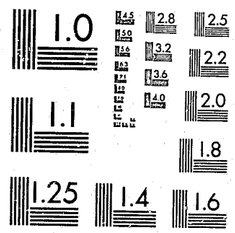

RESTITUTION AS AN ALTERNATIVE TO INCARCERATION: AN INTERRUPTED TIME SERIES ASSESSMENT OF FIVE FEDERALLY FUNDED RESTITUTION PROGRAMS

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INTRODUCTION

In February of 1978 the Office of Juvenile Justice and Delinquency Prevention (OJJDP) began soliciting proposals for a major initiative entitled "Restitution by Juvenile Offenders: An Alternative to Incarceration."[1] The policy expections held out for this program included:

1. A reduction in the number of youths incarcerated.
2. A reduction in recidivism of those youths involved in restitution programs.
3. Provision for some redress or satisfaction with regard to the reasonable value of the damage or loss suffered by victims of juvenile offenses.
4. Increased knowledge about the feasibility of restitution for juveniles in terms of cost effectiveness, impact upon differing categories of youthful offenders, and the juvenile justice process.
5. An increased sense of responsibility and accountability on the part of youthful offenders for their behavior.
6. Greater community confidence in the juvenile justice process.

These several policy expectations make it clear that the national juvenile restitution initiative was not designed solely for the purpose of encouraging restitution as a disposition/treatment strategy. The program announcement labels restitution an alternative to incarceration and the first objective of the initiative, as listed under desired results, is a reduction in the number of juvenile offenders incarcerated. In this spirit, considerable emphasis was placed throughout application and project start-up phases on the fact that the initative was intended to deal with

control for nationwide trends in the incarceration of youthful offenders, the analytic strategy chosen for the assessment presented in this report is capable of statistically controling for trends in incarceration within the jurisdictions considered. A more pressing issue for this evaluation of restitution program impact, however, concerns the initiative's target population and how the characteristics of youths actually served can materially effect evaluation results. This issue will be briefly discussed in the next section of this report.

Following sections will introduce the methodology adopted for evaluation, the data collected, the statistical intervention model used, and site-by-site assessments of the effect of restitution upon incarcerations.

serious offenders who would normally be incarcerated. This emphasis is consistent with OJJDP concern that initiative resourses not be expended on any youth who otherwise would have been diverted rather than adjudicated. This report assesses the impact the Juvenile Restitution Initiative has had upon the incarceration of youthful offenders in five selected jurisdictions (Ada County, ID, Belmont/Harrison Counties, OH, Jefferson County, KY, Wayne County, MI, and Washington, DC) which participated in the initiative and finds OJJDP policy expectations met in four of the sites evaluated. Three sites provided clear indications of a downward turn in incarceration trends associated with the establishment of their restitution projects, one site showed a increase in both incarceration level and trend coincidental with project start-up, and one site displayed an immediate increase in the number of youths incarcerated combined with a strong decrease in incarceration trend subsequent to the beginning of the restitution project.

Several issues confound straightforward assessment.[2] Because of the possibility of nationwide incarceration trends existing prior to the establishment of the restitution initiative, and their possible interaction with state juvenile codes and local policies, quantitative changes in the patterns of incarceration for youthful offenders might be difficult to interpret. For example, if incarcerations are generally decreasing throughout the country, then a decrease of incarcerations in jurisdictions with restitution projects cannot be attributed solely to the influence of the initiative. Conversely, if incarcerations are generally increasing, then the initiative may appear to have failed in its objective even if it actually reduced the rate of increase. While it has proved impractical to

control for nationwide trends in the incarceration of youthful offenders, the analytic strategy chosen for the assessment presented in this report is capable of statistically controling for trends in incarceration within the jurisdictions considered. A more pressing issue for this evaluation of restitution program impact, however, concerns the initiative's target population and how the characteristics of youths actually served can materially effect evaluation results. This issue will be briefly discussed in the next section of this report.

Following sections will introduce the methodology adopted for evaluation, the data collected, the statistical intervention model used, and site-by-site assessments of the effect of restitution upon incarcerations.

I. INITIATIVE TARGET POPULATION

Many federally sponsored service delivery programs fail to concisely define their "target populations" and consequently experience difficultly assessing guideline compliance. OJJDP's restitution initiative has proven no exception in this regard.[3]

Though the initiative was billed as "an alternative to incarceration," the target population is not explicitly defined in the program announcement.

> The target population is youth who have committed misdemeanors and/or felony offenses and are adjudicated delinquent as a result of a formal fact-finding hearing or a counseled plea of guilty. It is expected that projects will include juvenile offenders with varying categories of misdemeanors and/or felony offenses, including property offenses and offenses against persons. This excludes victimless crimes and the crime of non-negligent homocide. Using data on the number of youth adjudicated in 1975 and 1976, each community will define the target population by precise criteria, and develop action projects which provide for restitution by offenders as described above. (Restitution by Juvenile Offenders: An Alternative to Incarceration, 1978:101)

OJJDP clearly preferred the target population to consist of youths who would have been incarcerated if not referred to the restitution project. No initiative-wide criteria were developed, however, which specified for individual projects how they might demonstrate guideline compliance. In short, no general manner was established for identification of youth who would have been incarcerated in the absence of the restitution initiative.

Having left open each jurisdiction's specification of the target population, the problem becomes localized with the resulting consequence that the great majority of jurisdictions were unable to develop

incarceration profiles. Given the dearth of readily accessable quantitative information regarding characteristics of youthful offenders in most jurisdictions, specifying the target population became necessarily transformed into a question of establishing project eligibility criteria. This circumstance, which is not an unususal one for service delivery programs, can lead to unintended consequences which complicate program evaluation. Most important among the potential unintended consequences is that termed "widening the net." This happens when youths not originally intended for program participation are subsequently included. In the case of the restitution initiative this would occur if judges view restitution as an attractive disposition when compared to other alternatives and therefore elect to adjudicate youths for the primary purpose of getting them into a restitution program. Such actions could result in a dilution of the target population through the admixture of less serious offenders in restitution programs.

The analysis problem should be clear. The success of the restitution initiative in reducing incarceration within a particular jurisdiction is dependent in part upon the degree to which project referrals conform to a jurisdiction's incarceration profile. The more closely project referrals resemble youth who would have previously been incarcerated, the greater the possible and detectable impact of the restitution project. The more unlike the incarceration profile referrals become, the more diminshed the potential impact of the restitution program. The problem of determining what constitutes an appropriate referral and the degree to which individual projects accept appropriate referrals, unfortunately, is one which cannot

be unambiguously resolved. In response, IPA developed five unofficial criteria for assessing referral appropriateness.

The approach taken by IPA in attempting to determine whether the projects served the target population was based on the assumption that the appropriate group consists of "serious offenders" and that a serious offender is (a) a juvenile without extensive criminal history but whose referral offense is of a serious nature and/or (b) a chronic offender whose referral offense is either a misdemeanor or felony, but not necessarily one that is especially serious.

Rather than develop one specific standard which a referral would need to meet in order to be considered "appropriate" for the target population, five alternative standards were constructed.[4] Each alternative standard sets forth specific and measurable criteria which, if met by a referral, would constitute "eligibility" for the initiative under that particular standard. This approach allows the reader to select a set of standards closest to those he or she prefers and then assess the degree to which a project served the desired target population.

Each of the standards developed by IPA are based upon the offense seriousness-offense history matrix as presented in Figure A.1 (see Appendix). This matrix employs a combination of offense type and dollar loss (the offense seriousness components) along with the youth's number of prior delinquent offenses and the number of offenses concurrent with the referral offense (the offense history component). Figure A.2 contains five separate seriousness matrices, each of which constitutes distinct criteria for the appropriateness of referrals. The shaded areas represent referral

characteristics deemed inappropriate for the particular standard. Table A.1 describes each standard in narrative form.

