COMMERCIAL SECURITY SURVEYS AND BURGLARY REDUCTION: A TIME-SERIES ANALYSIS

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The purpose of this paper is twofold: (a) to present some evaluation results from a Crime Prevention Through Environmental Design (CPTED) program in Portland, Oregon; and (b) to further acquaint criminal justice analysts with a multi-step regression approach to time-series analysis. Both purposes are viewed as important and timely. First, police departments across the country are generally employing crime prevention techniques without sufficient documentation about their usefulness. Second, a plethora of data suitable for time-series analysis is presently available but under utilized by the vast majority of the nations' crime analysts. Now that many social scientists are becoming familiar with this analytical technique, universities and other agencies which can provide access to, and technical assistance for, time-series computer routines are more readily available to crime analysts.

In the mid-1970's the National Institute of Law Enforcement and Criminal Justice awarded a contract to the Westinghouse Electric Corporation to further knowledge about CPTED (Tien, Reppetto, & Haines, 1976). As part of this work, a CPTED demonstration project was supported in a commercial sector of northeast Portland, Oregon. The target area was a three-and-one half mile section of a commercial strip divided by Union Avenue, one of Portland's major north-south thoroughfares. Prior to the 1960's the Union Avenue business community had been the major commercial area in Northeast

Portland. But following the building of two interstate highways and the nearby construction of an enormous shopping mall businesses began to leave Union Avenue. As the area's property values went down, lower-income minority members moved in. Then, in 1968, the area experienced riots following Dr. Martin Luther King's assassination. By this time, Union Avenue had developed a reputation as a high crime area and business patronage continued to decline, presumably as a consequence of fear of crime. Thus the viability of the Union Avenue business community continued to be undermined.

In 1974, due to the perserverance of some key persons in the Union Avenue business community, and with the encouragement and support of Portland's mayor and city commissioners, a major revitalization effort was planned with Westinghouse's assistance. Applying CPTED theory, a demonstration plan was written which recommended changes in Union Avenue's physical and social environments, with the aim of reducing both crime and fear, and thereby increasing the viability of Union Avenue businesses.

Part of this Portland CPTED effort involved security surveys of 210 commercial establishments in the target area. In CPTED theory, security surveys are recommended in order to promote the concept of access control. The primary objective of access control is to keep potential offenders out of areas where they may commit crimes, by creating physical and psychological barriers. Physical barriers refer to obstacles that make unlawful entry more difficult (e.g., locks, alarms, guards, etc). Psychological barriers are hypothesized to form when potential offenders perceive their chances of successfully executing a crime as being very low; and thus regard an area as unattractive to commit unlawful entry.

To increase the amount of access control at Union Avenue businesses Portland police officers performed extensive security surveys of all existing commercial establishments during February, 1976. The police made recommendations for security improvements and conducted follow-up surveys six and twelve months later, to assess and further encourage adoption of the recommendations. The subsequent evaluation of the entire Portland CPTED effort (Lavrakas, Normoyle & Wagener, 1978) determined that of the 150 commercial establishments for which security recommendations had been made approximately 80% reported following at least some of the recommendations.

These security surveys and related improvements were hypothesized to reduce commercial burglaries. To test this hypothesis crime reports for commercial burglary were retrieved from the Portland Police Bureau's files, for a three year period (October 1974 thru September 1977). The amount of data that could be retrieved was limited by budget constraints. Each crime report filed in northeast Portland during this time period had to be hand-screened to determine if it occurred within the target area. In addition to the commercial burglary data, crime reports for commercial robbery and residential burglary were tabulated for the same three year period. These data would serve as comparisons for the commercial burglary data, within the context of a multiple time-series methodology (Campbell & Stanely, 1963).

