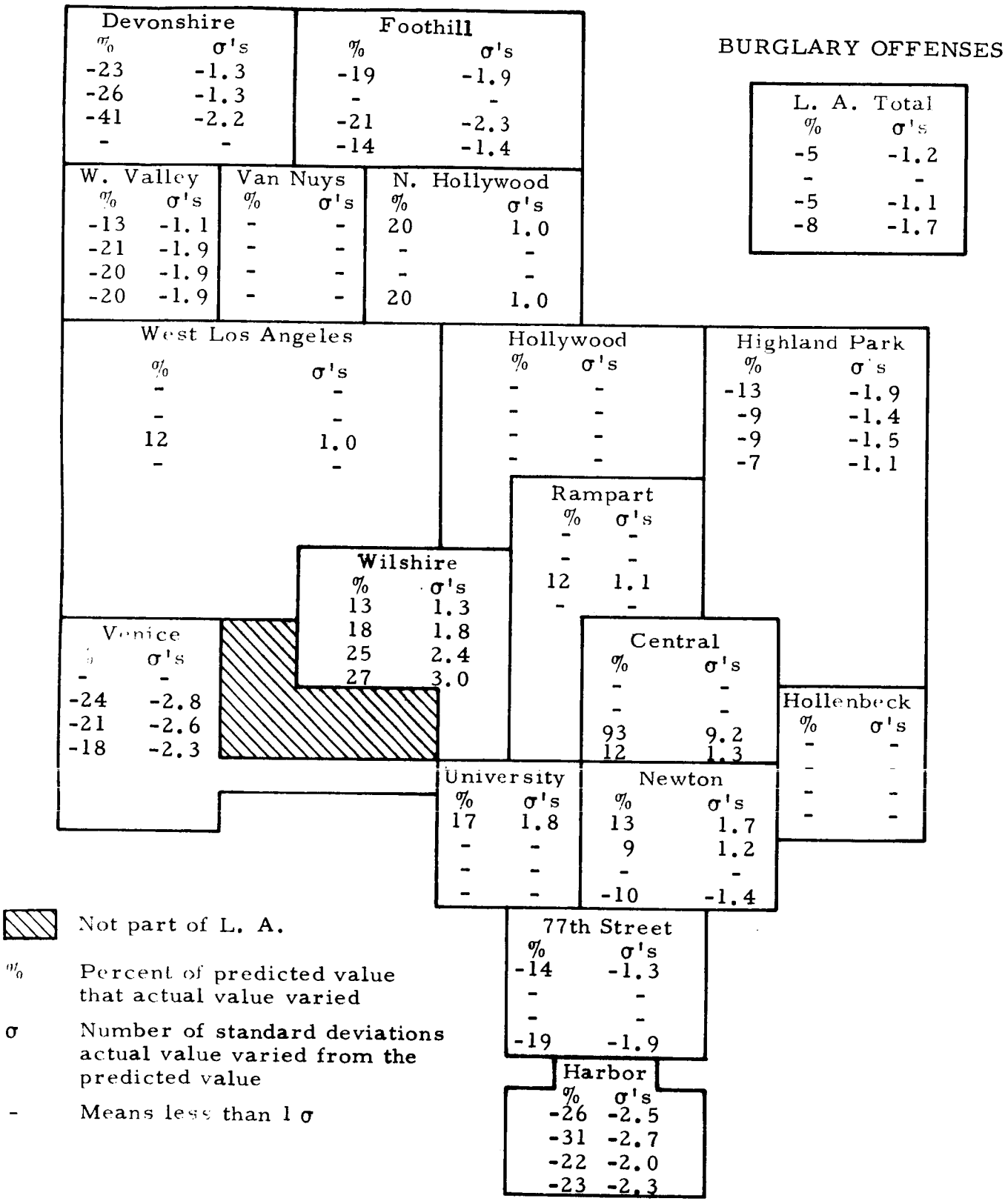

Fig. 6. Comparisons - actual vs. predicted occurrences: Burglary offenses

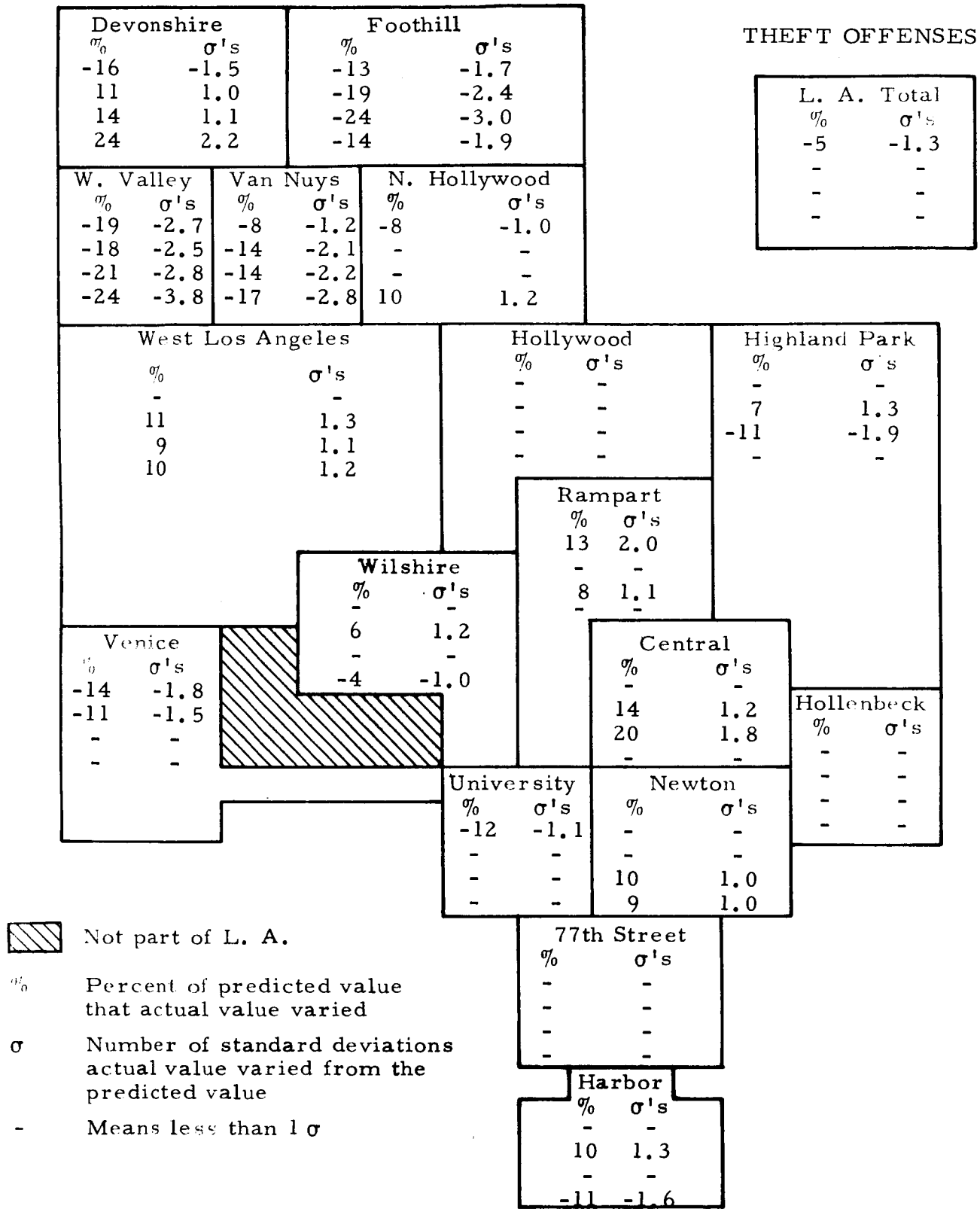

Fig. 7. Comparisons - actual vs. predicted occurrences: Theft offenses

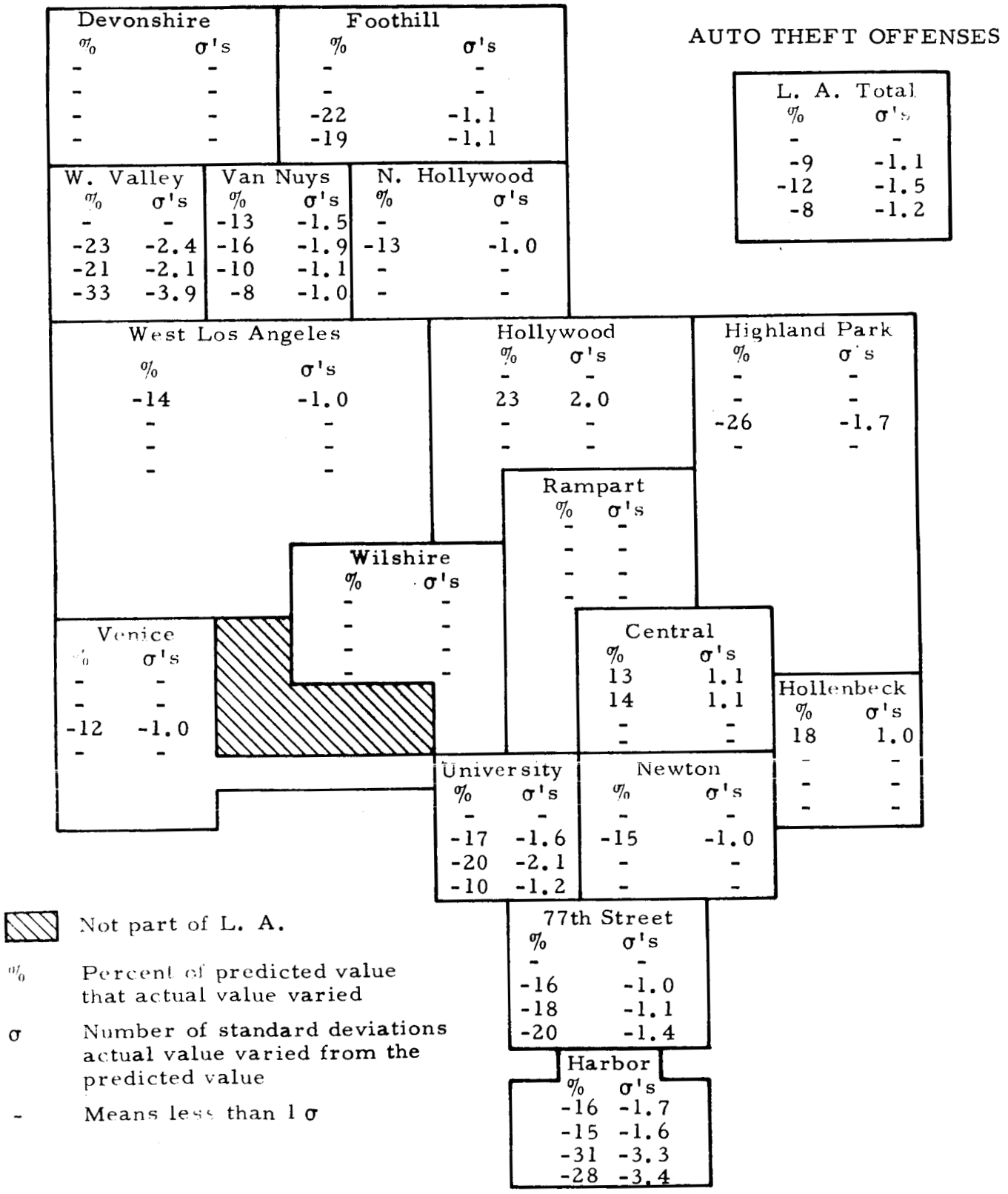

Fig. 8. Comparisons - actual vs. predicted occurrences: Auto Theft offenses

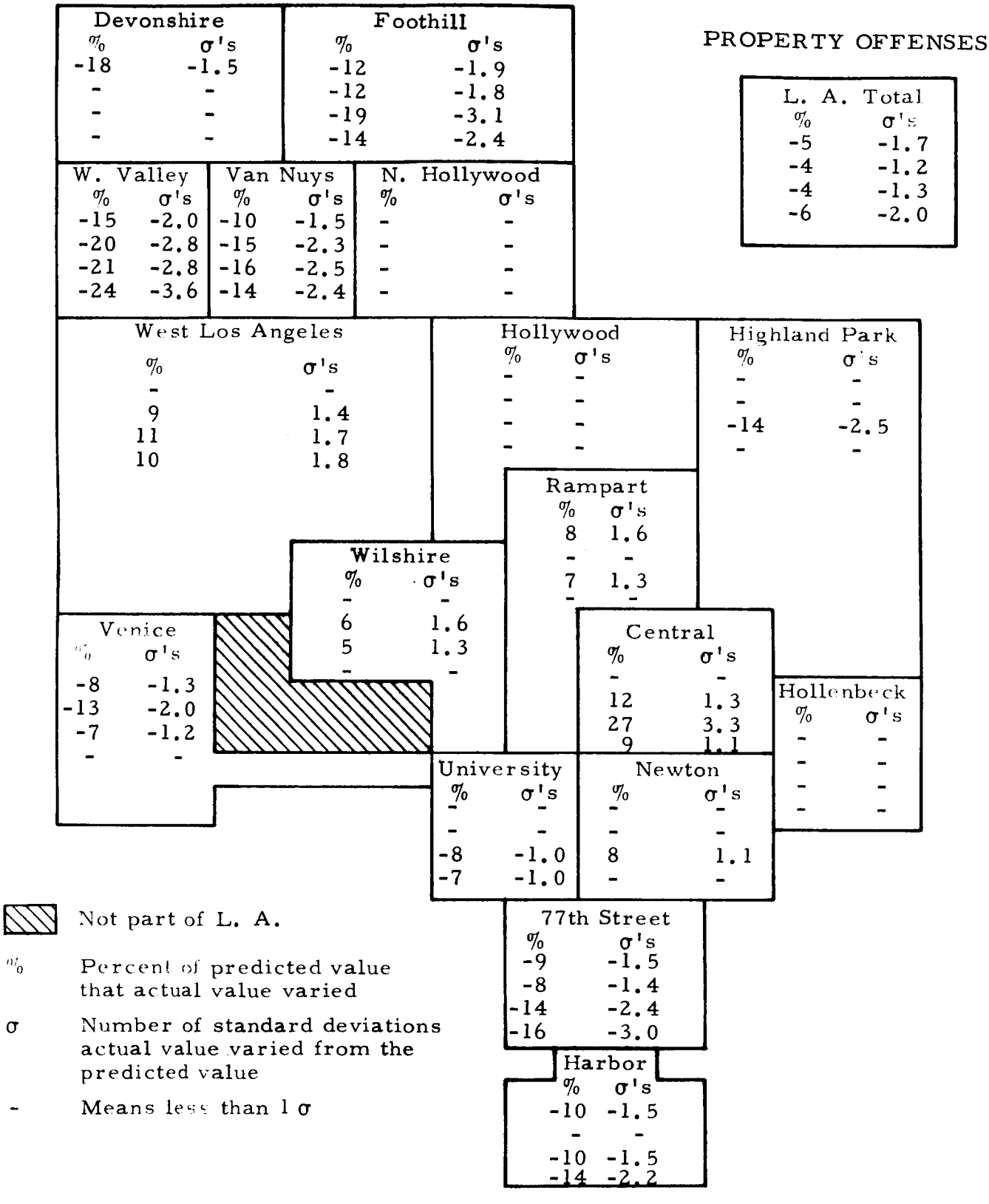

Fig. 9. Comparisons - actual vs. predicted occurrences: Property offenses

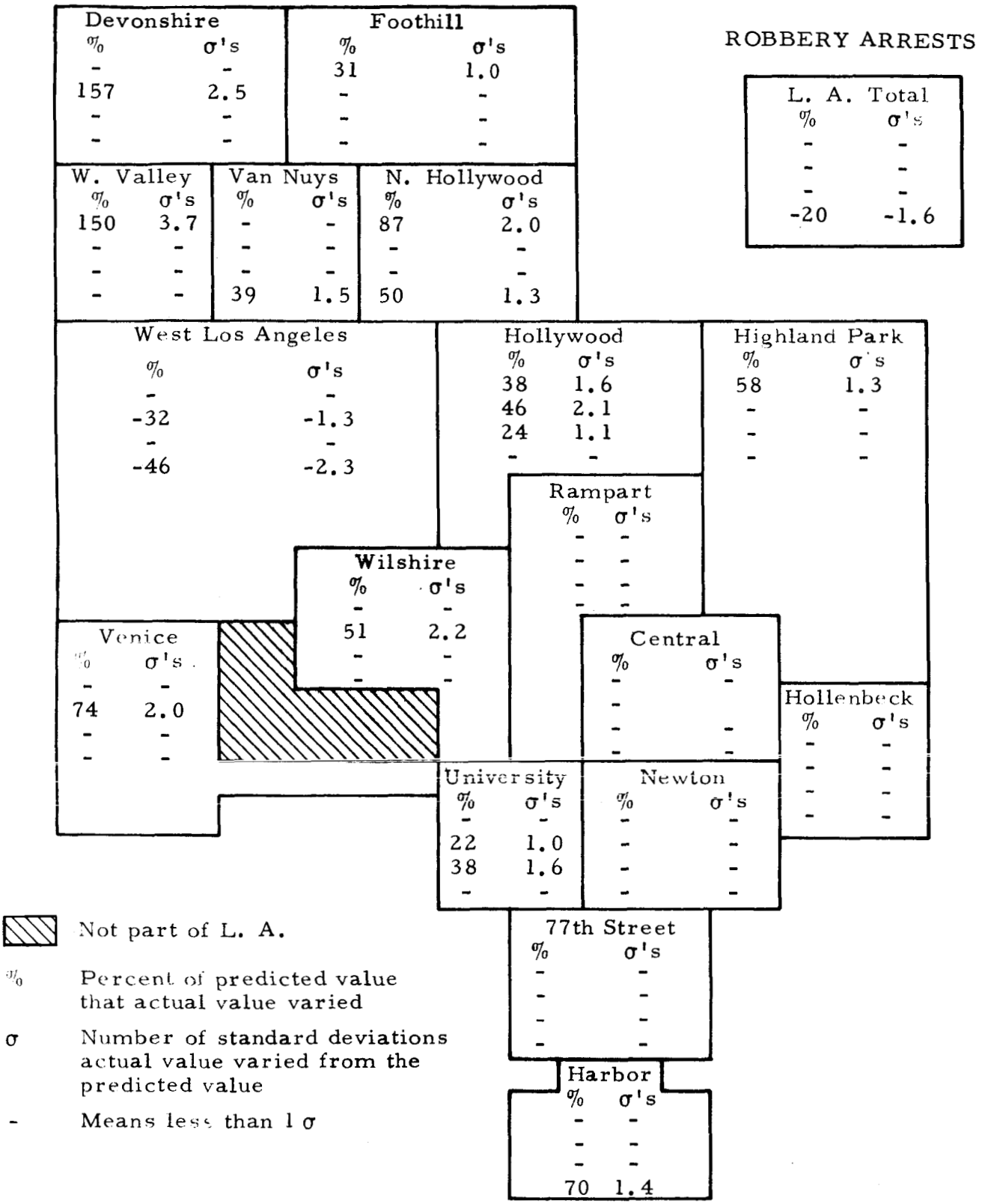

Fig. 10. Comparisons - actual vs. predicted occurrences: Robbery arrests

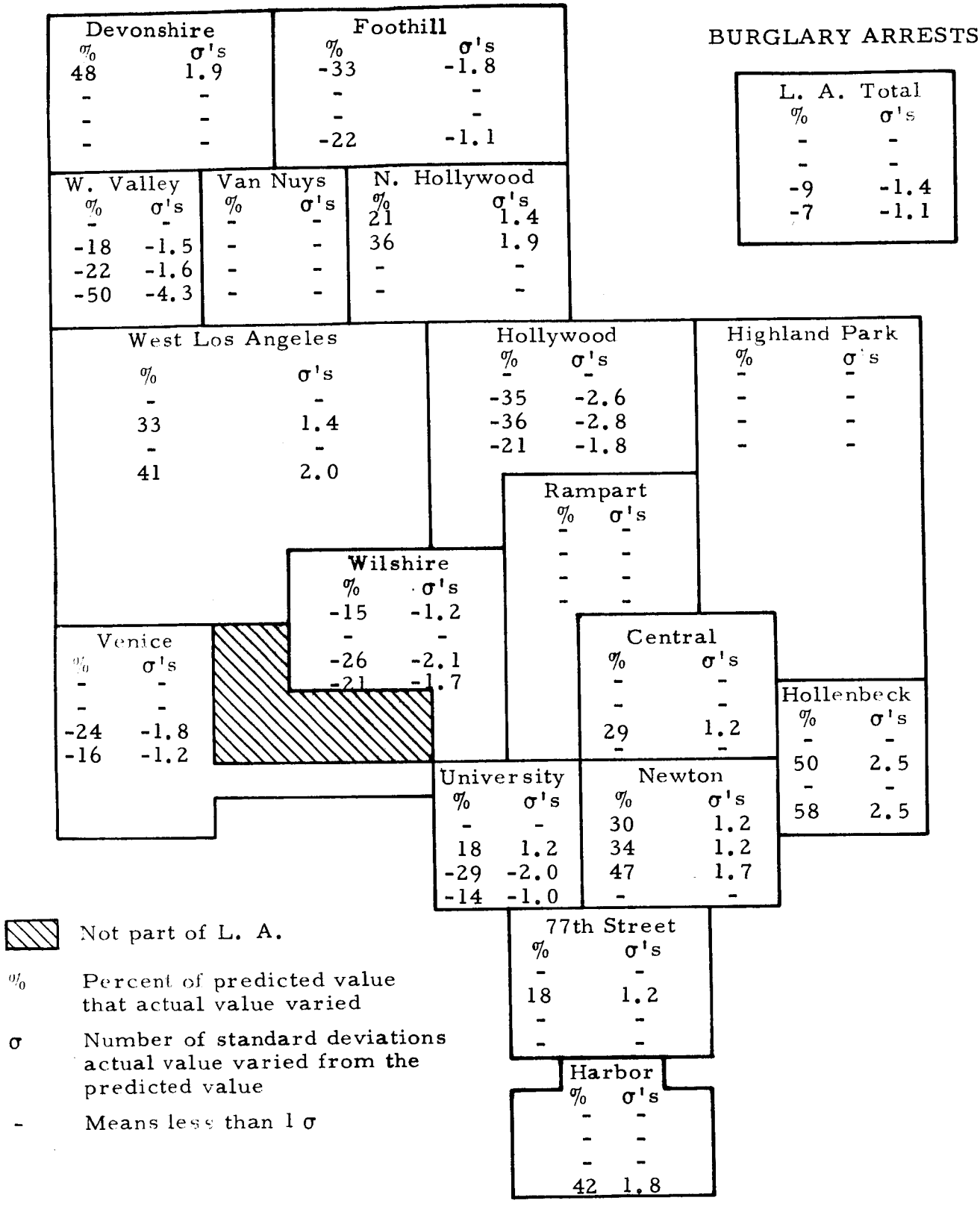

Fig. 11. Comparisons - actual vs. predicted occurrences: Burglary arrests

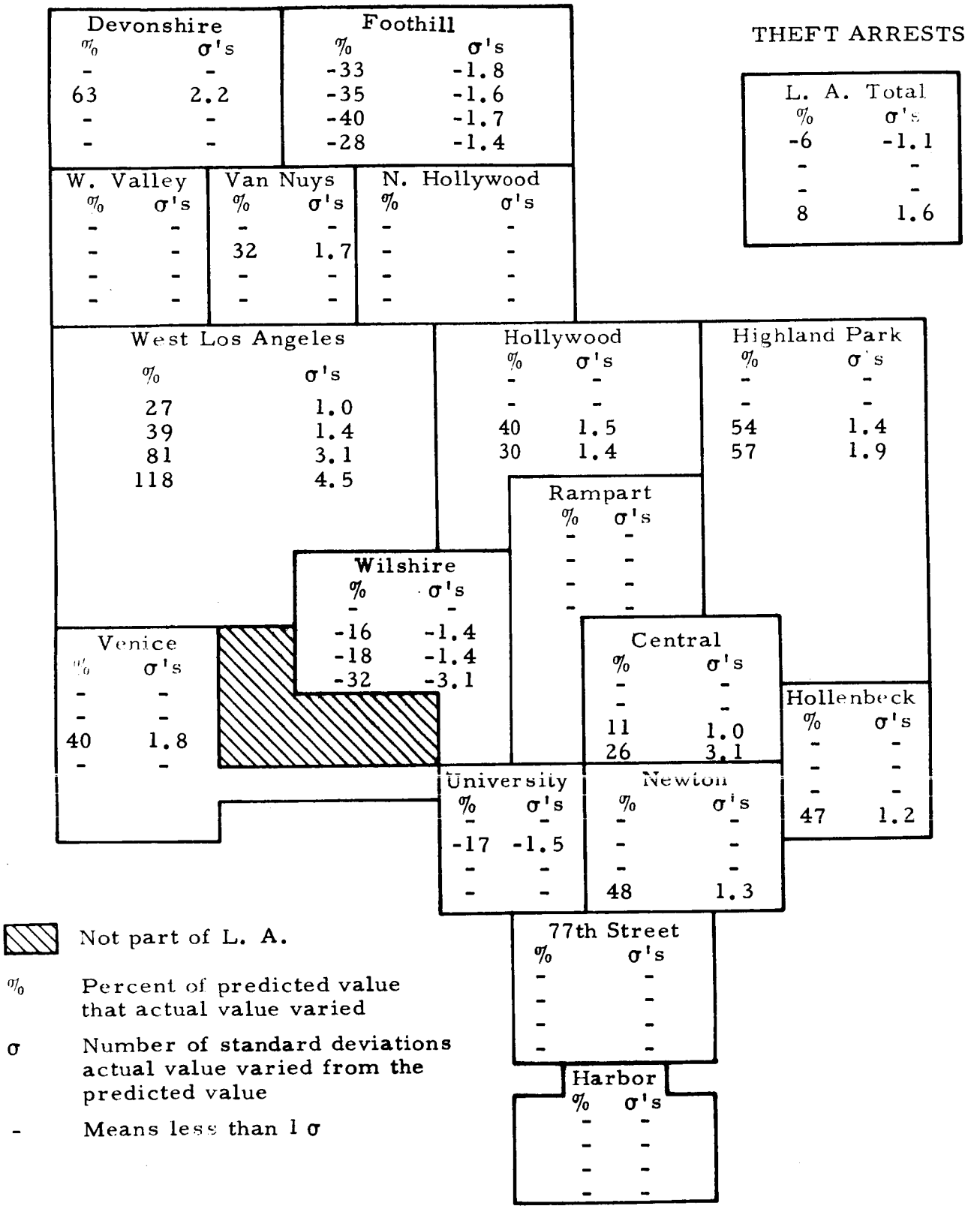

Fig. 12. Comparisons - actual vs. predicted occurrences: Theft arrests

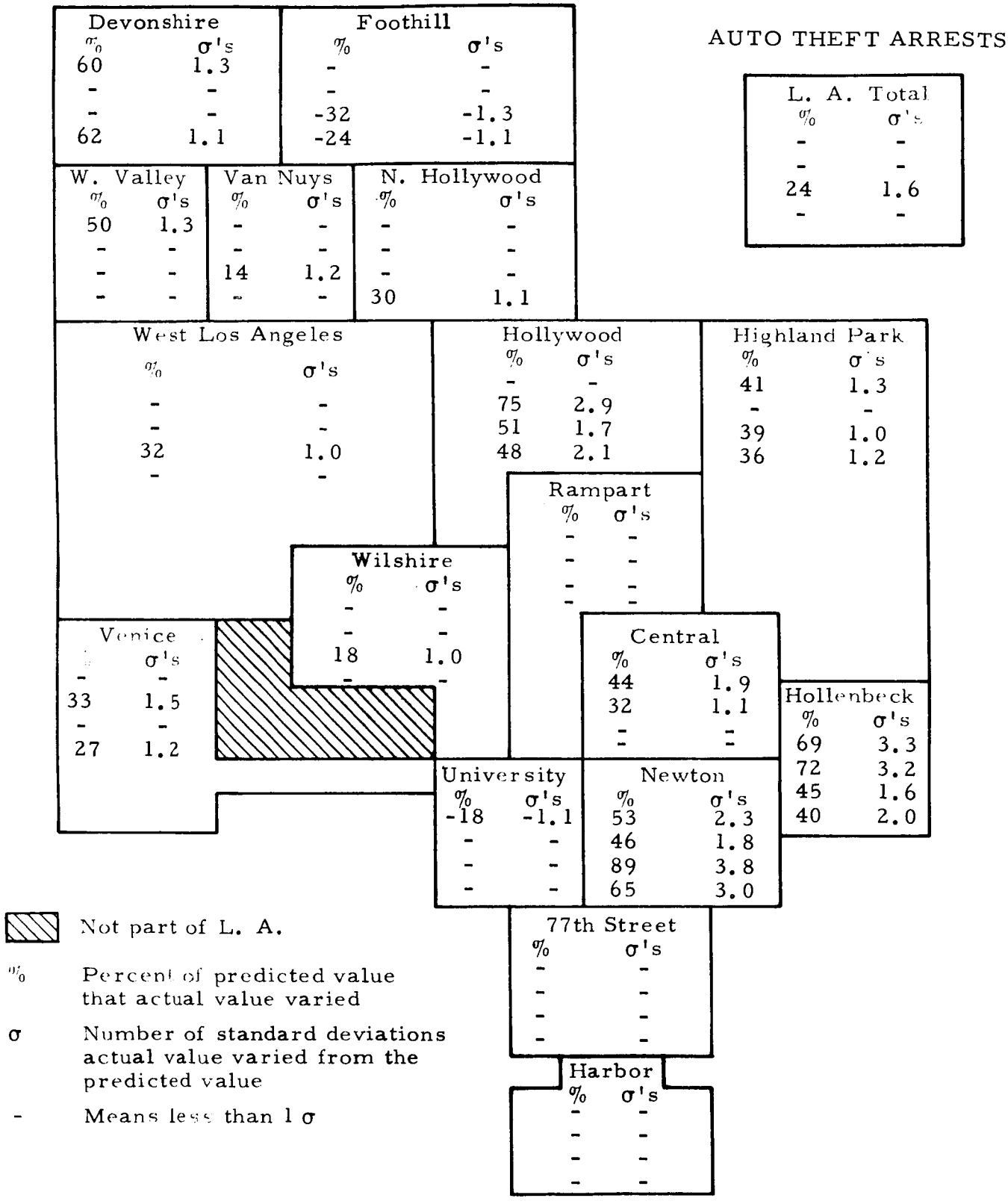

Fig. 13. Comparisons - actual vs. predicted occurrences: Auto theft arrests

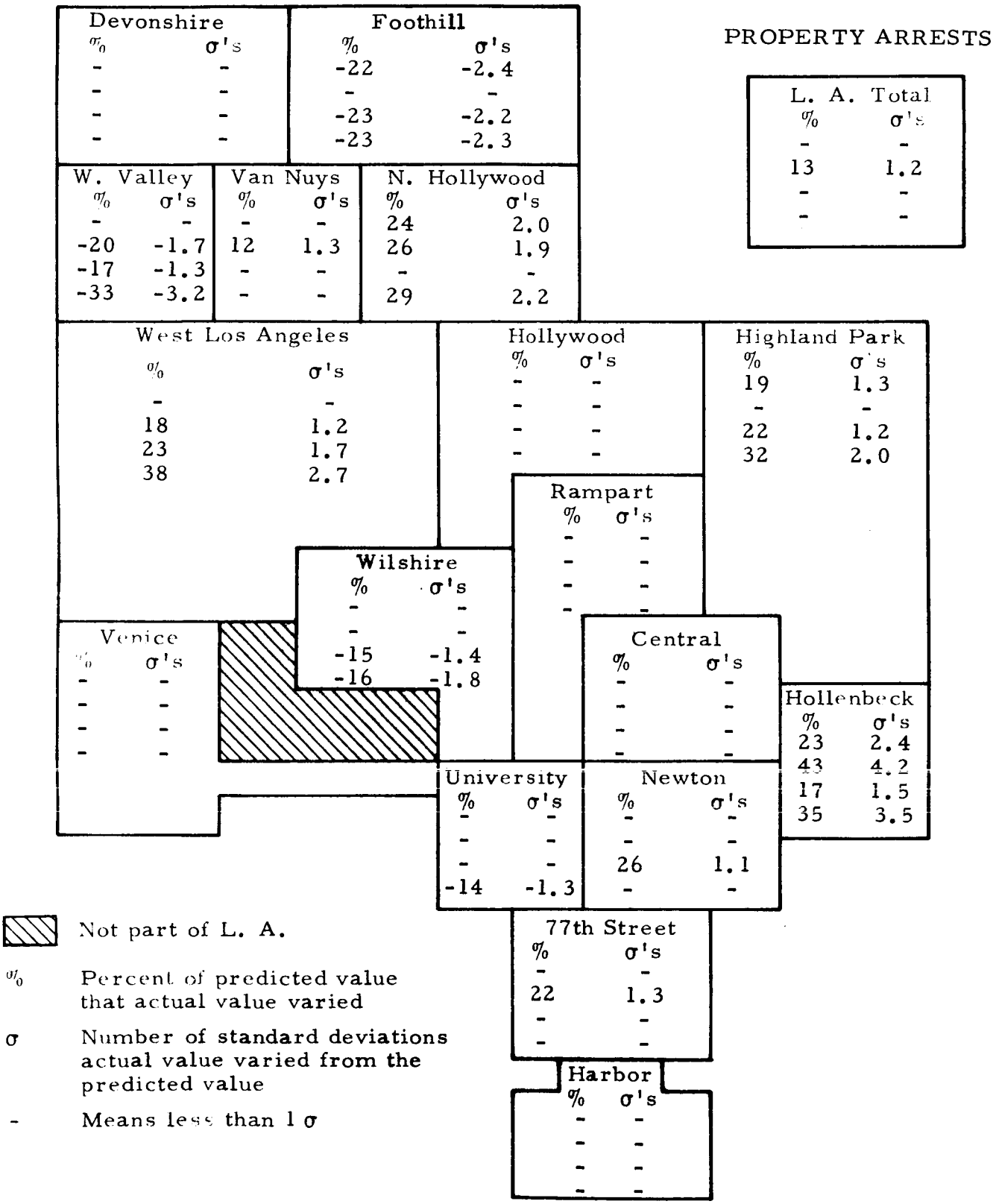

Fig. 14. Comparisons - actual vs. predicted occurrences: Property arrests

Using the results shown in Figs. 5 through 14, a value of σ that is significant* was determined. Tables 7 and 8 indicate the significant σ level and the number of times (in calendar quarters) that this value was equalled or exceeded in each crime category for the test and non-test divisions. The tables also indicate a minus or plus value. The minus value means that the actual occurrences were fewer than predicted and a plus value means more than predicted.

The validity of the prediction technique is verified by the data presented in Table 7. This table represents 480 predictions. (Represented in the data are 17 divisions, 4 "areas", 2 "areas" minus the test divisions located in those areas, and the L. A. totals. For each of these there are four crimes plus a total, each of which is predicted for 4 quarters. Thus, 480 predictions.) Of these 480 predictions only 43 significantly deviated more than was expected. There is greater than 90% confidence that these 43 deviations could not have occurred randomly.