For each of the sites analyzed in this report, the percentage of cases referred prior to January, 1980 conforming to each of the five seriousness standards is presented in Table I.1. Though it is acknowledged that this presentation does not obviate the difficulties surrounding unknown incarceration profiles, the seriousness matrices do provide a context within which the reader may assess the seriousness of referrals in the sites considered.

TABLE I.1 Percentage of Referrals Which Meet or Exceed Appropriate Referral Standards*

REFERRAL STANDARD	SITE				
	Ada ID	Belmont/ Harrison OH	Jefferson KY	Wayne MI	Washington DC
I. Serious or Repeat Offenders	94	96	99	96	91
II. Serious Offenders	90	93	98	93	69
III. Serious and/or Repeat Offenders	74	59	94	82	73
IV. Repeat Offenders	53	44	61	42	78
V. Chronic and Very Serious Offenders	33	15	38	25	50
Number of Referrals	266	27	111	205	101

*Based upon referrals through December, 1979 only. The total number of referrals evaluated for appropriateness in each site is lower than that reported in the site-specific sections due to the presence of missing data.

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II. GENERAL METHODOLOGY AND DATA COLLECTION

Originally, the national evaluation proposed to assess the efficacy of restitution programs in reducing incarceration in a number of distinct manners.[5] Due to data availability and time constraints, it was decided that assessment would be carried out solely through the implementation of an interrupted time series methodology. The logic of this design is rather straightforward and attractive given the type of evaluation desired. Measures on a dependent variable (incarcerations) are taken taken at a number of time points both prior and subsequent to the implementation of an intervention of interest (restitution programs). An analysis is then undertaken to determine whether a statistically significant change in the series occured as a result of the intervention (for e.g., a change in either the level or trend of the series). If no change is detected, the intervention is presumed to have had no substantial effect. To facilitate the evaluation, IPA requested monthly disposition and incarceration data by offense from each of the 88 jurisdictions participating in the juvenile restitution initiative. The period of data requested covered January 1977 (prior to the initiation of any federally sponsored restitution programs) through December of 1979 (subsequent to the beginning of all programs).

The Interrupted Time Series Quasi-Experiment

Campbell and Stanley (1963) pointed out the potential value of interrupted time series designs for measuring the effectiveness of policy changes, program implementations, or other naturally occuring quasi-experiments. Since that time, this approach has been used in a number of criminal justice studies including evaluations of new traffic laws (Campbell and Ross, 1968; Glass, 1968; Ross, Campbell, and Glass, 1970), studies of gun control legislation impact (Zimring, 1975; Deutsch and Alt, 1977; Hay and McCleary, 1979; Berk et al., 1979), and estimating the impact of decriminalization (Aaronson, Dienes, and Musheno, 1977; 1978).

The popularity of this design stems from practical and theoretical considerations. From a practical perspective, the investigator can often make use of data routinely collected by operational agencies, such as arrest and offense counts, thereby facilitating a relatively inexpensive, quick, and even (when necessary) post hoc evaluation of the impact of a particular policy or legislative change. From a theoretical perspecitve, the information provided by an interrupted time series design is especially well suited for determining whether a public problem was ameliorated through the implementation of a particular policy or program (see Glass, Willson, and Gottman, 1975:5).

Researchers are also attracted to this design because, when properly implemented, it controls for many of the threats to internal and external validity which often cast doubt upon research findings (see Kepka, 1972 for elaboration). Not only should the occurance of change be established in intervention studies, causal attribution is desired. In many situations interrupted time series quasi-experimental designs are simply better suited for the task of evaluating rival hypotheses than other available designs.

As stated above, the logic of the interrupted time series quasi-experimental (ITSQE) design is rather easily grasped. The qualifyer

"quasi-experimental" means that this design incorporates "...treatments, outcome measures, and experimental units, but does not use random assignment to create the comparisons from which treatment-caused change is inferred." (Cook and Campbell, 1979:6) The purpose of analyzing data from such a design is to infer whether the treatment had any effect upon the series. If an impact did occur, then observations after the intervention should be quantitatively different than those before. That is, the series should show sign of interruption or discontinuity at the expected point in time (stated in this fashion the ITSQE has much in common logically with the regression-discontinuity design -- see Campbell and Cook, 1979).

One of the attractions of this design is that it is able to capture the fact that interventions do not merely have "an effect" but an "effect pattern" over time. A posttreatment time series can be effected by a treatment in several different ways and consequently there are many dimensions which may be used to characterize an effect pattern. This research only considers two dimensions of possible discontinuity: series level and series trend.

The first dimension, series level, assesses whether the establishment of a restitution program is associated with a detectable change in the number of youths incarcerated at (or, when the model specification contains lagged endogenous variables, asymptotically thereafter -- see footnote 8) the point of intervention. Based upon the program announcement the expectation would be that if a restitution program effected incarcerations immediately then the number of youths incarcerated would drop absolutely due to the placing of youths in restitution programs. The second

dimension, series slope, assesses whether the historical pattern of incarcerations has changed. This form of change would occur if, over time, the establishment of restitution programs caused a change in previously existing trends in incarceration proclivity by judges. Together, the cross-classification of these dimensions yields four possible patterns of impact:

1. no change in either level or trend,
2. change in series level but none in trend,
3. no change in level but a change in series trend, and
4. a change in both the level and trend of the series.

There is a third commonly used dimension for characterizing intervention impact: duration. It is often argued that program impact may well change the level and/or the trend of a series but that this change can be either temporary or permanent in nature. Though it is important to determine whether the effects of restitution programs upon incarceration persist or decay over time, the short postintervention horizon available (eleven months or less) makes such an assessment problematic. Therefore, the analysis strategy used here only considers changes in the dimensions of level and trend.

Data Collection and Response

IPA requested monthly incarceration and disposition data from 88 restitution sites covering the period from January 1977 through December 1979. It was anticipated at the time of the request that some sites would be unable to to gather the information. Unfortunately, potential problems

forseen and discussed in IPA's research proposal (such as "...woefully inadequate data systems within the juvenile courts. Whether sufficent data will be obtained to conduct the analysis is not yet known." (Schneider and Schneider, 1979:I-30,31)) proved considerably more widespread than anticipated.

Very few of the jurisdictions contacted were able to provide adequate system-wide data regarding monthly dispositions and incarcerations. Given the data requirements of this interrupted time series quasi-experiment, only five jurisdictions (5.7% of the total) responded with data of sufficent quality for statistical impact assessment. The response is very poor but seemingly unavoidable. Thirty-six (41%) of the sites contacted were unable to provide any information. Another twenty seven (31%) sites were able to provide some information but either because of data quality problems or reporting periods used (primarily yearly), the data was unusable for time series analysis. This left twenty five sites (28%) which were able to provide some monthly time series data. Upon inspection of these data, however, it became obvious that very few data sets could be analyzed. Some lacked information on both dispositions and incarcerations. Many sites were unable to separate out victimless crimes and homocide, and in some cases the numbers of either incarcerations or dispositions were so small as to produce "floor effects" in the series that would invalidate the statistical techniques used in this report.

This project was left, then, in the difficult position of having to work with only five time series. For this reason it cannot be asserted that the evaluations presented here constitutes a representative sample of

sites participating in the restitution initiative. These sites are obviously rather unique in at least their abilities to monitor and report system-wide data. Nonetheless, it is important to keep in mind that four of the five sites evaluated indicate a significant reduction in incarcerations associated with the establishment of restitution programs.

The following section introduces the general statistical intervention model used in this research and the modeling strategy followed during the specification of an appropriate intervention model.