METHOD

Each of the three data sets were analyzed as a time-series following a multi-step regression approach to this procedure. Figure 1 outlines the basic steps one undertakes when using this approach. Time-series analyses

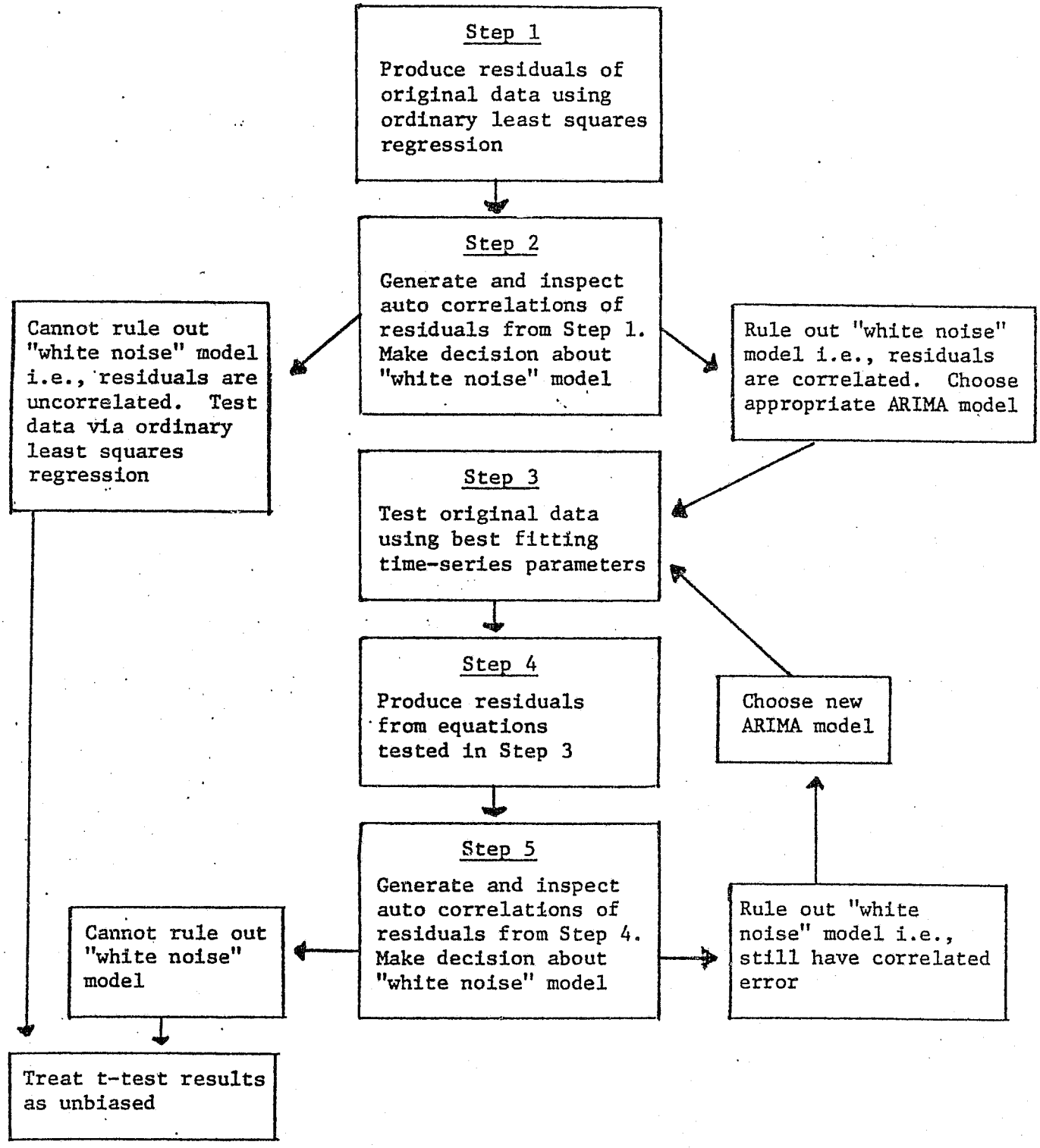


Figure 1. Regression Approach to Time-Series Analysis

are necessary when data are correlated over time, which produces a correlated error structure in the data. Ordinary least squares regression will not provide unbiased tests of such a data set. The time-series procedure allows one to identify the nature of the error structure and then perform statistical tests appropriate to the hypothesized error structure.

Step 1. A complete data set (36 months of crime reports) was submitted to a multiple regression analysis with "# of crimes/month" as the dependent variable, and predictor variables for slope, change in level, and change in slope. The variable for slope was represented by a vector coded 1, 2, 3, ..., 36 corresponding to each consecutive month during the October 1974 thru September 1977 time period. The variable for change in level was represented by a vector coded with "0's" for the months prior to the commercial security surveys (performed February, 1976), and coded with "1's" for the remaining months. Finally the variable for change in slope was represented by a vector coded with "0's" for months prior to the intervention, and with 1, 2, 3, ..., 20 for the remaining twenty months. Residuals were obtained from the multiple regression analysis.