Looking only at the 17 divisions in robbery, burglary, theft and auto theft, it can be seen that there are 32 significant deviations out of 272 predictions. Within these 32 deviations the following is noted with regard to the test and adjacent divisions:

1) Three negatives in University Division.
2) Nine negatives in West Valley.
3) In divisions adjacent to University there are two positive values and one negative value.
4) In divisions adjacent to West Valley there are one positive and two negative values. The positive value occurred in the same quarter as a negative value in West Valley and in the same crime.

*"Significant", as used in this report, means that with 90% confidence the values deemed significant are not random occurrences. This level of confidence was determined using standard statistical procedures, described in more detail in Appendix A.

Table 7. Significant results summary - offenses

(Number of calendar quarters in which actual occurrences were significantly above or below (+ or -) prediction.)

	Robbery	Burglary	Theft	Auto Theft	Total Property
Significant σ Level	2.0	2.5	2.3	1.8	2.5
Central	0	+1	0	0	+1
Rampart	+1	0	0	0	0
University*	-2	0	0	-1	0
Hollenbeck	0	0	0	0	0
Harbor	0	-2	0	-2	0
Hollywood	+1	0	0	-1	0
Wilshire	0	+1	0	0	0
West L. A.	0	0	0	0	0
Van Nuys	0	0	-1	-1	-1
West Valley*	-2	0	-4	-3	-3
Highland Pk.	0	0	0	0	-1
77th Street	-1	0	0	0	-1
Newton	0	0	0	0	0
Venice	0	-2	0	0	0
N. Hollywood	0	0	0	0	0
Foothill	-3	0	-2	0	-1
Devonshire	+1	0	0	0	0
Area 2[1]	0	0	0	0	0
Area 3[2]	0	0	0	0	0
Area 4[3]	-1	0	-1	0	-1
Area 5[4]	0	0	0	0	0
Area 2 minus University	0	0	0	0	0
Area 4 minus West Valley	0	0	0	0	0
L. A. Total	0	0	0	0	0

Note: Minus values are favorable.

*Test divisions.

[1]Area 2 contains University, Wilshire, 77th Street and Newton Divisions.

[2]Area 3 contains Central, Rampart, Hollenbeck, Hollywood, and Highland Park Divisions.

[3]Area 4 contains Van Nuys, West Valley, North Hollywood, Foothill, and Devonshire Divisions.

[4]Area 5 contains Harbor, West Los Angeles, and Venice Divisions.

Table 8. Significant results summary - arrests

(Number of calendar quarters in which actual occurrences were significantly above or below (+ or -) prediction.)

	Robbery	Burglary	Theft	Auto Theft	Total Property
Significant σ Level	2.0	2.0	2.0	2.4	2.3