III. THE ISDE INTERVENTION MODEL AND MODELING STRATEGY

The Fully Specified Statistical Intervention Model

One of the more popular contemporary classes of statistical models available for interrupted time series analysis is that stemming from the work of Box and Tiao (1965) and Box and Jenkins (1976) among others. The autoregressive-integrated-moving average (ARIMA) model is a very versatile perspective from which various stochastic, exogenous, and intervention components of a time series can be evaluated. Identification and estimation considerations, however, dictate this class of models to require series realizations longer than those available for this analysis (Glass et al., 1975; Velicer and Harrop, 1983). Consequently, the ARIMA methodology is not used here. Instead, impact is assessed by a variation of the stochastic difference equation intervention model as presented in Gottman (1981). Power analyses and Monte Carlo studies performed by Gottman (1981) and Wilson (1983) have shown the basic interrupted stochastic difference equation model (ISDE) to possess adequate statistical power and estimation accuracy under conditions similar to those confronted in this study (i.e., short, unbalanced series).

The ISDE statistical model used in this project draws upon the philosophy and concepts of time series decomposition used in business and economic forecasting applications for its foundation and interpretive framework. Decomposition methods assume a time series to have two major aspects: pattern and randomness (see Makridakis and Wheelwright, 1978). Depending upon the particular application and actual time series being

analyzed, pattern may be decomposed into components such as trend, cyclic behavior, and seasonality. In the present case pattern is considered to be the sum of three distinguishable components. These components are:

1. behavior due to the influence of exogenous factors,
2. behavior due to the stochastic (probabilistic) nature of the dependent series, and
3. behavior due to the intervention.[6]

The full ISDE model (including random perturbations) can be written as

$$Y_t = a_1 PRE + a_2 PST + b_3 PRETIME + b_4 PSTTIME + cDISPO + \Sigma\phi_i Y_{t-i} + e_t$$

where Y_t = incarceration series value at time t,

DISPO = value of disposition series at time t-i,

PRE = preintervention series constant,

PST = postintervention series constant,

PRETIME = suitably coded counter variable serving to detrend the preintervention series,

PSTTIME = suitably coded counter variable serving to detrend the postintervention series, and

e_t = a residual term NID$(0, \sigma^2)$.

Assuming n_1 preintervention observations, this model formulation can be divided into that portion which describes preintervention series behavior and that which patterns behavior after intervention.

$$Y_t \begin{cases} a_1 PRE + b_3 PRETIME + cDISPO + \Sigma\phi_i Y_{t-i} & t \leq n_1 \\ a_2 PST + b_4 PSTTIME + cDISPO + \Sigma\phi_i Y_{t-i} & t > n_1 \end{cases}$$

When written in matrix form the specifics of this partioning become clear. Setting the number of postintervention observations at n_2 and i = 1, the design matrix is

$$X = \begin{bmatrix} 1 & 0 & -(n_1 - .5) & 0 & DISPO(1) & Y(0) \\ 1 & 0 & -(n_1 - 1.5) & 0 & DISPO(2) & Y(1) \\ 1 & 0 & -(n_1 - 2.5) & 0 & DISPO(3) & Y(2) \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & 0 & -.5 & 0 & DISPO(n_1) & Y(n_1 - 1) \\ 0 & 1 & 0 & .5 & DISPO(n_1 + 1) & Y(n_1) \\ 0 & 1 & 0 & 1.5 & DISPO(n_1 + 2) & Y(n_1 + 1) \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 1 & 0 & n_2 - .5 & DISPO(n_1 + n_2) & Y(n_1 + n_2 - 1) \end{bmatrix}$$

Primary interest centers on the estimated response of the incarceration series to both qualitative dummy variables and variables encoded as counters representing time passage. This statistical model estimates the linear effect of the intervention in the two dimensions of level (a_1, a_2) and trend (b_3, b_4) through various codings of the intervention surrogate, time. Inclusion of the exogenous variable, dispositions, is made for much the same reason and with much the same logic as covariates are included in some analysis of covariance applications. Quite simply it is specified a priori that the number of incarcerations during any particular month are functionally related to dispositions. The disposition variable serves to adjust or control for variation in the dependent variable due to the influence of dispostions occuring within the

month (or previous months if evidence for a lagged relation is found). This inclusion is made to increase the precision of tests for intervention effects.[7]

Lagged endogenous variables model series stochastic behavior and thereby resolve potential estimation and inferential problems arising from serial dependence. In the presence of autocorrelated residuals, variance estimates and therefore the associated tests of statistical significance are biased. The use of appropriate lags of the dependent variable obviates this problem and allows the use of ordinary least squares (OLS) estimation procedures in time series applications (see Mann and Wold, 1943., Anderson, 1971, or Wilson, 1983 for elaboration on OLS appropriateness when lagged endogenous variables are used in this manner).

Quantified impact assessment in the dimensions being investigated requires formation of the sums $a_2 - a_1 = \delta_1$ and $b_4 - b_3 = \delta_2$. These quantities represent estimated changes in series level and trend, respectively, associated with (and inferred due to) the establishment of restitution projects. If $\delta_1 < 0$, then the project is considered to have had the immediate effect of lowering the number of youths incarcerated. Similiarly, if $\delta_2 < 0$, the trend in incarcerations is said to have lessened due to the establishment of the restitution project. Should no change have taken place in the level or trend of incarcerations, then $\delta_1 = \delta_2 = 0$ and if the effect of the installation of this new juvenile program was to increase incarceration level or trend, one or more of the deltas will be greater than zero.

Testing the significance of delta is accomplished by forming the

statistic (δ_1 is used for illustrative purposes)

$$t_{N-k} = \frac{\sqrt{N}\,\delta_1}{S_e\sqrt{a_{11} + a_{22} - 2a_{12}}}$$

where a_{11}, a_{22}, and a_{12} are appropriate elements of the $(X'X)^{-1}$ matrix and S_e is the regression standard error. The null hypothesis is $H_o = 0$. Given the short time series available and the exploratory nature of this evaluation, a significance level of .10 for a nondirectional, two-tailed test is used to evaluate the null hypothesis of no change in incarceration level or trend.

When lagged values of the dependent variable are excluded from final model specification, the behavioral interpretations of δ_1 and δ_2 are exactly those which would be given to a sum of (unstandardized) regression coefficents. As a_1 and a_2 represent intercept terms at the point of intervention, the value δ_1 is the estimated change in series level associated with the intervention. Since b_3 and b_4 are slope coefficents, δ_2 represents the cumulative incremental change per month in the number of youths incarcerated associated with the establishment of a restitution project. For example, if $\delta_1 = -12$ and $\delta_2 = -2.0$, it is inferred that the effect of the restitution project conforms with original OJJDP policy expectations. Coincidental with project start-up, an estimated twelve fewer youths were incarcerated and in each successive month the number of youths incarcerated is further cumulatively diminished by two (based upon preintervention expectations).

When lagged values of the incarceration series are included in final

model specification, interpretation of regression coefficents and associated delta values is not straightforward. This is because in neither the pre nor postintervention segments of the series do the observations lie on and about the plane described by $a_i + b_j$ + cDISPO. The influence of the stochastic component, $\Sigma\phi_i Y_{t-i}$, assures this. Instead, the series asymptotically approaches steady state levels. Representing the steady state solution as A + Bt + CDISPO, it can be shown that these steady states are functions of the ϕ's and b for the trend, the ϕ's and c for exogenous series contribution, and a_i, $\Sigma\phi_i$, B, and C for the level.[8] The functional forms which must be used for behavioral interpretation of the estimated coefficents are

[III.1] $$A = \frac{a - \Sigma\phi_i(i)B - \Sigma\phi_i(i)C}{1 - \Sigma\phi_i}$$

[III.2] $$B = \frac{b}{1 - \Sigma\phi_i}$$

[III.3] $$C = \frac{c}{1 - \Sigma\phi_i}$$

Considering [III.1] and [III.2], though the significance tests evaluate the hypotheses $a_1 = a_2$ and $b_3 = b_4$, the interpretation of differences must proceed using the quantities $A_2 - A_1$ and $B_4 - B_3$. This accomplished, the interpretation of these quantities is identical to that for δ_1 and δ_2.