Step 2. These residuals were submitted to the first-part of a time-series computer routine developed by Bower, Padia & Glass (1974) which produced auto-correlations and partial auto-correlations. Inspection of these auto-correlations and partial auto-correlations allows the analyst to choose the autoregressive-integrated moving average model [ARIMA (p,d,q)] which best fits the correlation structure of the residuals. If at this step, a white noise model (i.e., no correlated error in the data set) cannot be ruled out, the analysis can revert to an ordinary least-squares regression to test for intervention effects. On the other hand if the white noise

model, ARIMA (0,0,0), is ruled out due to individually significant auto-correlations, then an ARIMA (p,d,q) model is identified to fit the correlation structure of the residuals.

Step 3. If the white noise model is ruled out, the original data (not the residuals) are submitted to the second-part of the time-series computer program along with the ARIMA (p,d,q) model chosen in Step 2. The analyst also specifies at what point the intervention took place and what t-tests are desired. The computer routine then iterates through an internally (or externally) controlled number of increments, related to the specific ARIMA model being tested. The results of these iterations are inspected to locate the one that has a minimum error variance, i.e., the best fit. The computer routine also produces the desired t-values, but these are not yet treated as statistically valid.

Step 4. Residuals for this "best fitting" ARIMA (p,d,q) model are the obtained.

Step 5. These residuals are in turn submitted to the first part of the computer routine, to test again for the white noise model. This is done following the assumption that a valid ARIMA (p,d,q) model will lead to a set of uncorrelated residuals (i.e., "white noise"). If at this step the white noise model cannot be ruled out, the analyst can conclude that the ARIMA (p, d, q) model being tested is an appropriate one, and, thus the aforementioned t-tests are treated as statistically valid. If, on the other hand, the white noise model for these residuals is ruled out, the analyst must go back to Step 2 and choose a new ARIMA (p, d, q) model for retesting in Steps 3-5.

RESULTS

Commercial Burglary

Visual inspection of Figure 2 suggests that coinciding with and following the commercial security surveys there was a decrease in commercial burglary. The *t*-values from the ARIMA (0,0,2) model used indicated that this visual observation is statistically valid. Both a significant decrease in level [$t(32)=2.57$, $p<.01$] and a significant decrease in slope [$t(32)=-5.18$, $p<.001$] occurred after the commercial security surveys. These results indicate that during the 20 month "post" period there was a significant drop in Union Avenue's average monthly incidence of commercial burglaries. For the 16 months prior to the intervention commercial burglaries occurred at a monthly average of 16.4. Following the commercial security surveys this rate dropped to a monthly average of 8.4; a 48 percent decrease. In addition to this significant drop in the monthly incidence, the rate at which these burglaries occurred showed a significantly decreasing trend, i.e., as time went on (after the surveys) commercial burglaries continued to occur less frequently.

Commercial Robbery

In performing Step 1 of the time-series analysis with the commercial robbery data set it was determined that the white noise model, ARIMA (0,0,0) could not be ruled out. This suggested that the error structure in this data set was uncorrelated, and therefore ordinary least-squares regression could validly be used.

Visual inspection of Figure 3 indicates that there was basically no change in the reported rate of commercial robbery following the commercial security surveys. The *t*-values from the regression analysis support this observation, with no significant change in level [$t(32)=.01$, n.s.] or in

Figure 2. Commercial Burglaries 10/74 thru 9/77.