Central	0	0	+1	0	0
Rampart	0	0	0	0	0
University*	0	-1	0	0	0
Hollenbeck	0	+2	0	+2	+3
Harbor	0	0	0	0	0
Hollywood	+1	-2	0	+1	0
Wilshire	+1	-1	-1	0	0
West L. A.	-1	+1	+2	0	+1
Van Nuys	0	0	0	0	0
West Valley*	+1	-1	0	0	-1
Highland Pk.	0	0	0	0	0
77th Street	0	0	0	0	0
Newton	0	0	0	+2	0
Venice	+1	0	0	0	0
N. Hollywood	+1	0	0	0	0
Foothill	0	0	0	0	-2
Devonshire	+1	0	+1	0	0
Area 2	0	0	0	0	0
Area 3	0	0	+1	0	0
Area 4	+1	-2	0	0	0
Area 5	0	+1	+2	0	0
Area 2 minus University	0	0	0	0	0
Area 4 minus West Valley	0	0	0	0	0
L. A. Total	0	0	0	0	0

Note: Plus values are favorable.

*Test divisions.

If the presence of the police acts as a repressant to crime, then any change in the effective deployed manpower should be reflected in the offenses committed. Table 9 shows the change in percent of deployed manpower from 1968 to 1969. This change includes the effects of the Crime Task Force effort. The CTF effort is included because the predictions are based on data that in includes the CTF effort in past years.

In Table 9 there are seven divisions that decreased in manpower by more than 5 percent. Of these seven divisions, three show results not expected; i.e., with a decrease in manpower there were also fewer crimes than predicted, by a statistically significant amount. Of these three, two are non-test divisions, Van Nuys and Harbor. The results in Van Nuys can most probably be attributed to the fact that an operational change, LEMRAS, occurred in the division during this period of time. This study did not find any systems, operational, or environmental changes in the Harbor Division that would explain the favorable significant changes that occurred during the test period. The results in the third division, West Valley, can be attributed to the helicopter. This is true because no changes in the system, the operation or the environment, other than the helicopter patrol, were found in the division.

The results shown in Table 9 in the University Division are not unexpected in relation to the results in other divisions, that is, with respect to the relation between police presence and the commission of crime.

Table 10 is presented to show what effect, by calendar quarters, the CTF has.