Modeling Strategy

For each of the five sites evaluated in this report a similiar series of analysis steps is taken. First, the dependent series (incarcerations) is plotted and visually inspected with special attention given to overall trends, outliers, possible discontinuities in series behavior coincidental with restitution project start-up, and any other obvious series characteristics. Next, the autocorrelation and partial autocorrelation functions (ACF and PACF) for the series are estimated and diplayed in correlograms. Examination of these correlograms provide indications as to the nature of possible time dependence in the incarceration series. These steps are also taken during consideration of the disposition series though the results of this examination are not directly reported. The purpose served by examining disposition series at this point is only to determine the reasonableness of including this series in the intervention model's specification. In all cases sufficent similiarity was found between the two series to warrant inclusion of the disposition series during preliminary model specification.

Following this nonstructural inspection of series characteristics, procedures are followed which lead to intervention model specification, estimation, diagnosis, and interpretation. As stated above, it is believed a priori that the number of incarcerations occurring in any particular month are functionally related to dispositions. This conjecture must be substantiated and the form of the functional relation determined (should it exist). To establish the relation between the incarceration and

disposition series, the lagged cross correlations of these series are computed. Inspection of these asymmetrical correlations at different lags provides evidence regarding the existence of an association between incarcerations and dispositions as well as the lag structure relating them.

Following the determination of appropriate incarceration/disposition specification, all intervention model variables (except lagged values of the dependent series) are entered into a stepwise regression procedure. The procedure decided upon uses backward/forward elimination techniques for the evaluation and estimation of variable contributions. During the first iteration of this process a regression is formed using all specified variables. Successive iterations singly exclude variables from the equation if they do not meet the specified significance criterion (p .10). In addition, after the third iteration all variables previously excluded are reevaluated for suitability. If, in these subsequent steps, variables meet inclusion criterion they reenter the equation. This process continues until all variables in the ISDE model are significant at the p = .10 level or below.

Before the resulting model can be accepted for interpretation of intervention effect it must be evaluated for adequacy. This evaluation is accomplished through a diagnosis of model residuals. If the residuals prove random then the requirements for OLS estimation and significance testing have been met and the model is accepted and interpreted. Should the residuals contain systematic information, however, the estimated model is deemed unacceptable. Inadequate models are respecified to include a lagged value of the dependent series and reentered into the stepwise

regression procedure as before (with the exception that the lagged dependent series is retained in the equation regardless of statistical significance). In this way a new model is gained for the incarceration series. After the new model is obtained its residuals are again diagnosed. If model residuals are random, the model is accepted and the estimated coefficents interpreted. If residuals still are nonrandom, then the order of lag for the dependent series is stepped up by one, entered into model specification and the stepwise process begins once again. The results of this modeling strategy for the five sites are presented in Table III.1.

TABLE III.1 Estimated Intervention Models

MODEL VARIABLES	RELATIONSHIP BETWEEN MODEL VARIABLES AND INCARCERATION: Unstandardized b	Standard Error b	Beta Weight	Multiple R Squared
ADA COUNTY, ID				.88
Incarcerations lagged	0.294**	0.175	0.29	
PRE	13.511 (18.850)	3.411	0.77	
PRETIME	0.487 (0.690)	0.155	0.55	
PST	17.931 (26.745)	6.093	1.03	
PSTTIME	-2.284 (-3.235)	0.875	-0.71	
BELMONT/HARRISON COUNTIES, OH				.81
Incarcerations lagged	0.219	0.105	0.22	
DISPO	0.180	0.026	0.64	
PSTTIME	-0.188* (-0.241)	0.096	-0.28	
JEFFERSON COUNTY, KY				.91
DISPO	0.068	0.004	0.57	
PRETIME	0.136*	0.068	0.20	
WAYNE COUNTY, MI				.98
DISPO	0.229	0.013	0.72	
PRETIME	-0.362*	0.195	-0.26	
PSTTIME	2.170	0.663	0.43	
WASHINGTON, DC				.97
DISPO	0.207	0.010	0.75	
PRETIME	0.281	0.122	0.28	

Coefficents marked with a single asterisk (*) are statistically significant at the p = .07 level or less. The coefficent marked doubly with asterisks (**) is significant at the p = .101 level. All remaining coefficents are statistically significant at p = .05 or less. Figures in parentheses are steady state coefficent solutions. All delta values are statistically significant at $p \leq .10$.

IV. ADA COUNTY, ID

The Ada County restitution project began accepting referrals in April of 1979. During the nine month period from project start-up through December, 1979, a total of two hundred seventy-four youths were referred to the project. This volume of referrals makes Ada County's project the largest considered in this report. Not surprisingly, this site also had the highest monthly average referral rate during 1979 (30.4).

Figure IV.1 presents a plotting of incarcerations in Ada County from January, 1977 through December of 1979. Visual inspection of this plot reveals a seeming discontiuity possibly associated with the establishment of the restitution project. That portion of the series prior to April of 1979, though containing numerious up and down turns, can be generally said to have a rising trend line. Though this trend appears to continue for a few months following project start-up, the overall impression of the postintervention time series segment is that it falls rather abruptly after the begining of the restitution program. A preliminary assessment of incarceration series behavior, then, indicates a noticable change in incarceration trends (from postive to negative) coinciding with the establishment of the Ada County restitution project. This drop, however, did not occur immediately so initial impressions of discontinuity must be subjected to other more quantified means of assessment before they can be accepted.

Inspection of the autocorrelation and partial autocorrelation functions (Figure IV.2) clearly shows the nonstationarity of Ada County's incarceration series. The ACF's do not dampen exponentially (as

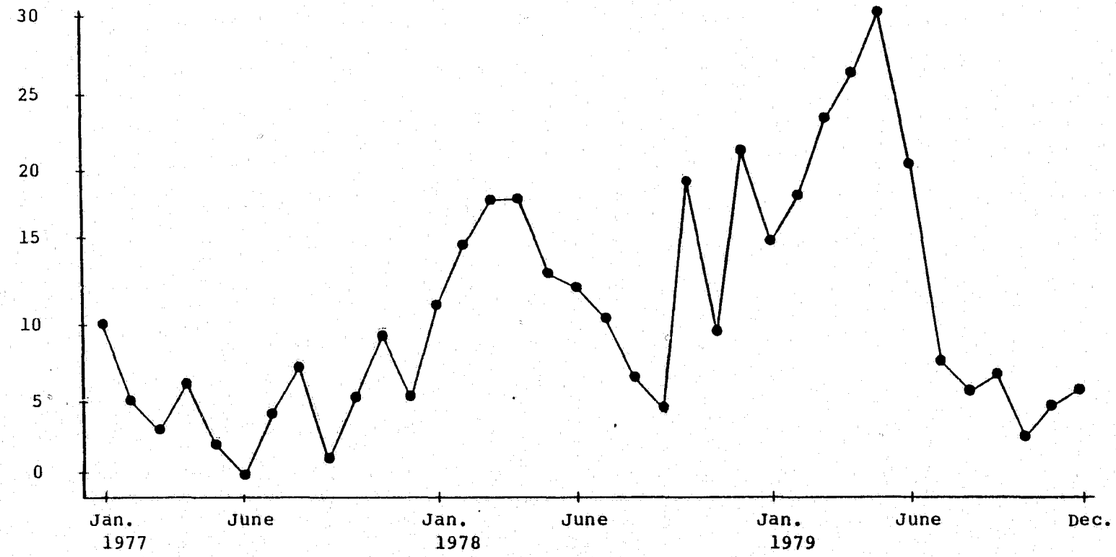

FIGURE IV.1 Ada County, ID: Incarcerations 1977 - 1979

realizations of autoregressive processes do) or cut off after a few lags (as would be expected if the generating process were some form of a moving-average) and the PACF contains a highly significant spike at lag one. Such a pattern indicates a series either trending or drifting in some deterministic fashion. As ISDE modeling does not require stationary time series, differencing or other transformations used to induce series stationarity are not necessary.