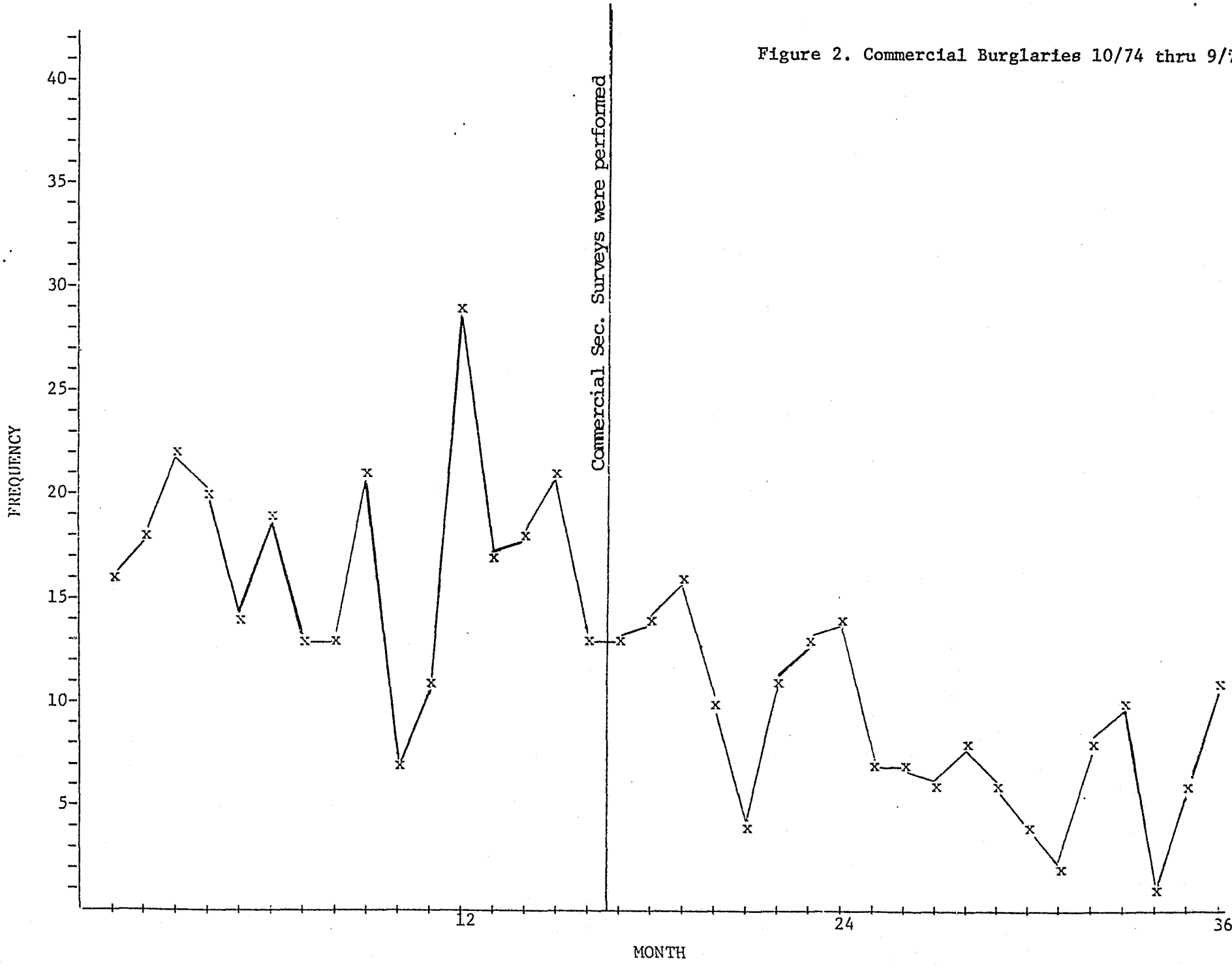