The validity of the arrest predictions is verified by the data in Table 8. Of the 480 predictions represented, only 39 significantly varied from the predicted values. Again looking only at the 17 divisions and the crimes of robbery, burglary, theft and auto theft, it is found that only 25 out of 272 were significant deviations. There are 18 positive (favorable) deviations and 7 negative. Only in one quarter did a test division have a positive deviation and that was in West Valley, in the first quarter in robbery.

Table 9. Comparison of significant deviations with changes (1969 vs 1968) in operational man-days expended*

Division	% Change in Manpower	Number of Significant[1] Deviations in Offenses (in calendar quarters)
Central	-15	+1
Rampart	+4	+1
University	+2	-3
Hollenbeck	-7	0
Harbor	-7	-4
Hollywood	+7	+1, -1[2]
Wilshire	+4	+1
West L. A.	+3	0
Van Nuys	-8	-2
West Valley	-6	-9
Highland Pk.	-9	0
77th Street	+4	-1
Newton	-1	0
Venice	+15	-2
N. Hollywood	+2	0
Foothill	+1	-5
Devonshire	-6	+1

Note: Minus deviations are favorable.

(1) As defined on page 36.

(2) Robbery deviation was positive, auto theft was negative.

*Operational man-days expended is defined as the sum of divisional man-days and CTF man-days.

Table 10. CTF manpower in percent of deployed manpower by 1969 quarters

Division	Quarter			
	1	2	3	4
Central	2	4	(6)	1
Rampart	(6)	15	12	12
University	22	(11)	(10)	(12)
Hollenbeck	5	5	0	0
Harbor	(2)	(1)	(0)	(1)
Hollywood	8	(14)	7	24
Wilshire	10	4	3	(20)
West L. A.	4	2	9	10
Van Nuys	6	(3)	10	(4)
West Valley	(10)	(0)	(1)	(0)
Highland Pk.	0	0	5	2
77th Street	5	9	(16)	14
Newton	5	12	6	8
Venice	1	(9)	(10)	4
N. Hollywood	11	10	7	2
Foothill	0	(10)	(5)	(9)
Devonshire	25	9	(0)	6

Note: The circled values indicate a quarter in which a significant deviation occurred. A plain flag indicates an unfavorable deviation, a crossed flag means a mix of favorable and unfavorable deviations, and no flag means favorable.

There were two negative deviations in the test divisions, one in each. In University it was in the third quarter in burglary and in West Valley it was in the fourth quarter in robbery. Concurrently with the West Valley negative deviation, there was in the adjoining division of West Los Angeles a significant positive deviation in the same crime; however, no conclusion can be drawn from this fact.

In the divisions adjoining University there were three positive and two negative deviations and in those adjoining West Valley there were six positive and one negative deviation.

Table 11 shows the arrests made by the CTF in the divisions in the test year. Table 11 also shows, by division and crime category, what percent of the total arrests were made by the CTF.

From Table 11, the following is observed:

1) With one exception (University-robbery), whenever the CTF made 10% or more of the annual arrests, a favorable significant deviation occurred.
2) In four cases the CTF arrests correspond to unfavorable deviations.

There is only one case where the favorable significant deviation in arrests occurred in the same quarter as an increase in offenses and that was in Hollywood - auto theft (Figs. 8 and 13). In one case, West Valley - robbery, there was a significant favorable deviation in arrests in the first quarter followed by two quarters of decreased offenses.

This study did not disclose any other changes to the police system or operation that appear to have any correlation to the arrest deviations. The above arrest data do not lead to any positive conclusions.

B. CRIME TRENDS

The rate of change of occurrences for offenses is shown in Table 12 and for arrests in Table 13. The same data base was used to compute these values

Table 11. CTF arrests in 1969

Division	Robbery		Burglary		Auto Theft	
	Number	% of Division* Arrests	Number	% of Division* Arrests	Number	% of Division* Arrests
Central	5	1	5	1	4	1
Rampart	10	3	19	3	11	2
University	74	11	(54)/	4	67	7
Hollenbeck	3	2	(4)	1	(3)	1
Harbor	0	0	2	1	0	0
Hollywood	(60)	14	(44)/	5	(69)	12
Wilshire	(52)	10	(42)/	6	27	5
West L. A.	(1)/	1	(3)	1	10	6
Van Nuys	5	3	9	2	4	2
West Valley	(8)	7	(0)/	0	2	1
Highland Pk.	0	0	0	0	0	0
77th Street	98	8	90	4	116	6
Newton	13	3	5	1	(17)	3
Venice	(3)/	2	12	3	8	3
N. Hollywood	(0)	0	2	1	6	3
Foothill	1	0	12	2	9	3
Devonshire	(7)	16	3	1	5	5

Note: Circled values indicate a crime/division combination for which one or more quarters showed a significant deviation from the predicted value. The flagged circles indicate unfavorable deviations.

*Percentage of the 1969 total division arrests for the specified crime by the CTF.

Table 12. Rate of change of offenses - % change from prior year

	Year						
	63	64	65	66	67	68	69
ROBBERY							
University	+11	+1	+11	+1	+35	+10	-2
Area 2* minus University	+1	+4	+15	+1	+40	+2	+8
West Valley	-21	+91	+50	-15	+22	+64	-19
Area 4** minus West Valley	+29	+4	+29	+8	+8	+41	0
L. A. Total	+3	+6	+19	-1	+25	+14	+5
BURGLARY							
University	+22	-1	+14	+6	-4	+15	+8
Area 2 minus University	+6	-1	+20	+6	+14	+3	+8
West Valley	+2	+34	+29	+17	+5	+4	-5
Area 4 minus West Valley	+14	+12	+26	+16	+2	+8	-6
L. A. Total	+9	+4	+18	+10	+7	+6	+3
THEFT							
University	+6	+6	+1	+1	-1	+17	-2
Area 2 minus University	+5	+10	+5	-1	+3	+6	+2
West Valley	+11	+31	+23	+15	+9	+12	-8
Area 4 minus West Valley	+8	+16	+15	+8	+7	+10	-1
L. A. Total	+4	+13	+7	+5	+6	+8	+3
AUTO THEFT							
University	+7	+18	+4	-3	+21	+27	-8
Area 2 minus University	+5	+22	+7	-3	+14	+30	-3
West Valley	+1	+23	+33	+14	+15	+11	-4
Area 4 minus West Valley	+13	+7	+22	+21	-1	+30	0
L. A. Total	+5	+16	+13	+5	+9	+26	+1
TOTAL PROPERTY							
University	+11	+5	+7	+1	+4	+17	0
Area 2 minus University	+5	+8	+11	+2	+11	+8	+3
West Valley	+7	+31	+27	+15	+8	+10	-6
Area 4 minus West Valley	+11	+13	+19	+12	+4	+12	-2
L. A. Total	+6	+10	+12	+7	+8	+10	+3

*Area 2 contains University, Wilshire, 77th Street and Newton Divisions.

**Area 4 contains West Valley, Van Nuys, North Hollywood, Foothill and Devonshire Divisions.

Table 13. Rate of change of arrests - % change from prior year

	Year						
	63	64	65	66	67	68	69
ROBBERY							
University	-23	-4	+21	-16	+26	+4	+4
Area 2* minus University	+2	-14	-4	-15	+51	+14	0
West Valley	(Values not meaningful due to small					-2	+6
Area 4** minus West Valley	number of occurrences)					+16	+27
L. A. Total	-5	-7	0	-14	+35	+13	+3
BURGLARY							
University	0	-12	+75	-28	-4	+34	-7
Area 2 minus University	-8	-11	+64	-39	+8	+8	+8
West Valley	+9	+6	+34	+14	+20	+15	-27
Area 4 minus West Valley	+12	-3	+7	+17	+14	+6	+6
L. A. Total	+2	-9	+30	-21	+11	+14	-7
THEFT							
University	-14	-8	-1	-6	+7	+18	+2
Area 2 minus University	+2	+14	+5	-15	+21	+10	0
West Valley	+22	+11	+65	+8	-16	+22	-11
Area 4 minus West Valley	+13	+9	-7	+11	+6	-3	+3
L. A. Total	+7	+10	+3	-3	+8	+6	+7
AUTO THEFT							
University	-6	+20	-10	-4	+19	+53	-2
Area 2 minus University	+15	+30	-12	-13	+17	+43	+11
West Valley	-4	+6	+29	-9	-16	+5	+13
Area 4 minus West Valley	+5	-5	+16	+10	-3	+26	+2
L. A. Total	+7	+16	-7	-1	+5	+41	+9
TOTAL PROPERTY							
University	-10	-3	+25	-17	+9	+28	+2
Area 2 minus University	0	+1	+20	-26	+20	+18	+5
West Valley	+8	+10	+45	+7	0	+15	-9
Area 4 minus West Valley	+11	+2	+3	+13	+7	+7	+6
L. A. Total	+3	+1	+10	-11	+12	+16	+6

*Area 2 contains University, Wilshire, 77th Street and Newton Divisions.

**Area 4 contains West Valley, Van Nuys, North Hollywood, Foothill and Devonshire Divisions.

as was used for the prediction models. This means that the data are geographically adjusted to account for changes that occurred during the years shown. The values shown were computed as follows:

$$\text{Value shown (in \%)} = \left(\frac{\text{Current Year - Previous Year}}{\text{Previous Year}}\right) \text{X } 100$$

where "Current Year" is the year for which the values are being computed.

An examination of Table 12 reveals that in the test divisions the rate of change of occurrences appears to have changed more than in the surrounding divisions and more than in L. A. as a whole. Care must be exercised in using these data because they do contain spurious noise, i.e., these data are not adjusted for riots or waves of crime that sometimes occur. However, by looking at the history of changes it can be determined if the rates are changing.

Looking now at the University Division, it is observed that in robbery the division has had a history of always increasing over the previous year, but in 1969 a decrease occurred in spite of the fact that the surrounding divisions continued increasing as did the city as a whole.

In the burglary category this does not appear to be the case but in theft and auto theft and to a lesser degree in total property, the change occurs.

The changes are even more pronounced in the West Valley Division. The changes occur in the surrounding area as well but are more pronounced in West Valley, with the exception of burglary. It is of interest to note that burglary is the only crime category in which West Valley did not experience a significant deviation from the predicted values.

Examination of Table 13 for the rate of change of arrests yields the following observations:

1) University continued to increase in arrests in robbery and theft while the surrounding area held constant and the whole city increased more than University.

2) University declined in burglary and auto theft, as did the city in burglary, but the surrounding area (area 2 minus University) continued to increase in both crimes as did the city as a whole in auto theft.
3) West Valley showed a very marked decline in burglary arrests while the surrounding area showed a steady increase and the city a slight decline.
4) West Valley declined in theft while the area and the city showed increasing rates of change.
5) In auto theft arrests West Valley experienced a marked increase in arrest trend while the area and the city had reduced rates of increase.

The mixed results in the arrest data appear in both the prediction comparison information and in the rate of change information. Statistically, it is not difficult to predict the number of arrests but there is no clear correlation between the arrest results and any systems or operational changes found in this study. This means that what happened was within the limits of probable uncertainty in the predictions, and the trends did not change in a manner that can be related to a known change in the system. This does not mean that the system and operational changes that were made had no effect, only that the effect was not greater than expected nor different from historical patterns in the case of the trends in arrests. Further, there is little correlation between significant changes in offenses or rates of change of offenses and the results in arrests or the rate of change of arrests.

C. OPERATIONAL INVOLVEMENT IN PART I CRIMES

The number of times the helicopter patrol responded to police calls indicates the degree of involvement of the patrol in the full range of police functions. The flight logs that are maintained by the flight crews on every flight contain this information. In addition to the number of calls acted upon, the flight logs also tell where the call originated, what type of a call it was and the results of any action taken.

Table 14 indicates the number of calls by type that the helicopter patrol received and acted upon in each test division in each watch flown in the first two calendar quarters of the test period. Data is presented on the types of flights, flight times, response times, number of responses, etc., in raw and parametric form in Tables 15 and 16, respectively.

When a call is initiated, a type of crime is assumed to have occurred or is in progress. Upon arrival at the scene it is sometimes discovered that the actual crime that occurred was not the one that was assumed to have occurred. Also many false alarms are discovered. Since the data under consideration was obtained from the helicopter flight logs, it reflects only what the flight crew is able to ascertain about the crime committed. On occasion the patrol is not involved long enough for the crew to determine what crime was actually committed. Tables 17 through 20 are summaries of the call volume and disposition for each watch flown in each division by quarters. The tables show the call source, how many times the actual crime was as assumed before arrival, how many turned out to be another type of crime, how many remained unknown to the crew and how many were false alarms. The three types of call sources shown are defined as follows:

1) Radio. A call heard by the crew while monitoring the division radio frequency and on which the crew decided to take action.
2) Observation. A call that originates from the helicopter crew observing a situation requiring possible police action.
3) Station. A call received by the helicopter crew specifically requesting them to take action. Many of these were surveillance assignments made by the Division Commander at the beginning of the watch - prior to the flight.

The "confirmed" column indicates the number of times the crime that occurred was as assumed. The column headed "other" shows the number of times the crime was not as called. The remaining columns are self-explanatory.

Table 21 shows the number of Part I crimes reported in the two divisions and the number and percent of those reported crimes that the helicopter patrol was involved in. As can be seen from the table, the helicopter patrol was involved in anywhere from 2.0 to 4.2 percent of the reported crimes.