The plot and correlograms of the disposition series (not shown) display a general similiarity (upward trend) with those of the incarceration series. As is to be expected, though, the general level of the disposition series is higher than that of the incarceration series. The most obvious dissimiliarity between the two series, however, is the fact that the disposition series does not display a marked drop on or about the time of restitution project start-up. Instead, the overall trend of this series is more accurately described as flattening in the latter months of 1979 (though considerable fluctuation in series values makes this only a general impression).

Unlike the results obtained in all other sites evaluated, examination of Ada county's lagged cross correlations does not provide a clear indication as to the existence or form of relation between the incarceration and disposition series. Figure IV.3 presents the cross correlations for the raw series. The pattern of nondampening and significant correlations indicates that one or both of the series considered is nonstationary and therefore not appropriate for specification purposes. Because of nonstationarity some or all of the correlations in

FIGURE IV.2 Autocorrelation and Partial Autocorrelation Functions for Ada County Incarceration Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.714	I XXXXXXX+XXXXXXXXXX
2	0.545	I XXXXXXXXXX+XX
3	0.318	I XXXXXXXX +
4	0.113	I XXX +
5	-0.039	XI +
6	-0.137	XXXI +
7	-0.174	XXXXI +
8	-0.175	XXXXI +
9	-0.159	XXXXI +
10	-0.098	XXI +
11	0.041	I X +
12	-0.036	I X

Ljung-Box Q (@ lag 9) = 42

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.714	I XXXXXXX+XXXXXXXXXX
2	0.073	I XX +
3	-0.194	XXXXXI +
4	-0.155	XXXXI +
5	-0.056	XI +
6	-0.020	XI +
7	0.011	I +
8	-0.005	I +
9	-0.030	XI +
10	0.047	I X +
11	0.205	I XXXXX +
12	-0.174	XXXXI +

Figure IV.3 are spurious and therefore both series must be prewhitened prior to the determination of the disposition series lag structure appropriate for intervention modeling (see Makridakis and Wheelwright, 1978:382-384).

Figure IV.4 shows the cross correlations obtained when both series are prewhitened through linear detrending. The highest correlations in this figure occur at -3 and -2 lags (.389 and .368 respectively) which implies that the disposition series is a leading indicator for the incarceration series. This conclusion might be unwarranted, however, because of the discontinuity observed in the dependent series. In cases where the intervention effect accounts for a large measure of series variance, only one portion of the series (pre or postintervention) should be used for determining stochastic structure or the relationship between the input and output series (McCleary and Hay, 1980). Since the preintervention portion of the series is the longest of the two, only the first twenty-seven observations were used for evaluating the existence and form of relationship between incarcerations and dispostions.

Figure IV.5 reproduces the lagged cross correlations for these prewnitened series segments. Interestingly, none of the estimated correlations are significant when only preintervention series observations are used. It may very well be the case that the discontinuity identified in the incarceration series introduced spurious variation and so correlations. While Figures IV.3 and IV.4 indicated that dispostions were a leading incarceration indicator, no such

FIGURE IV.3 Lagged Cross Correlations for Ada County Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+
-10	-0.035	XI
-9	0.017	I
-8	0.098	IXX
-7	-0.027	XI
-6	0.027	IX
-5	0.137	IXXX
-4	0.262	IXXXXXXX
-3	0.389	IXXXXXXXX+X
-2	0.368	IXXXXXXX+X
-1	0.149	IXXXX
0	0.305	IXXXXXXXX
1	0.333	IXXXXXXXX
2	0.132	IXXX
3	0.172	IXXXX
4	-0.047	XI
5	-0.006	I
6	0.080	IXX
7	0.160	IXXXX
8	0.136	IXXX
9	0.116	IXXX
10	0.032	IX

FIGURE IV.4 Lagged Cross Correlations for Ada County Prewhitened Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
-10	-0.065	+ XXI +
-9	-0.021	+ XI +
-8	0.065	+ IXX +
-7	-0.080	+ XXI +
-6	-0.041	+ XI +
-5	0.065	+ IXX +
-4	0.204	+ IXXXXX +
-3	0.360	+ IXXXXXXXXX
-2	0.321	+ IXXXXXXXX
-1	0.073	+ IXX +
0	0.222	+ IXXXXXX +
1	0.236	+ IXXXXXX +
2	-0.007	+ I +
3	0.015	+ I +
4	-0.227	+ XXXXXXI +
5	-0.212	+ XXXXXI +
6	-0.112	+ XXXI +
7	-0.004	+ I +
8	0.005	+ I +
9	0.043	+ IX +
10	0.019	+ I +

FIGURE IV.5 Lagged Cross Correlations for Ada County Prewhitened Incarceration and Disposition Series: First Twenty-Seven Observations Only

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
-8	0.071	+ IXX +
-7	-0.120	+ XXXI +
-6	-0.110	+ XXXI +
-5	-0.285	+ XXXXXXXI +
-4	-0.377	+ XXXXXXXXI +
-3	-0.039	+ XI +
-2	0.205	+ IXXXXX +
-1	-0.191	+ XXXXXI +
0	0.265	+ IXXXXXXX +
1	0.341	+ IXXXXXXXX +
2	0.041	+ IX +
3	0.250	+ IXXXXXX +
4	-0.010	+ I +
5	-0.141	+ XXXXI +
6	-0.013	+ I +
7	-0.109	+ XXXI +
8	-0.176	+ XXXXI +

conclusion is drawn from Figure IV.5. In fact, there is no strong evidence suggesting any statistically significant association between the two series. Unlike the information gained by lagged cross correlations in all other sites, the Ada County data contain no clear indication of a relation between incarcerations and dispositions. In the absence of a clear choice for modeling specification, it was decided to attempt three different lag structure relations (no lag, two lags, and three lags) between the disposition and incarceration series. The determination of proper specification was made dependent upon the information gained in the separate modelings.

Having inspected the series of interest and made observations regarding its univariate behavior and possible forms of association with dispositions, the resolution of model specification began. For each lag structure model, all variables (except lagged values of the incarceration series) were entered into a stepwise regression. The stepwise procedure used a backward/forward elimination technique through which variables were successively excluded from the model if they did not meet significance criterion ($p \leq .10$). In addition, at each step of the modeling process variables previously excluded were evaluated for inclusion. If in these subsequent steps they met inclusion criterion, they reentered the model. This process continued until only those variables significant at the $p \leq .10$ level remained.

The results of these three regressions clearly pointed to a contemporaneous specification for the relation between incarcerations and dispositions. Neither of the lagged specifications ever approached

statistical significance. Therefore, only the stepwise regression using nonlagged values for the disposition series was subjected to residual analysis.

This modeling strategy yielded a regression equation having five independent variables (DISPO, PRE, PRETIME, PST, and PSTTIME). Examination of this model's residuals, however, revealed significant nonrandom behavior (Box-Ljung Q = 15) so it is deemed unacceptable. Because of the presence of information contained in model residuals, a singly lagged value of the incarceration series was entered (and not allowed to be dropped regardless of significance level) into the initial equation and the modeling process started again. Interestingly, when lagged values of the incarceration series were forced into the equation, the influence of dispositions became statistically insignificant.