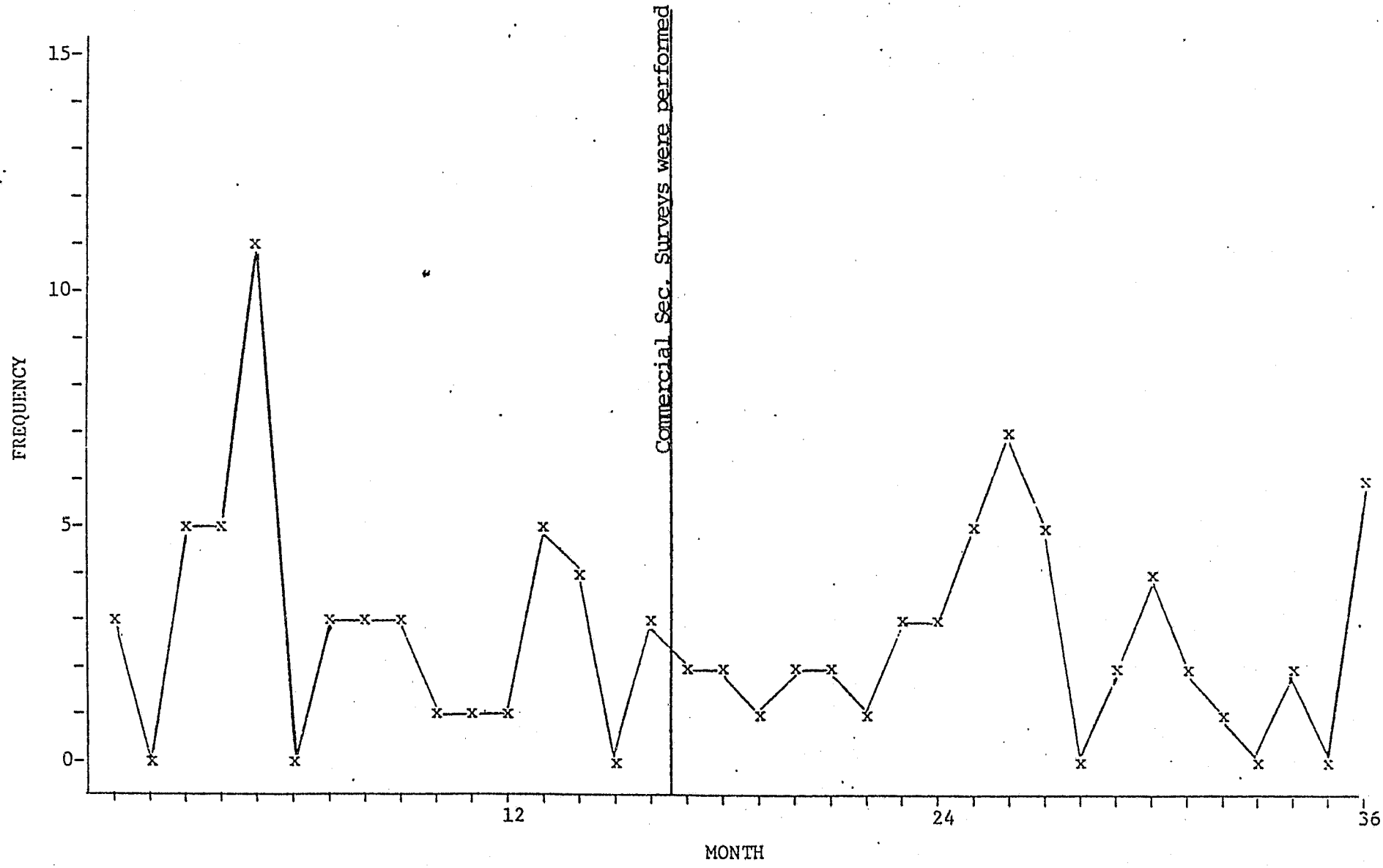