Table 14. Call volume by type

Division	Call Type	First Quarter		Second Quarter	
		Day Watch	Night* Watch	Day Watch	Night Watch
University	Robbery	61	29	62	71
	Burglary	140	105	124	206
	Theft	41	8	30	10
	Auto Theft	33	7	49	48
	Other Part I	16	11	24	37
	Total Part I	291	160	289	372
	Part II	52	32	51	91
	Public Order	72	22	83	57
	Public Service	7	8	19	5
	Traffic Safety	9	8	18	13
	Total	431	230	460	538
West Valley	Robbery	30	19	44	21
	Burglary	264	107	294	401
	Theft	29	16	279	18
	Auto Theft	81	10	97	27
	Other Part I	10	8	6	16
	Total Part I	414	160	720	483
	Part II	74	39	87	175
	Public Order	42	17	43	53
	Public Service	26	7	23	12
	Traffic Safety	18	12	11	27
	Total	574	235	884	750
Both Divisions	Total	1005	465	1344	1288

*Did not fly night watch until February 26, 1969

Table 15. Basic data for flight types, times, and call responses

DIVISION	WATCH	MONTH	NUMBER OF FLIGHT TYPES				TOTAL TIME (h)				NUMBER OF CALLS			TOTAL RADIO CALL RESPONSE TIME (min)	TOTAL TIME ON ALL CALLS (min)	NUMBER OF WATCHES FLOWN
			TRANSIT	PATROL	OTHER	TOTAL	TRANSIT	PATROL	OTHER	TOTAL	RADIO	OBSERVATION	STATION			
UNIV.	DAY	JAN	101	68	6	175	24.4	72.4	3.8	100.6	83	8	18	93	1362	20
		FEB	144	82	1	227	31.5	94.5	0.7	126.7	119	21	19	110	1998	25
		MAR	152	85	3	240	31.1	123.2	3.2	157.5	119	27	17	149	1773	29
		APR	176	92	3	271	29.0	118.3	3.0	150.3	113	27	10	90	1792	29
		MAY	137	72	1	210	24.1	104.7	0.5	129.3	114	17	5	75	1614	29
		JUNE	156	86	–	242	26.6	123.2	–	149.8	136	25	13	166	1933	30
	NIGHT	JAN	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		FEB	20	11	–	31	3.6	13.8	–	17.4	15	4	4	13	224	3
		MAR	175	87	–	262	29.0	111.5	–	140.5	166	22	19	185	2122	27
		APR	151	81	–	232	30.4	114.2	–	144.6	158	26	1	240	2144	27
		MAY	137	68	4	209	27.0	84.7	2.7	114.4	143	16	6	153	1403	25
		JUNE	146	74	1	221	25.7	109.7	0.8	136.2	147	33	7	152	1693	27
W. VAL.	DAY	JAN	51	63	5	119	21.3	79.3	5.6	106.2	46	24	18	104	1181	23
		FEB	52	74	8	134	21.4	84.7	4.4	110.5	69	35	87	140	1522	24
		MAR	64	96	5	165	22.9	132.0	4.7	160.6	87	66	151	137	2663	30
		APR	65	86	5	156	22.4	112.6	3.9	140.9	79	16	220	101	2616	29
		MAY	58	73	5	136	22.8	106.5	2.5	131.8	92	22	166	128	2242	27
		JUNE	60	80	3	143	22.3	115.2	0.7	138.2	95	38	156	158	2282	29
	NIGHT	JAN	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		FEB	6	9	–	15.0	2.3	12.0	–	14.3	14	1	4	22	230	3
		MAR	59	87	–	146.0	22.6	115.3	–	137.9	127	37	52	234	2011	28
		APR	60	83	2	145.0	23.2	115.9	1.4	140.5	144	21	76	227	1674	28
		MAY	59	73	3	135.0	22.1	100.9	1.7	124.7	154	15	71	222	1538	26
		JUNE	56	78	–	13.4	21.7	110.8	–	132.5	146	18	105	204	1610	26

Table 16. Parametric data for flight types, times, and call responses

DIVISION	WATCH	MONTH	NUMBER OF FLIGHTS PER WATCH				AVERAGE TIME PER WATCH (h)				AVERAGE TIME PER FLIGHT (h)			AVERAGE NO. OF CALLS PER WATCH			AVERAGE RESPONSE TIME PER RADIO CALL (min)	AVERAGE TOTAL TIME ON CALL PER WATCH (min)	AVERAGE TIME PER CALL (min)
			TRANSIT	PATROL	OTHER	TOTAL	TRANSIT	PATROL	OTHER	TOTAL	TRANSIT	PATROL	OTHER	RADIO	OBSERVATION	STATION			
UNIV.	DAY	JAN	5.1	3.4	0.3	8.8	1.2	3.6	0.2	5.0	0.3	1.1	0.6	4.2	0.4	0.9	1.1	68.1	12.5
		FEB	5.8	3.3	–	9.1	1.3	3.8	–	5.1	0.2	1.2	0.7	4.8	0.8	0.8	0.9	79.9	12.6
		MAR	5.2	2.9	0.1	8.3	1.1	4.2	0.1	5.4	0.2	1.4	1.1	4.1	0.9	0.6	1.3	61.1	10.9
		APR	6.1	3.2	0.1	9.3	1.0	4.1	0.1	5.2	0.2	1.3	1.0	3.9	0.9	0.3	0.8	61.8	11.9
		MAY	4.7	2.5	–	7.2	0.8	3.6	–	4.4	0.2	1.5	0.5	3.9	0.6	0.2	0.7	55.6	11.9
		JUNE	5.2	2.9	–	8.1	0.9	4.1	–	5.0	0.2	1.4	–	4.5	0.8	0.4	1.2	64.4	11.1
	NIGHT	JAN	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		FEB	6.7	3.7	–	10.4	1.2	4.6	–	5.8	0.2	1.3	–	5.0	1.3	1.3	0.9	74.7	9.7
		MAR	6.5	3.2	–	9.7	1.1	4.1	–	5.2	0.2	1.3	–	6.1	0.8	0.7	1.1	78.6	10.3
		APR	5.6	3.0	–	8.6	1.1	4.2	–	5.3	0.2	1.4	–	5.9	1.0	–	1.5	79.4	11.6
		MAY	5.5	2.7	0.2	8.4	1.1	3.4	0.1	4.6	0.2	1.2	0.7	5.7	0.6	0.2	1.1	56.1	8.5
		JUNE	5.4	2.7	–	8.2	1.0	4.1	–	5.0	0.2	1.5	0.8	5.4	1.2	0.3	1.0	62.7	9.1
W.VAL.	DAY	JAN	2.2	2.7	0.2	5.1	0.9	3.4	0.2	4.6	0.4	1.3	1.1	2.0	1.0	0.8	2.3	51.3	13.4
		FEB	2.2	3.1	0.3	5.6	0.9	3.5	0.2	4.6	0.4	1.1	0.6	2.9	1.5	3.6	2.0	63.4	8.0
		MAR	2.1	3.2	0.2	5.5	0.8	4.4	0.2	5.4	0.4	1.4	0.2	2.9	2.2	5.0	1.6	88.8	8.8
		APR	2.2	3.0	0.2	5.4	0.8	3.9	0.1	4.8	0.3	1.3	0.8	2.7	0.6	7.6	1.3	90.2	8.3
		MAY	2.1	2.7	0.2	5.0	0.8	3.9	0.1	4.8	0.4	1.5	0.5	3.4	0.8	6.1	1.4	83.0	8.0
		JUNE	2.1	2.8	0.1	5.0	0.8	4.0	–	4.8	0.4	1.4	0.2	3.3	1.3	5.4	1.7	78.7	7.9
	NIGHT	JAN	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		FEB	2.0	3.0	–	5.0	0.8	4.0	–	4.8	0.4	1.3	–	4.7	0.3	1.3	1.6	76.7	12.1
		MAR	2.1	3.1	–	5.2	0.8	4.1	–	4.9	0.4	1.3	–	4.5	1.3	1.9	1.8	71.8	9.3
		APR	2.1	3.0	0.1	5.2	0.8	4.1	0.1	5.0	0.4	1.4	0.7	5.1	0.8	2.7	1.6	59.7	6.9
		MAY	2.3	2.8	0.1	5.2	0.9	3.9	0.1	4.9	0.4	1.4	0.6	5.9	0.6	2.7	1.4	59.2	6.4
		JUNE	2.2	3.0	–	5.2	0.8	4.3	–	5.1	0.4	1.4	–	5.6	0.7	4.0	1.4	61.9	6.0

Table 17. First quarter call volume and disposition, University Division

ACTIVITY	CALL SOURCE	DAY WATCH					NIGHT WATCH				
		CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL	CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL
PART I CRIMES	RADIO	84	11	16	122	233	37	-	15	83	135
	OBSERVATION	1	1	1	35	38	-	2	1	10	13
	STATION	1	-	4	15	20	-	-	-	12	12
	TOTAL	86	12	21	172	291	37	2	16	105	160
PART II CRIMES	RADIO	17	-	6	13	36	10	2	2	10	24
	OBSERVATION	3	2	-	2	7	-	-	-	4	4
	STATION	2	-	1	6	9	-	-	-	4	4
	TOTAL	22	2	7	21	52	10	2	2	18	32
PUBLIC ORDER	RADIO	13	1	5	26	45	5	-	2	9	16
	OBSERVATION	3	-	-	1	4	2	-	1	-	3
	STATION	-	-	8	15	23	1	-	-	2	3
	TOTAL	16	1	13	42	72	8	-	3	11	22
PUBLIC SERVICE	RADIO	2	-	-	2	4	3	-	-	1	4
	OBSERVATION	3	-	-	-	3	1	-	-	-	1
	STATION	-	-	-	-	-	3	-	-	-	3
	TOTAL	5	-	-	2	7	7	-	-	1	8
TRAFFIC SAFETY	RADIO	2	-	-	1	3	-	-	-	2	2
	OBSERVATION	4	-	-	-	4	3	-	-	2	5
	STATION	1	-	1	-	2	1	-	-	-	1
	TOTAL	7	-	1	1	9	4	-	-	4	8
TOTAL	RADIO	118	12	27	164	321	55	2	19	105	181
	OBSERVATION	14	3	1	38	56	6	2	2	16	26
	STATION	4	-	14	36	54	5	-	-	18	23
	TOTAL	136	15	42	238	431	66	4	21	139	230

*Did not fly night watch until February 26, 1969.

Table 18. Second quarter call volume and disposition, University Division

ACTIVITY	CALL SOURCE	DAY WATCH					NIGHT WATCH				
		CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL	CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL
PART I CRIMES	RADIO	93	8	15	127	243	92	8	26	177	303
	OBSERVATION	2	1	3	34	40	5	-	4	49	58
	STATION	3	-	-	13	16	1	-	-	10	11
	TOTAL	98	9	18	174	299	98	8	30	236	372
PART II CRIMES	RADIO	29	3	2	13	47	25	2	8	50	85
	OBSERVATION	2	-	-	2	4	2	1	-	2	5
	STATION	-	-	-	-	-	-	-	1	-	1
	TOTAL	31	3	2	15	51	27	3	9	52	91
PUBLIC ORDER	RADIO	26	4	1	37	68	12	3	7	32	54
	OBSERVATION	2	-	-	1	3	-	-	1	-	1
	STATION	-	-	-	12	12	-	-	1	1	2
	TOTAL	28	4	1	50	83	12	3	9	33	57
PUBLIC SERVICE	RADIO	6	1	1	1	9	-	-	-	-	-
	OBSERVATION	10	-	-	-	10	4	-	-	1	5
	STATION	-	-	-	-	-	-	-	-	-	-
	TOTAL	16	1	1	1	19	4	-	-	1	5
TRAFFIC SAFETY	RADIO	3	-	1	2	6	3	1	1	2	7
	OBSERVATION	12	-	-	-	12	4	-	1	1	6
	STATION	-	-	-	-	-	-	-	-	-	-
	TOTAL	15	-	1	2	18	7	1	2	3	13
TOTAL	RADIO	157	16	20	180	373	132	14	42	261	449
	OBSERVATION	28	1	3	37	69	15	1	6	53	75
	STATION	3	-	-	25	28	1	-	2	11	14
	TOTAL	188	17	23	242	470	148	15	50	325	538

Table 19. First quarter call volume and disposition, West Valley Division

ACTIVITY	CALL SOURCE	DAY WATCH					NIGHT WATCH				
		CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL	CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL
PART I CRIMES	RADIO	30	2	10	52	94	19	-	8	49	76
	OBSERVATION	10	-	7	71	88	-	-	4	29	33
	STATION	5	-	2	225	232	-	-	5	46	51
	TOTAL	45	2	19	348	414	19	-	17	124	160
PART II CRIMES	RADIO	36	2	6	13	57	21	-	3	14	38
	OBSERVATION	7	-	1	4	12	-	-	-	1	1
	STATION	1	-	-	4	5	-	-	-	-	-
	TOTAL	44	2	7	21	74	21	-	3	15	39
PUBLIC ORDER	RADIO	9	-	2	13	24	2	-	1	10	13
	OBSERVATION	2	-	-	-	2	-	-	1	-	1
	STATION	4	-	2	10	16	-	-	1	2	3
	TOTAL	15	-	4	23	42	2	-	3	12	17
PUBLIC SERVICE	RADIO	9	1	1	2	13	2	-	-	3	5
	OBSERVATION	9	-	-	1	10	1	-	-	-	1
	STATION	-	-	1	2	3	-	-	-	1	1
	TOTAL	18	1	2	5	26	3	-	-	4	7
TRAFFIC SAFETY	RADIO	12	-	2	1	15	4	-	-	5	9
	OBSERVATION	2	-	-	1	3	1	-	-	1	2
	STATION	-	-	-	-	-	-	-	-	1	1
	TOTAL	14	-	2	2	18	5	-	-	7	12
TOTAL	RADIO	96	5	21	81	203	48	-	12	81	141
	OBSERVATION	30	-	8	77	115	2	-	5	31	38
	STATION	10	-	5	241	256	-	-	6	50	56
	TOTAL	136	5	34	399	574	50	-	23	162	235

*Did not fly night watch until February 26, 1969.