This second modeling stage produced a model (Model #1) which, while acceptable in some respects, is not entirely without problems. The autocorrelations and partial autocorrelations of the residuals for Model #1 are reproduced in Figure IV.6. These correlograms obviously contain some pattern and three PACF's are estimated to be statistically significant. Starting at lag four the pattern of negative values is clearly set and only broken at lag eleven. It is possible that some trend or seasonality (though the estimated spectral density function indicates neither) remains in these residuals. Contrasting with visual impressions, the Ljung-Box Q of 9.1 suggests that the residual series is random. Since the evidence on the residuals is mixed it is decided to step up the order of lagging for the endogenous series by one and

reestimate an intervention model using first and second lags in the model specification.

The third stage in the modeling of the Ada County incarceration series reinitiated the stepwise regression procedure with two lagged terms. This stage resulted in a model containing the same intervention variables as those retained in Model #1 and having coefficent estimates quite similiar in magnitude. The obtained Model #2 residuals were then evaluated. Figure IV.7 displays the ACF and PACF's for these residuals. Whereas Model #1 correlograms had three significant values, Model #2 estimates contained only one statistically significant partial autocorrelation. The Ljung-Box Q was reduced as well, but not by a particularly large amount (especially given the loss of a further degree of freedom). What is most noticeable, however, is the persistence of pattern in lagged ACF and PACF values. Though diminished somewhat in magnitude, the similiarity in residual behavior for Models #1 and #2 is striking. This fact led to further modelings using three then four lagged terms. The pattern showed gradual signs of disolving but the loss in degrees of freedom swiftly became unacceptable (four intervention terms and four lagged terms) given the general stability of intervention results. It was decided to accept the most parsimonious model which yielded marginal residual acceptability (Model #1). This is not an entirely satisfying decision but a defensable one, nonetheless. Overfitting the stochastic component did not result in significant improvement in residual behavior. Most likely it would take a realization much longer than that provided for this research to

FIGURE IV.6 Residual Autocorrelation and Partial Autocorrelation Functions for Ada County Fitted Intervention Model #1

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.030	+ IX +
2	0.112	+ IXXX +
3	-0.069	+ XXI +
4	-0.296	+XXXXXXXI +
5	-0.244	+ XXXXXXI +
6	-0.179	+ XXXXI +
7	-0.085	+ XXI +
8	-0.065	+ XXI +
9	-0.063	+ XXI +
10	-0.079	+ XXI +
11	0.330	+ IXXXXXXXX +
12	0.143	+ IXXXX +

Ljung-Box Q (@ lag 9) = 9.1

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.030	+ IX +
2	0.111	+ IXXX +
3	-0.076	+ XXI +
4	-0.310	XXXXXXXXI +
5	-0.241	+ XXXXXXI +
6	-0.139	+ XXXI +
7	-0.095	+ XXI +
8	-0.198	+ XXXXXI +
9	-0.305	XXXXXXXXI +
10	-0.409	XXXXXXXXXXI +
11	0.101	+ IXXX +
12	0.025	+ IX +

FIGURE IV.7 Residual Autocorrelation and Partial Autocorrelation Functions for Ada County Fitted Intervention Model #2

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.067	IXX
2	0.110	IXXX
3	-0.092	XXI
4	-0.269	XXXXXXXI
5	-0.210	XXXXXI
6	-0.188	XXXXXI
7	-0.103	XXXI
8	-0.110	XXXI
9	-0.072	XXI
10	-0.077	XXI
11	0.286	IXXXXXXX
12	0.171	IXXXX

Ljung-Box Q (@ lag 9) = 8.6

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.067	IXX
2	0.106	IXXX
3	-0.107	XXXI
4	-0.275	XXXXXXXI
5	-0.176	XXXXI
6	-0.137	XXXI
7	-0.121	XXXI
8	-0.218	XXXXXI
9	-0.251	XXXXXXI
10	-0.317	XXXXXXXXI
11	0.089	IXX
12	-0.006	I

adequately model all series components.

Table III.1 presented the estimated intervention effects for Ada County's Model #1. This model contains four significant intervention parameter estimates (PRE, PRETIME, PST, and PSTTIME). Comparing the obtained coefficents, it is quite clear that restitution program start-up is associated with a very sharp change in incarceration trends. Prior to the beginning of the Federally funded restitution program incarcerations were linearly increasing. After the program started this trend reversed itself and incarcerations began decreasing. Interestingly, the impact of the program upon incarcerations appears to have lagged a few months behind program beginning as the level coefficent for the postintervention segment of the series is higher than that estimated for the preintervention series. As discussed in footnote eight, the behavioral interpretation of intervention coefficents does not proceed straightforwardly when lagged values of the dependent series are included in the model. Instead, the asymptotic or steady state levels for the coefficents must be determined before interpretation and formation of the delta values.

The intervention effect in Ada County was very clear. There was an increase by approximately eight youths ($\delta_1 = 7.895$) in the number incarcerated associated with project start-up. This immediate increase in series level, however, was nullified within two months by the dramatic change in incarceration trend coinciding with project operation ($\delta_2 = -3.925$). Both change coefficents, incidentally, were statistically significant at the p = .05 level or less. While it is true that the change in level and trend were not realized instantly, the rather small coefficent

estimated for the lagged incarceration series assures that more than 85% of the asymptotic impact is felt before two months passed (see McCleary and Hay, 1980:154-160 and Gottman, 1981:351-353).

Disregarding the small error introduced by considering the steady state intervention effect to have fully occured in April of 1979, extrapolation of the estimated cumulative impact for the year following project start-up leads to the expectation that approximately two hundred ninty-eight fewer youths will be incarcerated in Ada County. The plotting of actual versus predicted series values (Figure IV.8) illustrates this circumstance. This figure also makes it clear that such extrapolation cannot be carried on too long and have validity as within a fairly short time period negative predictions would be encountered. There is an obvious floor that enters into the estimation of effect. These comments notwithstanding, the Ada County program proved an effective alternative to incarceration.

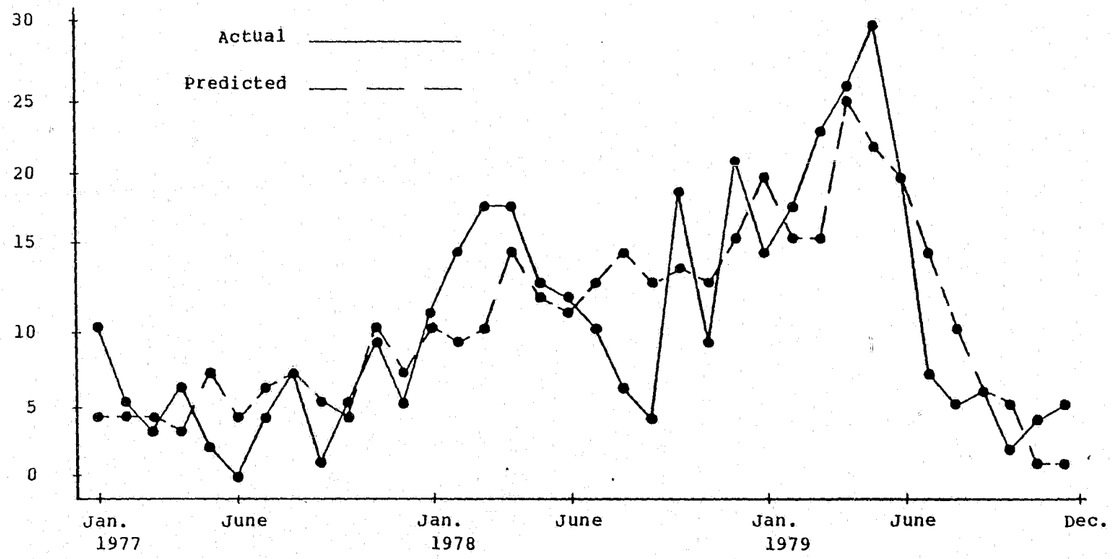

FIGURE IV.7 Ada County, ID: 1977 - 1979 Overlay Plot of Predicted Versus Actual Incarcerations