Figure 3. Commercial Robberies 10/74 thru 9/77



slope [$t(32)=.96$, n.s.]. Thus, there appears to have been no change in Union Avenue's commercial robbery rate associated with the commercial security surveys. Since the security surveys were performed in an attempt to decrease unlawful entry there had not been an expected reduction in commercial robbery. Had a decrease in commercial robbery been found, it may have indicated a general decrease in crime within the target area, independent of the security surveys.

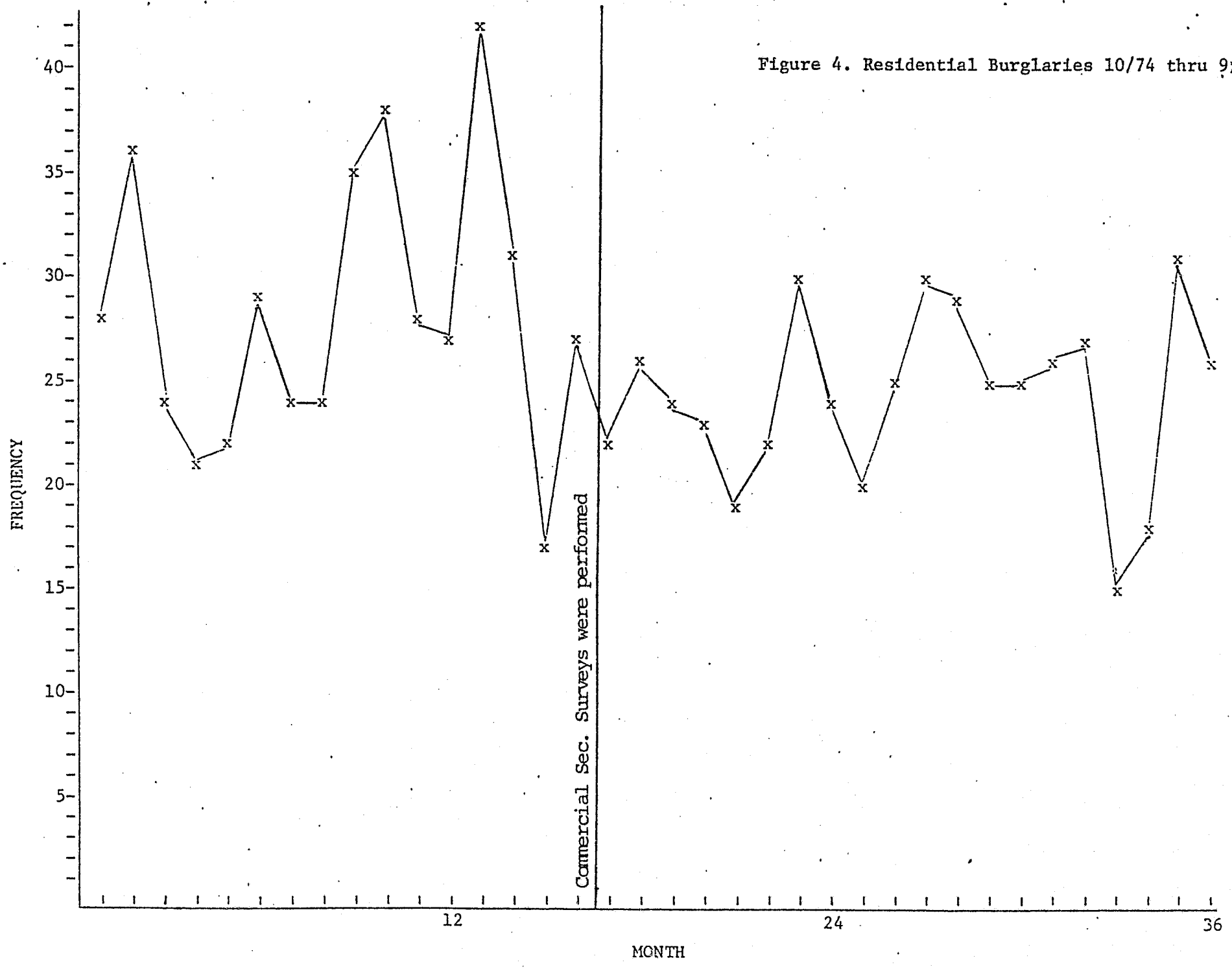
Residential Burglary

As previously mentioned residential burglary data were also collected to serve as a comparison for the commercial burglary data. Since the security surveys were performed only in commercial establishments, one would not expect any increase in the target-hardness of the area's residences. Visual inspection of Figure 4 suggests that there was a decrease in residential burglary following the commercial security surveys. The t-values from an ARIMA (0,1,2) model indicates that there was a significant decrease in level ($t(32)=-1.98$, $p<.05$), but not in slope ($t(32)=-.53$, n.s.). For the 16 months prior to the intervention the monthly average of residential burglary had been 28.3. Following the intervention the monthly average was 24.3; this is a significant decrease of 14 percent.

DISCUSSION

The results from the three time-series analyses provide an interesting pattern for interpretation. As was first seen, there was a large and significant reduction in commercial burglaries following the security surveys. On the other hand, there was no decrease in commercial robberies. Finally, there was a small, but significant reduction in residential burglary, even

Figure 4. Residential Burglaries 10/74 thru 9/7



though the security surveys had not been performed in residences. This observed decrease in residential burglary is especially interesting. First, it appears to rule out the possibility that the commercial security surveys caused a burglary displacement from the commercial environment to the residential environment. And second, it raises the possibility that the commercial security surveys had an effect on the residential environment's incidence of burglary.