Table 20. Second quarter call volume and disposition, West Valley Division

ACTIVITY	CALL SOURCE	DAY WATCH					NIGHT WATCH				
		CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL	CONFIRMED	OTHER	UNKNOWN	FALSE ALARM	TOTAL
PART I CRIMES	RADIO	42	2	14	86	144	39	2	16	163	220
	OBSERVATION	2	1	10	46	59	1	-	5	30	36
	STATION	1	-	-	516	517	-	-	-	227	227
	TOTAL	45	3	24	648	720	40	2	21	420	483
PART II CRIMES	RADIO	42	2	5	28	77	70	1	12	52	135
	OBSERVATION	4	-	-	2	6	6	-	1	2	9
	STATION	-	-	-	4	4	-	-	-	21	21
	TOTAL	46	2	5	34	87	76	1	13	75	165
PUBLIC ORDER	RADIO	3	1	3	15	22	15	-	9	25	49
	OBSERVATION	1	-	-	-	1	-	-	-	-	-
	STATION	-	-	-	20	20	-	-	-	4	4
	TOTAL	4	1	3	35	43	15	-	9	29	53
PUBLIC SERVICE	RADIO	7	-	-	8	15	7	-	-	2	9
	OBSERVATION	6	-	-	1	7	3	-	-	-	3
	STATION	1	-	-	-	1	-	-	-	-	-
	TOTAL	14	-	-	9	23	10	-	-	2	12
TRAFFIC SAFETY	RADIO	4	-	2	3	9	9	-	1	11	21
	OBSERVATION	2	-	-	-	2	4	1	-	1	6
	STATION	-	-	-	-	-	-	-	-	-	-
	TOTAL	6	-	2	3	11	13	1	1	12	27
TOTAL	RADIO	98	5	24	140	267	140	3	38	253	434
	OBSERVATION	15	1	10	49	75	14	1	6	33	54
	STATION	2	-	-	540	542	-	-	-	252	252
	TOTAL	115	6	34	729	884	154	4	44	538	740

Table 21. Helicopter patrol involvement in Part I crimes

Division	Quarter	Part I Crimes Reported in Division	Confirmed Part I Crimes Responded to by Helicopter	Percent Helicopter Involved
University	First	5020	123	2.5
	Second	4685	196	4.2
West Valley	First	3164	64	2.0
	Second	2985	85	2.8

Table 22 is a tabulation of the results with respect to whether or not an offender was apprehended. The apprehensions are the total arrests made for an event that actually occurred. In the "public service event" the apprehension status indicates whether or not the service was rendered. Using these results and the divisional total arrests in robbery, burglary, theft and auto theft, the amount of helicopter patrol involvement in arrests can be determined. The arrests made when the helicopter patrol was involved reflect the results of the helicopter-patrol car team. It would be a very arbitrary decision to attribute any particular arrest to either the car or the helicopter. There is no way of determining if the arrest would or would not have been made if the helicopter had not been on the scene in every situation that arose during the test period. The number of arrests made by the helicopter-patrol car team compared to the division total is presented in Table 23. Only the crimes of robbery, burglary, theft and auto theft are shown.

Tables 14 through 20 and Table 22 also contain the flight log information for other activities. These tables show that the helicopter patrol did not spend a great deal of time in performing police functions other than control and reduction of crime. For the purposes of the experiment, these results are desirable.

Table 22. Call results

DIVISION	Event	First Quarter						Second Quarter					
		Day Watch			Night Watch *			Day Watch			Night Watch		
		Apprehended**	Not Apprehended	Total	Apprehended	Not Apprehended	Total	Apprehended	Not Apprehended	Total	Apprehended	Not Apprehended	Total
UNIVERSITY	Robbery	5	18	23	2	12	14	6	23	29	5	22	27
	Burglary	22	21	43	7	7	14	13	19	32	12	20	32
	Theft	11	11	22	3	0	3	5	14	19	2	4	6
	Auto Theft	6	3	9	1	1	2	8	6	14	13	3	16
	Other Part I	2	4	6	1	0	1	7	8	15	11	9	20
	Total Part I	46	57	103	14	20	34	39	70	109	43	58	101
	Part II	20	8	28	7	5	12	31	5	36	21	10	31
	Public Order	17	2	19	4	4	8	25	5	30	10	4	14
	Public Service	3	2	5	6	1	7	14	1	15	4	0	4
	Traffic Safety	7	0	7	4	0	4	14	2	16	5	3	8
	Total	93	69	162	35	30	65	123	83	206	83	75	158
WEST VALLEY	Robbery	1	4	5	0	3	3	2	5	7	3	4	7
	Burglary	7	12	19	4	4	8	12	14	26	8	7	15
	Theft	1	3	4	1	0	1	1	1	2	3	5	8
	Auto Theft	13	2	15	1	0	1	4	6	10	6	1	7
	Other Part I	0	2	2	3	3	6	1	1	2	2	3	5
	Total Part I	22	23	45	9	10	19	20	27	47	22	20	42
	Part II	32	13	45	17	4	21	48	2	50	69	9	78
	Public Order	18	0	18	2	0	2	3	1	4	14	1	15
	Public Service	16	2	18	2	1	3	10	4	14	6	4	10
	Traffic Safety	13	1	14	5	0	5	5	1	6	11	2	13
	Total	101	39	140	35	15	50	86	35	121	122	36	158

* Night watch not flown until February 26, 1969.

** Apprehended by the helicopter and patrol car as a team.

Table 23. Team and divisional arrests

Division	Crime	Arrests				Team as % of Total	
		Total Division		Team			
		1st Quarter	2nd Quarter	1st Quarter	2nd Quarter	1st Quarter	2nd Quarter
University	Robbery	187	176	7	11	3.7	6.3
	Burglary	357	410	29	25	8.1	6.1
	Theft	181	142	14	7	7.7	4.9
	Auto theft	233	242	7	21	3.0	8.7
West Valley	Robbery	55	21	1	5	1.8	23.8
	Burglary	150	136	11	20	7.3	14.7
	Theft	153	161	2	4	1.3	2.5
	Auto theft	81	43	14	10	17.3	23.2

There is also a long list of incidents wherein the helicopter performed a task that no other police vehicle could possibly have performed. These tasks range from locating a lost horse to warning children, at play on railroad tracks, of an oncoming runaway train. These are subjective in nature and therefore no value can be placed upon them in a direct sense. Public opinion of the police, however, is affected by incidents of this type, and a favorable opinion will result in citizen cooperation with the police; consequently, these tasks and others like them that can only be accomplished by means of a helicopter must be considered in this evaluation as positive factors.

D. POLICE AND PUBLIC OPINION POLLS

1. Public Opinion Poll

The public opinion poll was conducted in two segments, the first being a residential survey conducted between February 10 and 18, 1970 and the second being a survey of the businessmen in the test divisions. This entire effort was carried out by General Behavioral Systems, Inc. (GBS) of Torrance, California under contract to the Jet Propulsion Laboratory. The entire GBS report is in Volume III of this report. The tabulated data related to the GBS report is not presented in this report but is on file at JPL. A summary of the results is presented here to show the general attitudes of the public.

It was found that the residential public in the test divisions is very aware of the police helicopter patrols. The awareness level is about 84%. Interestingly, a lower percentage, 68%, of the businessmen interviewed were aware that the police fly helicopters over their business locations. In comparison, only 18% of the respondents in areas not having patrols were aware that the police use helicopters.

The most common reaction when a helicopter is heard is that it is the police. In the West Valley, 47% of the residents said the police or police-related activities were their reaction to hearing a helicopter. In the University Division, this reaction was even higher, 63%. The most undesirable feature of the helicopters, to residents, appears to be noise. Lights and danger of

accident were ranked much lower. Respondents in both study divisions placed invasion of privacy very low in their overall ranking. Noise was not mentioned, by businessmen, as having an effect, and the most commonly stated good effects mentioned by them were a feeling of protection and reduced crime rate.

The total sample of residents of the test divisions ranked crime prevention and assisting an arrest as more suitable uses for helicopter patrols than rescue work or traffic control. The respondents in the non-test areas ranked rescue work and traffic control higher.

There appears to be considerable public support for the continuation of helicopter patrols in both test divisions. Eighty-nine percent of the total sample of residents favor continuation, with no significant difference between the two divisions. Ninety-three percent of the businessmen favor continuation. The strength of this reaction is better understood when the answers to the question of how much additional tax or rent the respondent was willing to pay to keep the helicopter in the area are examined. (This question was answered only by those who favored continuation.) Table 24 contains these results. The response of the businessmen to this question was 24% willing to pay one or more dollars.

Needs for educating the public were found both within areas presently served by helicopter patrols and in communities to be served. Special groups requiring special education were found to be young blacks in the University Division and the well-to-do in the West Valley Division. Both groups need information that shows that helicopter patrols meet certain of their needs, without threatening other needs. For the youth of the University Division, there is a need to show that the helicopter patrols provide faster response and are effective in reducing crime without posing a threat to the exercise of civil rights. For the West Valley Division, there is a need to show that the helicopters are effective in providing protection without increasing the net cost to the individual.

A summary of some of the key points is shown in Table 25.

Table 24. Willingness to pay for helicopter patrol (residential only)

	Amount Per Month	Annual Family Income ($)							
		Less than 6K		6K to 10K		10K to 15K		Over 15K	
		Number	%	Number	%	Number	%	Number	%
Total	0 to $1	46	71	41	67	38	58	46	75
	Over $1	19	29	20	33	27	42	15	25
West Valley	0 to $1	7	87	16	70	25	53	37	73
	Over $1	1	13	7	30	22	47	14	27
University	0 to $1	39	68	25	66	13	72	9	90
	Over $1	18	32	13	34	5	28	1	10

Table 25. Key points of the community poll

	Percent
Awareness of helicopter patrols	
Residents	84
Businessmen	68
Non-test area residents	18
Reaction to hearing helicopter is that it is the police	
University	63
West Valley	47
Continuation of patrols, favorable	
Residents	89
Businessmen	93

2. Police Opinion Poll

The police poll was conducted in August-September of 1969 and therefore does not encompass the full test period. The poll was conducted by the officer in charge of the helicopter unit. The results are discussed here and details presented in Volume III of this report.

The objectives of this poll were to determine how the patrolman felt about the helicopter patrol. The patrolmen were also asked to relate some of their personal experiences in working with the helicopter unit: This provided backup and verification of the flight log information. Many narrative descriptions of the helicopter patrol's responses to calls were obtained. These descriptions cannot stand alone as evaluations of effectiveness, but do serve to bring certain aspects of the helicopter patrol into focus in a personal manner. (These descriptions are not presented in this report but are documented in the helicopter unit of the LAPD.)

The police were almost unanimous in believing that the helicopter was an advantage to their activities, that it should be continued as a patrol vehicle, and should be expanded to other divisions. Three-fourths of the officers said yes when asked if they had been able to apprehend a suspect because of the helicopter. Ninety-six percent of the responses were positive when asked if the helicopter provides any officer security. Much of this was in the officer-needs-assistance, or back-up, category. It tends to divide the attention of a suspect and provides a psychological advantage. There is a decided tendency for suspects to cool down. In talking with suspects, officers report a strong apprehensiveness -- the feeling of not being able to get away once spotted. Security was provided in another way. When the helicopter responded to a call, 88% of the officers said it was there before a ground unit, 9% said it as at the same time, leaving 3% saying it arrived after the ground unit. The early arrival permitted communicating information on the situation to the responding ground unit.

From a different point of view, however, early arrival causes some problems -- many curable through improvement of operational procedures. Seventeen percent said yes when asked if the helicopter hindered them in any manner. The reason given in the majority of cases was that the noise alerted the suspect, who then knows a radio car is soon to follow. The lights can have the same effect. Noise from the helicopters also tends to draw people out-of-doors, hindering investigation or apprehension.

Two-thirds of the officers responded positively to the question, "Is there any equipment which you should have to enable you to make better use of the helicopter?" The near-unanimous answer was improved communications. A summary of the results is shown in Table 26.

Table 26. Results of the police poll

	Percent
Helicopter is an advantage	100
Made an apprehension due to helicopter	75
Provides officer security	96
Helicopter first at scene	88
Helicopter provides some hindrance	17
Need improved communications, etc.	65

SECTION VI

OTHER EVALUATION CONSIDERATIONS

A. THE DEMOGRAPHY AND EFFECTIVENESS

1. Demography

In order to apply any of the results or conclusions of the helicopter patrol program to other geographic locations the test areas must be described in demographic terms. This description should encompass all the major factors which may affect the results of the study. This is not to say that the results of the program would only be applicable to an area which is essentially a copy of the test area but rather that, if one is to project results, one must have a base from which to project. The next step would then be to describe new areas using the same variables.

Numerous studies have been conducted attempting to correlate the sociological and demographic structure of an urban area to crime. The results of such studies have produced several models with which the authors attempted to reduce the sociological, ecological and demographic data to a common base using mathematical techniques.

In pursuing possible methods which would be readily applicable to the current problem, the following models were reviewed:

1) Shevky-Bell Typology (Ref. 2).
2) C. F. Schmid Factor Analysis (Ref. 3).
3) R. C. Tyron Cluster Analysis (Ref. 4).
4) Judith Wilks Ecological Correlates of Crime and Delinquency (Ref. 5).