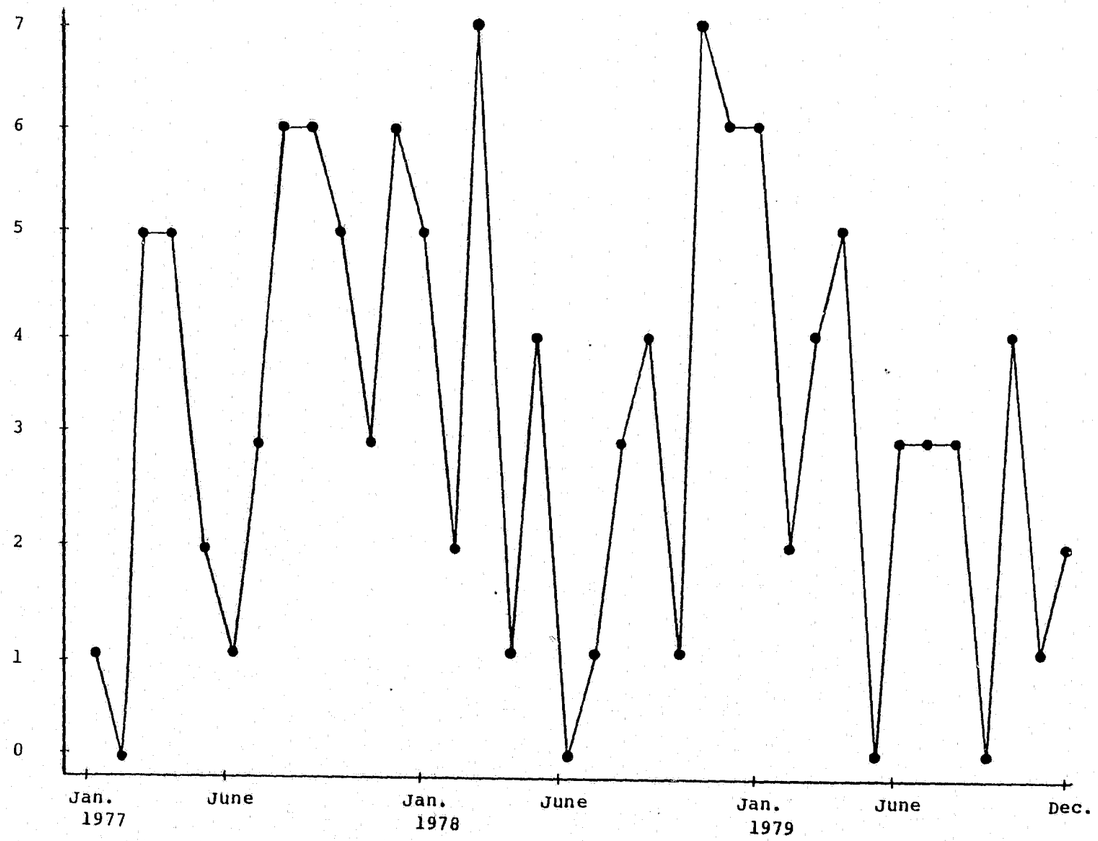

FIGURE V.1 Belmont/Harrison Counties, OH: Incarcerations 1977 - 1979

and partial autocorrelations. This pattern is too indistinct, though, for identification.

The plot of the disposition series and the pattern of its correlograms (not shown) appear rather similiar to those for the incarceration series though its mean level (15.5 dispositions per month) is higher. This time series seems to fluctuate randomly about its average value and the correlograms display no significant spikes or recognizable pattern of behavior.

Moving to an inspection of the lagged cross correlations between the incarceration (dependent) and disposition (independent) series, Figure V.3 convincingly demonstrates the relation between incarcerations and dispositions to be strong and contemporaneous. Only at lag zero is there a significant correlation (r = .513) between the two series. Since neither series is trending or drifting to any noticable degree, no transformation of the series is required in order to obtain intelligible cross correlations as was the case for Ada County, ID. Though there are additional lags which approach statistical significance in value, the overall impression is that modeling should proceed with a synchronic specification between the disposition and incarceration series.

Having inspected the incarceration series and made preliminary observations regarding univariate series behavior and its relation with the disposition series, the identification stage of model specification can proceed. In the first iteration all model variables (PRE, PST, PRETIME, PSTTIME, and DISPO) except lagged values of the incarceration series were included in a stepwise regression. This modeling strategy used a

FIGURE V.2 Autocorrelation and Partial Autocorrelation Functions for Belmont/Harrison Incarceration Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.055	+ IX +
2	0.053	+ IX +
3	0.020	+ IX +
4	0.129	+ IXXX +
5	-0.094	+ XXI +
6	-0.190	+ XXXXXI +
7	-0.190	+ XXXXXI +
8	-0.117	+ XXXI +
9	-0.165	+ XXXXI +
10	-0.154	+ XXXXI +
11	0.046	+ IX +
12	0.012	+ I +

Ljung-Box Q (@ lag 9) = 6.7

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.055	+ IX +
2	0.050	+ IX +
3	0.015	+ I +
4	0.125	+ IXXX +
5	-0.111	+ XXXI +
6	-0.197	+ XXXXXI +
7	-0.177	+ XXXXI +
8	-0.109	+ XXXI +
9	-0.123	+ XXXI +
10	-0.108	+ XXXI +
11	0.083	+ IXX +
12	-0.010	+ I +

FIGURE V.3 Lagged Cross Correlations for Belmont/Harrison Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+
-10	-0.116	+ XXXI +
-9	-0.078	+ XXI +
-8	-0.106	+ XXXI +
-7	-0.023	+ XI +
-6	-0.046	+ XI +
-5	-0.037	+ XI +
-4	0.023	+ IX +
-3	0.064	+ IXX +
-2	-0.212	+ XXXXXI +
-1	-0.233	+ XXXXXXI +
0	0.513	+ IXXXXXXX+XXXXX
1	-0.283	+XXXXXXXI +
2	0.135	+ IXXX +
3	0.083	+ IXX +
4	0.283	+ IXXXXXXXX+
5	0.068	+ IXX +
6	-0.118	+ XXXI +
7	-0.149	+ XXXXI +
8	0.083	+ IXX +
9	0.008	+ I +
10	-0.022	+ XI +

backward/forward elimination method whereby variables were sequentially excluded from the regression if they failed to meet a significance criterion of $p \leq .10$ or less. In addition, at each step of the modeling process variables previously excluded from the regression were reevaluated for inclusion. If, in these subsequent steps, variables met criterion for use, they reentered the model. This process continued until only those variables significant at the $r \leq .10$ level were included in the intervention model. This procedure yielded a model containing the independent variables DISPO, PRE, and PSTTIME.

Inspection of residuals for this model, however, revealed significant autocorrelation and the intervention model was diagnosed as inadequate. A backward/forward regression was initiated again only now a single lagged value of the dependent series (incarcerations) was included among the variables considered (this variable was forced in the equation and not allowed to be excluded regardless of statistical significance).