These data were not collected in an experimental setting, and thus do not allow for the rigorous causal interpretations associated with true experiments. But the three data sets analyzed via time-series do allow for some causal reasoning. It is our judgment and that of a Portland crime prevention specialist that the following interpretation is most reasonable:

> Commercial security surveys, in serving as a means of implementing access control, are not meant to solely create physical barriers to potential burglars. We suggest that the Union Avenue security surveys created psychological barriers to potential burglars by causing them to perceive an increase in their risk. The commercial security surveys brought a relatively large number of police officers to the target area during February 1976, and during the follow-up surveys. This inordinate visibility of police officers was undoubtedly perceived by the local burglar population, and may have become part of the intervention.* The much larger reduction in commercial burglaries vs. residential burglaries suggests that the security surveys

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*It was found in Minneapolis that most commercial burglaries are committed by local offenders (Friesbie et al, 1977).

and related security improvements at the commercial establishments, had a primary impact in the commercial environment. Yet there may have been a secondary impact in the residential environment which could account for the smaller, but significant, reduction in residential burglary. This secondary effect is thought to be the creation of a psychological barrier to local burglars.

What makes these arguments more compelling are results from the commercial robbery analysis and other Portland crime data. If the reduction in commercial and residential burglary was occurring throughout Portland as a city-wide decrease in burglary or crime in general, then we would have an alternative explanation to the causal reasoning advanced above. In such an instance it could be suggested that it was not the commercial security surveys that were responsible for the reduction in burglary in the target area, but rather an across the board drop in crime. Two findings suggest that this was simply not the case. First, data from the Portland Police Bureau indicates that there was a four percent decrease in the city-wide commercial burglaries rate for 1976. This is not comparable to the nearly fifty percent reduction observed in the CPTED target area. Second, the security surveys, as an access control strategy, were not expected to reduce robbery. Thus the fact that no decrease in commercial robbery was observed, supports the reasoning that the commercial security surveys had an impact on the population of burglars. This further rules out the possibility that there was an overall decrease in crime, unrelated to the intervention.

Other findings from the evaluation of this Portland CPTED demonstration, support these conclusions. Interviews with 134 businessmen

and eight Union Avenue patrol officers found a consistent perception that these security surveys were effective crime deterrents. In addition, it was concluded that the security surveys had a positive impact on Union Avenue's social environment by increasing the business community's sense of confidence, and knowledge of crime prevention techniques.

CONCLUSION

A major intent of this paper was to provide information about the impact of commercial security surveys on burglary reduction. We feel that the evidence presented here demonstrates that the security surveys helped bring about the large reduction in commercial burglary, and appear to have had a secondary impact in also reducing residential burglary. The Union Avenue target area is similar to numerous other commercial strips which provide services for the users of major streets. Thus, the present results should have implications in many other settings throughout the nation.

An ancillary objective of this paper was to further familarize criminal justice analysts with ARIMA time-series analysis. The use of this technique is suggested whenever data are available at equal intervals in time; for example, crime reports on a daily, weekly, or monthly basis, as investigated here. It is very likely that such data are correlated across time. As mentioned earlier, ARIMA modelling provides one method for dealing with such data and testing intervention effects in an unbiased manner. It such a statistical procedure is not used it is possible that valid intervention effects will be obscured, leading to invalid policy decisions about a program's failure/success.

REFERENCES

Bower, C.P., Padia, W.L. & Glass, G.V. "TMS: Two Fortran IV Programs for Analysis of Time-Series Experiments." Laboratory of Educational Research, University of Colorado. October, 1974.

Campbell, D.T., & Stanely, J.C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1963.

Friesbie, D., Fishbine,G., Hintz, R., Joelson, M., & Nutter, J.B. Crime in minneapolis: proposals for prevention. Minneapolis: Governor's Commission on Crime Prevention and Control. May, 1977.

Lavrakas, P.J., Normoyle, J. & Wagener, J. "CPTED Commercial Demonstration Evaluation Report." Evanston, Ill.: Westinghouse Electric Corporation. February, 1978.

Tien, J., Reppetto, T., & Hanes, L. "Elements of CPTED." Arlington, Va.: Westinghouse Electric Corporation. May, 1976.

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