Each of these models utilized census tract data or some derivatives thereof to provide a frame within which the investigator could conduct his sociological study. Upon scrutiny, the validity of such studies seems to hinge upon the following:

1) Age of the data. The census is taken every ten years during the beginning of the decade. Therefore, as in this case, the data can be many years old before it is used. It is true that some areas do not change rapidly, but one has but to give a cursory look at the development in the urban areas to realize that data which is ten years old is virtually useless. This span of time is sufficiently large so that even the most well-thought-out projection techniques have inherently large uncertainties.

2) Validity of the authors' assumptions. Each researcher takes a different approach depending upon his own background. A prime example of this is the article by W. S. Robinson (Ref. 6), Ecological Correlations and the Behavior of Individuals. In this work the author points out that in an individual correlation the variables are descriptive properties of the individuals while in the ecological correlation the statistical object is a group of persons. After a mathematical discussion of the two methods of correlation, the author concluded that the ecological correlations are not equal to individual correlations. In the four models cited each uses either the ecological or individual correlation or a hybrid of the two. Therefore, even extreme caution in reviewing the assumptions does not guarantee meaningful results since the sociologists are in disagreement as to the correct method.

3) Mechanics of applying the mathematical models. The results of each model, assuming that the data and assumptions are valid, depend upon the application of the mathematical methods. In several of the models the mathematical techniques have actually been developed by the authors for the purpose of conducting the particular study. An indiscriminate acceptance of these methods would be unwise.

Due to the constraints imposed by above factors, implementation of the aforementioned models is difficult. Therefore, this report will present data obtained in the "Survey of Public Attitudes Toward Helicopter Surveillance Patrols."* This data is deemed to be valid since it was obtained in the test divisions with accepted statistical polling practice. In each case an attempt was made to correlate the data with other sources, e.g., the number and types of dwellings as presented in the Quarterly Bulletin of the Regional Planning Commission of Los Angeles County. When discrepancies occurred in the figures, the survey data was used because it is the most current data available. In some cases, data from several sources was used to obtain the desired statistics.

Each of the studies (Refs. 2-5) was reviewed with a view to which of the variables appeared most frequently in correlations with Part I crimes. These variables were:

1) Age of population
2) Race
3) Marital status
4) Income level
5) Education level
6) Occupation
7) Employment
8) Time in area
9) Housing
10) Family composition

Tables 27-36 present the data for the variables listed above. All of the data presented represents estimations as of 1 January 1970. Although it is certain that all of these figures changed during the test period, these differentials are not significant enough to alter the purpose of this data, namely to create a quantitative description of the areas.

*The GBS report. See Volume III.

Table 27. Geographic data

	University	West Valley
Square miles	13	55
Street miles	288	658
Number of public recreation facilities	11	11
Area of public recreation facilities (acres)	58	210*
Percent of division in hilly areas	0	30

*Borders on the Sepulveda flood basin, which is a 2000-acre facility.

Table 28. Housing data

	University	West Valley
Percent single-family dwellings	73	95
Percent multiple-family dwellings	27	5
Percent own	57	83
Percent rent	43	17

Table 29. Educational facilities

	University	West Valley
Number of elementary schools	17	45
Number of junior high schools	3	8
Number of senior high schools	3	6
Number of parochial schools	11	16
Enrollment of public elementary schools	16,500	29,300
Enrollment of public junior high schools	6,800	16,000
Enrollment of public senior high schools	7,100	16,700
Enrollment of parochial elementary schools	4,000	4,100
Enrollment of parochial high schools	550	1,600
Total elementary enrollment	20,500	33,400
Total high school enrollment	14,450	34,300

Table 30. Ethnic distribution

	University (%)	West Valley (%)
Negro	72.0	0.1
Caucasian	16.0	99.5
Other	12.0	0.4

Table 31. Educational level for male head of household

	University (%)	West Valley (%)
Grammar school	19	3
High school	32	29
College (no degree)	22	35
College (degree)	5	27
No male head of household	22	6

Table 32. Family income

Income (Dollars)	University (%)	West Valley (%)
Less than 6,000	45	7
6,000 - 10,000	30	18
10,000 - 15,000	17	35
More than 15,000	8	40

Table 33. Occupation of male head of household

	University (%)	West Valley (%)
Unskilled	9	3
Semi-skilled	26	13
Professional	6	23
Retired	16	5
Unemployed	6	3
No male head of household	22	6
Other	15	47

Table 34. Mobility -- time in the area

Time	University (%)	West Valley (%)
Less than 1 year	9.0	7.5
1 - 2 years	15.0	15.5
3 - 7 years	33.5	31.0
Over 7	42.5	46.0

Table 35. Marital status -- family size and composition

Status	University (%)	West Valley (%)
Single	10.7	6.0
Married	61.3	87.3
Separated	6.0	2.0
Divorced	10.7	1.3
Widowed	11.3	3.3
Adults only	52.5	32.7
Families with children	47.3	67.3
One to two children	29.4	21.5
Three to four children	38.0	49.5
Five or more	32.6	29.0

Table 36. Age of male and female heads of household

	University (%)	West Valley (%)
MALE		
Under 25	5.0	6.0
25 - 44	35.0	53.0
45 - 64	25.0	33.0
65 and over	35.0	8.0
FEMALE		
Under 25	8.0	11.0
25 - 44	41.5	55.0
45 - 64	30.5	29.0
65 and over	20.0	10.0

In order to be able to quantitatively compare areas such as the two test divisions, the Shevky-Bell Typology would be extremely useful. This typology is a classification device for the construction of social type of census tract populations. The three indices used are:

1) Urbanization (or family status)

   a) Fertility ratio
   b) Proportions of women in the work force
   c) Number of single family detached dwellings

2) Segregation (or ethnic status)

   a) Race
   b) Nativity

3) Social rank (or economic status)

a) Rent
b) Education level
c) Occupational status

The typology consists of constructing a three-dimensional space using the three indices presented above. Then social area types are said to be areas with similar scores (Ref. 2). The model of Ref. 5 was designed for a census tract, but the analysis is valid for any homogeneous region. After the analysis has been conducted and the scores computed, the area is no longer a geographic or ecological area, but a social area. Once areas are identified as social rather than mere geographic entities, comparisons between nonadjacent regions becomes possible. Theoretically, areas in different parts of the world could be referred to as being sociologically similar if they have similar scores.

2. Effectiveness Related to Demography

The correlation of effectiveness and demography is not a straight-forward exercise. As to effectiveness, it is clear from the predictions - actuals comparison that the helicopter patrol had a greater effect as to repression of crime in the West Valley Division. There was also an effect in the University Division but this effect was most noticeable from the standpoint of reversing the trend in crime.

The only extrapolation that can therefore be made is that, if the helicopters are used in an area similar to the West Valley Division, a significant crime repression will result in a short period of time, about six months. If the objective is to reverse the crime trend or at least to halt the rise in crime in a high crime rate area, then an area similar to the University Division should be selected for helicopter use. When the 1970 census data become available the Shevky-Bell indices should be computed for all divisions and a reevaluation of the extrapolation should be made.

B. INCREASING EFFECTIVENESS

1. Introduction

Although the effectiveness of the helicopter patrol operation during 1969 in the two test divisions appears to have been quite satisfactory for a break-in and trial period, an objective study of the operation, given the perspective of the entire year's experience, has suggested a few possibilities for improvement. Since it is not the province of this task to deal with advanced payloads, this section will be limited for the most part to a discussion of functional requirements. In addition to a study of the flight logs and what statistical information was available, the background for these suggestions was obtained from interviews and discussions with the commanders of the test divisions and other police personnel, both flight crews and supervisory, and with JPL personnel working in related areas.

2. Equipment

a. Airborne

(1) Aircraft. The Bell 47G5 helicopters presently operated by LAPD have proven on the whole to be satisfactory aircraft with their current payload and mode of operation but there do exist a number of aircraft-related areas where improvements could increase the effectiveness of the patrol operation. Of these perhaps the most important is aircraft noise. Few complaints concerning police helicopter noise have been received in either of the test divisions after a small initial flurry and the acceptance of the existing noise level by the general public is confirmed by the opinion poll (Section VI).

A quieter helicopter would have a number of important advantages.

Cox in Ref. 7 indicates that a fairly simple set of modifications to a 3000-lb single-shaft turbine propelled helicopter (military version of the Bell 206A Jet Ranger) reduced the perceived noise level (a measure of annoyance)

from 6-9 dB in hover and to 13 dB at cruise at the cost of a significant but acceptable degradation in performance characteristics. A helicopter possessing those noise characteristics would have the following advantages:

1) Without exceeding the perceived noise levels of the present helicopters, it could operate as low as 300 ft at night and even lower by day.
2) The time interval between auditory detection and arrival would be less than 10 seconds in most cases for a helicopter flying at its 107-knot cruising speed. This neglects the favorable effects of sound absorption due to trees and buildings which is increased as the operating altitude is reduced.
3) More operational sites could be used without annoyance to the neighborhood thus increasing flexibility.
4) From noise considerations, 24-hour operations would probably be feasible.

It should be noted parenthetically that the machine described above in its unmodified version has a perceived noise level about 13 dB lower than the 47G5 models in current use. Furthermore, in the 47G5's the dominating noise source is the reciprocating engine, not the rotor system of the turbine-powered machine, and therefore the modifications to the rotors which lowered the noise level of the Jet Ranger would not benefit the 47G5 until the engine noise has been substantially reduced.

Air crews have reported that effectiveness in observation is reduced and fatigue increased in night operation by reflections on the canopy from both running lights and ground lights. In the case of the running lights, a study of the problem may result in some combination of shielding, relocation and perhaps the addition of extra lights which can eliminate or greatly reduce reflection from that source while still satisfying F.A.A. regulations concerning aircraft lighting. With regard to canopy reflections a cursory investigation revealed that glare-reducing coatings can currently be applied to plexiglas by means of spraying, electrolytic plating, or vacuum coating (spattering). The

suitability of any or all of these methods for the purpose at hand is a matter for further examination and perhaps experiment.

(2) Payload. The Dynocular system (an image-stabilized monocular with a zoom lens) currently in experimental use is reported as being of only limited usefulness even in daylight mainly because the upper limit of magnification, which is 12 X, is not quite sufficient to identify figures on the ground or to read license plates from operational altitudes. The obvious suggestion to use a zoom lens of greater maximum magnification may be limited by the abilities of the image-stabilization system but is worthy of investigation. An image-enhancement capability is also required to increase usefulness during night operation.

The presently used hand-held camera is also limited in the same way by the magnification of its lens. In the case of the camera, the usefulness of a more powerful telephoto lens can readily be determined experimentally. At some point the telephoto-lens-equipped camera will require artificial stabilization but it may be that figures on the ground will become identifiable before that point is reached and while the field of view remains sufficiently large to be usable. Ultimately an image-recording capability should be incorporated in the image-stabilized and image-enhanced viewing system. Reduction in the helicopter noise level would also reduce the magnitude of the observation problem by permitting operation at lower altitudes.

b. Ground

(1) Alarms. One of the best ways of increasing the effectiveness of the law enforcement helicopter system is to better utilize its capability for rapid response. In present business alarm systems the alarm is monitored by an answering service which relays the message to police control. They in turn put out a call to appropriate radio cars which may be monitored by the helicopter. Direct communication from the alarm to the patrolling helicopter could result in a large decrease in response time to the point where the presence of the helicopter would be more effective in pinning down the criminal at the scene, if the alarm had been triggered during the commission of the crime, or in trailing the fleeing criminal if the alarm had not been activated

until after his departure from the scene. Commensurate with such use, there would have to be a significant improvement in such alarm systems with respect to the false alarm rates.

The mobile business (mobile tradesman, public conveyance, or truck) represents the worst case. In no instance do these vehicles operate on schedules which are sufficiently rigid to allow the time of the alarm to be used to locate the crime to an acceptable degree of accuracy. Therefore, the alarm system must either automatically transmit a description of the location or, more likely, provide a signal on which the helicopter can home. Range information would also be useful and might prove essential in order to minimize the response time. A visual signal on the vehicle might also be required. The problem of interference with regular communication or other alarm calls does exist but satisfactory solutions can probably be found.

The case of the fixed location business is simpler. Here the alarm can trigger a prerecorded tape, giving location, and activate a visual signal to establish the exact building for the helicopter. The beacon system for reasons of uniformity with the mobile system might also be used in spite of its somewhat greater complexity. In any alarm system the location of the trigger should be a matter for ingenious consideration and a reasonable degree of flexibility should be designed into the system. That feature in addition to a good training and education program should serve to increase the percentage of alarms turned in while the crime is in progress which would further enhance the helicopter's effectiveness.

A related development which would be of considerable use is an officer-in-trouble signaler. This device, which would have to be compact, light, and rugged, could either transmit directly to the helicopter and to police control or the radio car could be used as a relay station. By this means the rapid response capability coupled with the proven effectiveness of a hovering helicopter in supporting an officer-in-trouble could be extended to the officer who was isolated from his car.

(2) Location Identification. In the test districts, through familiarization of the crews with the district and the successful implementation of a business roof identification program, the problem of quickly flying to a given address in the business districts has been small. However, in the hilly residential areas in the West Valley Division the location of an address has occasionally presented more of a problem due to the winding streets and the reluctance of residents to put the somewhat unsightly numbers on their roofs. The development of a visual aid, in the form of a roof light which is inexpensive and easy to install, might be of considerable help in this case. Such a device could be activated by an unauthorized entry either alone or in conjunction with an audible alarm; or the light by itself could be lighted by the resident following a call to the police. Such units (connected to burglar alarms) are currently available but are too expensive for general home use. False alarms could be a problem with this device.

Another means of reducing the problem of spotting a given location would be to paint or otherwise install identification numbers on the street at certain significant intersections in areas where they were needed. This simple technique would be cheap, fast and might be especially useful during the initial period of operation in a new division before the crews have had time to become completely familiar with their district from the air. Also, such simple procedures as persuading home owners in dark residential districts to turn on yard and patio lights could be of considerable benefit to the helicopter crew as well as to ground units.

3. Communications

It goes without saying that an effective communications system is central to increasing the effectiveness of the police helicopter by reducing its response time.

a. Auxiliary Receivers

Interviews with personnel in the two test divisions revealed an interesting difference of opinion concerning the adequacy of the communication system as

related to helicopter operation. In the West Valley Division the current system was considered to be satisfactory but in the University Division it was given a lower rating. The difference was a result of the fact that all the black-and-white cars in the West Valley Division carry the extra receive-only unit on divisional frequency which allows them to monitor divisional transmissions while talking with the helicopter on a tactical frequency. The black-and-white units in University Division, which were not yet equipped with the extra unit, had to isolate themselves from divisional communications when in contact with the helicopter on the tactical frequency. It is suggested that the planned equipping of all black-and-white units in the department with this extra receiver be co-ordinated with any extension of helicopter use to new divisions and that the University Division be given priority if helicopter use is continued there.

b. Interference

The earliest indications of another problem in communications which will grow rapidly if the use of helicopters becomes more wide-spread was reported in the West Valley Division when flying over the hills near Mulholland Drive and the southern boundary of the district. There, occasionally troublesome interference occurs on divisional "out" frequencies (the frequencies on which mobile units transmit to their division), three of which are currently shared by all LAPD divisions. Some form of multiplexing may eventually be required to solve this interference problem. Perhaps the solution to the interference problem may also serve to improve communication security to some extent although special techniques will no doubt be required for complete security.

c. Equipment Flexibility

If more helicopters are to be added to the force, the problem of flexibility of communication equipment will become more acute. That is, the equipment must either be capable of operation in many, if not all, of the districts; or the conversion must be fast and simple – no more than a change of modules. If such is not the case the logistics of helicopter deployment will be complicated and the useful time of a given machine will be reduced because of its inability to operate in more than one division.

4. Operational Considerations

a. Strategic

(1) Morning Watch Flights. At present helicopter flying ceases between 0200 and 0800, a fact that has undoubtedly been noted by criminal elements within the test districts. In spite of the fact that ground forces, at least in the University Division, would like to have the flights extend into the morning watch, this action has not been taken to date principally because the noise from the helicopter will be most objectionable during the early morning hours when the greatest part of the population is sleeping and background noise is at a minimum. While this is no doubt true, it is suggested that, because of the potential advantages of even occasional early morning patrols at random intervals, a series of experimental flights during this time period be initiated. Nominal patrol altitudes might be increased somewhat over the present 1000-1100 ft during initial flights even though the decrease in observational ability is recognized. If public reaction is not adverse during the initial phase, later flights might be carried out at the 1000-1100 ft altitude range. The low-noise machines discussed earlier would permit operation at much lower altitudes than these. Limitations other than noise such as those involving flight crews and maintenance may prevent full-time coverage during the early morning hours but the advantages in decreasing the predictability of the hours of helicopter patrol may justify these morning watch patrols occasionally even if the time for them must be taken from what are now the normal hours of patrol.

(2) Scheduling. As the number of helicopters in a given system grows, an increased amount of consideration must be given to the scheduling of ground operations at the heliport in order to minimize helicopter down-time while avoiding a discernible pattern for patrol hours. At some time consideration must also be given to the relative merits of the establishment of additional heliports versus the enlargements of existing facilities. In some districts the establishment of roof-top heliports to pick up observers may be possible at locations where ground operations would be objectionable due to noise. (Fire regulations will not permit refueling from roof tops.)

b. Tactical

(1) Operational Altitudes. Although the public opinion survey discussed in paragraph V-D-1 contains no direct questions as to the degree of annoyance experienced by residents of the test divisions as a result of helicopter operation, it does contain indirect evidence that the noise level reaching the ground, in terms of annoyance, is near its practical optimum for the presently used helicopters. Although, in total, almost 44.9% of the respondents cited "noise level", "vibration", or "distinctive sound" as reasons for awareness of helicopters, only 3.4% said it disturbed their sleep and all of these were in West Valley. (By way of comparison, 5.6% were aware because it interrupted their TV viewing.) The relative absence of disturbance to sleep is confirmed by the sharp drops in both test divisions in awareness of helicopter patrols which occur between 2300 and 2400 even though the patrols continue until after 0100. It therefore appears that the current operational altitudes of 700-800 ft in day and 1000-1100 at night are about as low as is acceptable to the public using the current helicopters. A possible exception might be the night altitude used in University Division since no one in that division reported that the present level disturbed sleep. The average ambient background noise level in that division, at any hour, is undoubtedly higher than in West Valley at the same time.

(2) Command Authority. In the course of the interviews with police personnel the opinion was expressed that occasionally the effectiveness of a tactical operation involving the helicopter was decreased because the observer was limited to coordination by way of suggestions since he does not normally have the authority to issue orders. The question of whether observers should be sergeants, or whether sergeants should fly at certain times, or other solutions to this problem can best be left to police management.

(3) Blade Slap. Even for a given helicopter type and operational altitude, the way in which the helicopter is operated can make a considerable difference in the noise produced. Of particular concern is the occurrence of a phenomenon known as "blade slap". This colloquialism has been applied to the sharp cracking sound associated under certain conditions

with helicopter rotors and is by far the most annoying sound of any of the rotor noise sources. Even for helicopter types such as the 47G5's where the reciprocating engine is normally the dominant noise source, blade slap becomes dominant when it occurs. The source of this noise is the interaction between the continuous vortex stream shed from the tip of all lifting blades and the following blade. In climb or horizontal flight this vortex stream, which has a downward component when shed, passes beneath the following blade. However, during descent at a moderate rate or during a flare maneuver when the rotor has become heavily loaded the following blade may, itself, have descended sufficiently so that it will pass through or near the vortex stream during some part of its rotation. Many of the modifications as discussed earlier which would be made to alleviate blade noise such as reducing blade loading or shaping blade tips will also have some effect on reducing the intensity of blade slap because they work toward reducing the strength of the tip vortex. The best solution to the problem is for the pilot to be familiar with the exact operational conditions that will produce blade slap in his helicopter and to avoid them in so far as is possible.

(4) Crew Fatigue. The problems of crew fatigue during their relatively long periods of flight were recognized early in the implementation phase of the helicopter program and better seats were installed. Other fatigue-producing effects are the noise and vibration environment as well as the use of the Dynocular system and the glare problem. In most of the above instances there is little more that can be done to improve the present machines but the effects should be kept in mind when evaluating candidate machines for future procurements.

(5) Hearing Damage. In connection with helicopter cabin noise, it may be worth noting that the military has been incurring hearing damage among the crews of military helicopters to the extent that the payment of disability claims for that reason represents a sizable sum. How much of this damage, if any, is due to the discharge of ordnance from the helicopter is not known. The periodic physical examinations for flight certification should be monitored for evidences of hearing deficiencies among police air crews and if necessary special hearing examinations should be instituted. Current industrial

standards, while varying slightly, tend to require noise exposure control and hearing testing if there is habitual exposure to continuous noise at 85-90 decibels in a frequency range of about 300-1200 cycles per second. If the noise spectrum within the cabin of the 47G5 machines is not known, it can readily be measured with a precision sound level meter or similar instrument.

c. Training

(1) Supervision. Within the test divisions the supervisory personnel (sergeants and lieutenants) have been directed to make occasional patrol flights for the purpose of familiarizing themselves with the appearance of their divisions from the air. In the course of these flights the supervisors have sometimes been able to observe how their ground units comply with good police procedures. In some cases they have used the camera for purposes of documentation and identification. It is believed by the police management that this supervisory technique has a favorable effect on the work of the ground units and should be continued.

(2) Familiarization Flights. Although it is not possible with the present two-place equipment, the initiation of a program of familiarization flights for the personnel of the radio cars in divisions using patrol helicopters should be given consideration if and when the extra space becomes available in the helicopters. The flights should be an integral part of an officer orientation program on the helicopter program and police tactics with helicopter support, particularly in any new divisions being added to the program.

(3) Academy Lectures. Lectures on the helicopter program and the effect of this close air support on police tactics in various situations should be included in the curriculum of the police academy.

5. Community Relations

a. Public Education

In order to be effective, programs of public education must define the communication needs of both the public and the police, establish communication

objectives and decide on approaches which can be expected to meet those objectives. A detailed discussion of this area is contained in Volume III under the heading, "Recommendations for an Approach to Public Education".

b. Helicopter Identification

The advantages of using distinctively marked cars for most kinds of police work such as the favorable effect of the presence of a black-and-white unit on the strict observance of traffic regulations is well known. Although exceptions undoubtedly exist, it is likely that the police helicopter, too, should be readily identifiable. The present Bell 47G5 models are not of a configuration that is suitable for the display of identification other than what is now in use on the fuel tanks unless a special panel is carried for the purpose. In any case, the helicopter could be made more identifiable during flights after dark by the use of small flood lights to illuminate the "POLICE" sign when desired.

SECTION VII

CONCLUSIONS

A. CRIME EFFECTIVENESS

1. Overall

In the test divisions the resulting changes in the trends in the Part I Property Crimes and the number of times the actual offenses committed were significantly lower than the predicted offenses can only be attributed to the helicopter patrol operations. No other changes within the police system were found that could account for these results.

The apparent lack of significant results in the arrest data on a divisional basis does not accurately reflect the results found in the operational analysis. On an operational basis the helicopter-car patrol team effected arrests in 45 percent of the calls responded to. These arrests did not require investigative assistance prior to arrest. The city as a whole makes arrests equal to 16 percent of the total offenses committed, including those made through investigative followups.

2. Specific Crimes and Areas

The results indicate that the helicopter patrol was most effective against robbery, auto theft and theft in the West Valley Division and against robbery and auto theft in the University Division.

3. Operation

The operational results indicate that the helicopter-car patrol team affects almost three times as many arrests as the city as a whole per reported

offense. This provides greater officer security to the ground unit because the helicopter patrol crew selects those calls that present the greatest potential of an arrest being made, thus the criminal is most likely to be at the scene. The fast response time of the helicopter unit further enhances the possibility of making an arrest.

B. OPINION POLLS

1. Public

The residents of the test areas accept the helicopter patrols as a necessary part of the police system and strongly favor the continuation of the patrols.

2. Police

The patrolmen in the test divisions overwhelmingly favor the continuation of the helicopter patrol program and state that officer security is one of the benefits of the patrols.

REFERENCES

1. Municipal Police Administration, Fifth Edition, p. 7. Published for the Institute for Training in Municipal Administration by the International City Managers' Association, 1313 E. 60th St., Chicago, Ill., 1961.

2. Shevky, E., and Bell, W., Social Area Analysis, Stanford University Press, 1955.

3. Schmid, Calvin E., Urban Crime Areas, Part 1, American Sociological Review, Vol. 24, August 1960.

4. Tyron, Robert C., Identification of Social Areas by Cluster Analysis, University of California Publications in Psychology, Vol. 8, No. 1, 1955.

5. Bell, Wendell, The Utility of the Shevky Typology for the Design of Urban Sub-Area Field Studies, The Journal of Social Psychology, 1958, pp. 71-83.

6. Robinson, W. S., Ecological Correlations and the Behavior of Individuals, American Sociological Review.

7. Cox, C. R., Helicopter Noise Reduction and Its Effect on Operations, Paper 352, presented at 25th Annual National Forum of the American Helicopter Society, May 1969.

APPENDIX A

DETERMINING STATISTICAL SIGNIFICANCE

In the process of predicting the number of offenses and arrests that would occur, a probable uncertainty for each prediction was calculated. The calculation of these values is part of the prediction methodology.

The resulting standard deviation would theoretically be the level at which a 68% confidence could be expressed that any values equalling or exceeding that value could not have occurred by random chance. It was felt that this was not a high enough confidence level. To ensure that only the deviations that were beyond the 90% confidence level would be utilized in the evaluation the following approach was used.

1) Treat the deviations in numbers of standard deviations as random variables using the absolute values.
2) Determine the standard deviation of the new random variable.
3) Find the level at which 90% confidence could be expressed that any value equalling or exceeding that level could not have occurred randomly.

The absolute values were used because it is the deviation from zero that is desired. The advantage of using this method to determine significance level is that it is not dependent on the prediction model accuracy.

The standard deviation from zero is calculated using

$$\text{Significant } \sigma = \sqrt{\frac{\sum_{J=1}^{N} {}_J X^2}{N}}$$

where

N = number of variables

X = the random variable

Table 1 is a tabulation of the standard deviation for each crime being considered. Using standard normal curve statistical tables the number of standard deviations that yields 90% confidence is determined to be 1.645. Table 1 also shows this value.

From the table it is noted that the 90% confidence level is different for each crime. This is due to the fact that the same prediction model was not used for each crime and the history of each crime in each division is different.

Table 1. Significant value determination

	Crime	Standard Deviation	Significant Value of σ
Offenses	Robbery	1.22	2.0
	Burglary	1.52	2.5
	Theft	1.40	2.3
	Auto theft	1.09	1.8
	Total property	1.52	2.5
Arrests	Robbery	1.21	2.0
	Burglary	1.22	2.0
	Theft	1.21	2.0
	Auto theft	1.46	2.4
	Total property	1.39	2.3

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