This second stepwise regression yielded acceptable results. The autocorrelations and partial autocorrelations of the residuals from the respecified model are reproduced in Figure V.4. These correlograms have no significant spikes and the Ljung-Box Q statistic indicate the residuals to be random. There remain in each, however, indications of patterned behavior similiar to those observed in the raw series correlograms. As was the case with the raw incarceration series autocorrelations and partial autocorrelations, though, the pattern is statistically nonsignificant and cannot be used as conclusive evidence for rejecting the fitted model or as a rationale for including further stochastic terms. As noted in the

FIGURE V.4 Residual Autocorrelation and Partial Autocorrelation Functions for Fitted Belmont/Harrison Intervention Model

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.196	IXXXXX
2	-0.030	XI
3	-0.232	XXXXXXI
4	-0.137	XXXI
5	-0.222	XXXXXXI
6	-0.104	XXXI
7	-0.157	XXXXI
8	-0.038	XI
9	-0.023	XI
10	-0.036	XI
11	0.263	IXXXXXXX
12	0.262	IXXXXXXX

Ljung-Box Q (@ lag 9) = 8.3

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.196	IXXXXX
2	-0.071	XXI
3	-0.223	XXXXXXI
4	-0.054	XI
5	-0.220	XXXXXI
6	-0.097	XXI
7	-0.214	XXXXXI
8	-0.129	XXXI
9	-0.149	XXXXI
10	-0.250	XXXXXXI
11	0.172	IXXXX
12	0.042	IX

analysis of residuals for the Ada County model, most likely the particular realization investigated here is too short for unambiguous stochastic identification. Overfitting the stochastic component improved nothing.

Table III.1 presented the results of intervention modeling for the Belmont/Harrison incarceration series. There is only one significant intervention parameter estimate, PSTTIME. The indication, then, is that the effect of the restitution program upon incarcerations in this case only took place in the area of postintervention trend. Further, because PSTTIME's value is negative, the estimated effect was to turn the trend downward. As discussed in footnote eight, the behavioral interpretation of intervention coefficents does not proceed straightforwardly when lagged values of the dependent series are included in model specification. Rather, the asymptotic value for intervention effect must be determined prior to interpretation. In this case the steady state value for the postintervention trend is -0.241 (significant at $p \leq .10$). Since the preintervention trend is zero, the delta parameter for intervention effect is -0.241. Though the change in trend due to the intervention does not immediately become felt in the postintervention series, the rather small coefficent associated with the lagged value of the dependent series assures that more than 90% of the asymptotic impact is realized with two months (see McCleary and Hay, 1980:154-160 and Gottman, 1981:351-353).

Disregarding the rather small error introduced by considering the steady state effect of intervention to have occurred during February, 1979, extrapolation of the statistical estimate leads to a conclusion that the expected cumulative impact for the year following project start-up is the

incarceration of approximately nineteen fewer youths than would be expected based upon trends observed prior to the establishment of the Federally funded restitution program. Given the quite low numbers of youths ordinarily incarcerated in any particular month, the estimated cumulative reduction by nineteen youths is very substantial. The Belmont/Harrison Restitution Project, then, met OJJDP's policy expectations.

The plotting of actual versus predicted incarcerations (Figure V.5) demonstrates that the fitted model conforms well to the empirical series. This figure also highlights the predicted downswing in incarcerations associated with the beginning of the restitution project (even though the plot is presented in two-, rather than the more appropriate, three-space). It is also fairly clear that extrapolations such as that reported in the previous paragraph cannot be carried too far beyond the end of 1979 as very quickly negative values will be encountered. There is an obvious floor that enters into this evaluation of program impact as the change in trend detected can be sustained for only about a one year period before bottoming out. These comments notwithstanding, the Belmont/Harrison program has provided evidence that restitution in this site proved an effective alternative to incarceration.

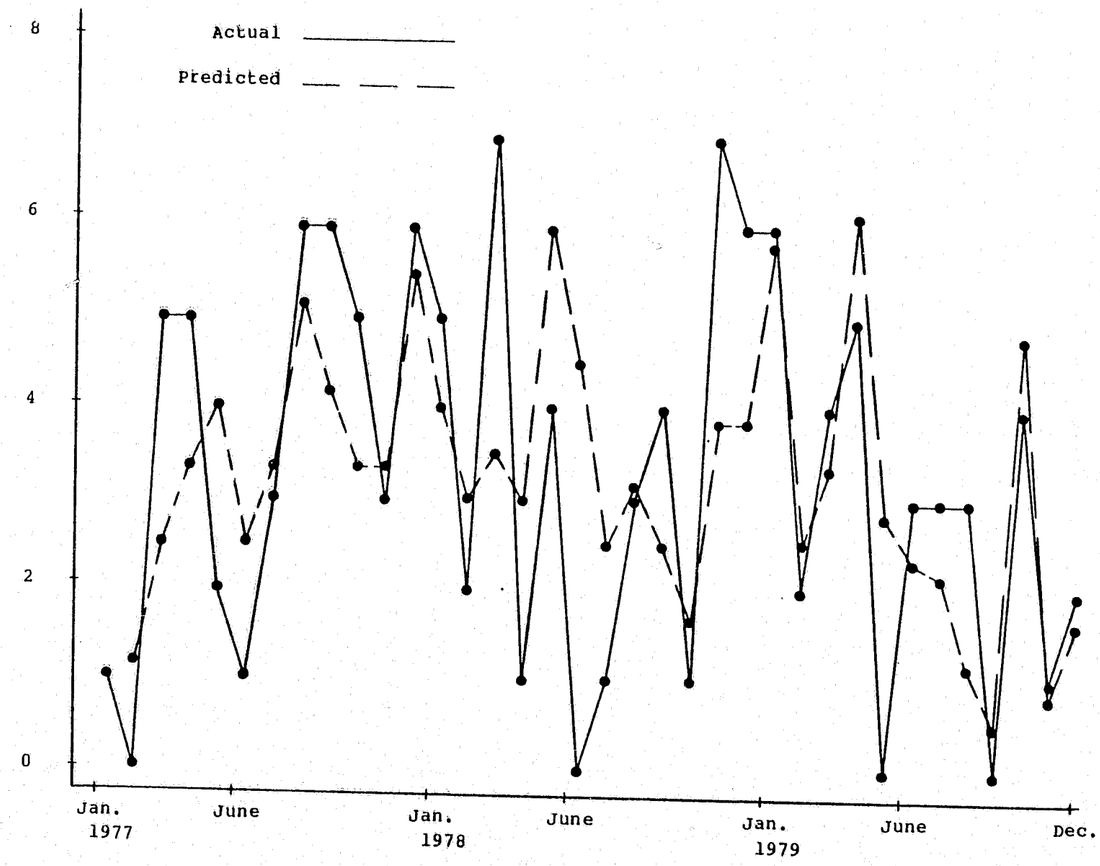

FIGURE V.5 Belmont/Harrison Counties, OH: 1977 - 1979 Overlay Plot of Predicted Versus Actual Incarcerations

VI. JEFFERSON COUNTY, KENTUCKY

The Jefferson County restitution project began accepting referrals in March of 1979. During the ten month period from project start-up through December, 1979, a total of one hundred-forteen youths entered this restitution project. Among the projects considered in this report these one hundred-forteen referrals result in both an absolute number of referrals and an average number of monthly referrals (11.4) slightly lower than the average observed across the five sites (151.6 and 16.8 respectively).

Figure VI.1 presents a plotting of incarcerations in Jefferson County from January, 1977 through December of 1979. A visual inspection of this plot reveals an increasing trend in incarcerations over the period considered. Indeed, a simple linear regression using time as the independent variable yields a statistically significant positive slope value (b = .365). Considering such a generally rising incarceration trend and the point of intervention, it is difficult to visually conclude whether any evidence exists for an intervention effect. Fluctuations in series values prior to the intervention point appear similiar to those afterward. At this subjective level of evaluation it would be difficult to convincingly argue for a fundamental discontinuity between the pre and postintervention segments of the Jefferson County incarceration time series.

Inspection of the autocorrelation and partial autocorrelation functions (Figure VI.2) confirms the impression of a trending series. The ACF's do not die out exponentially or cut off after a few lags and the

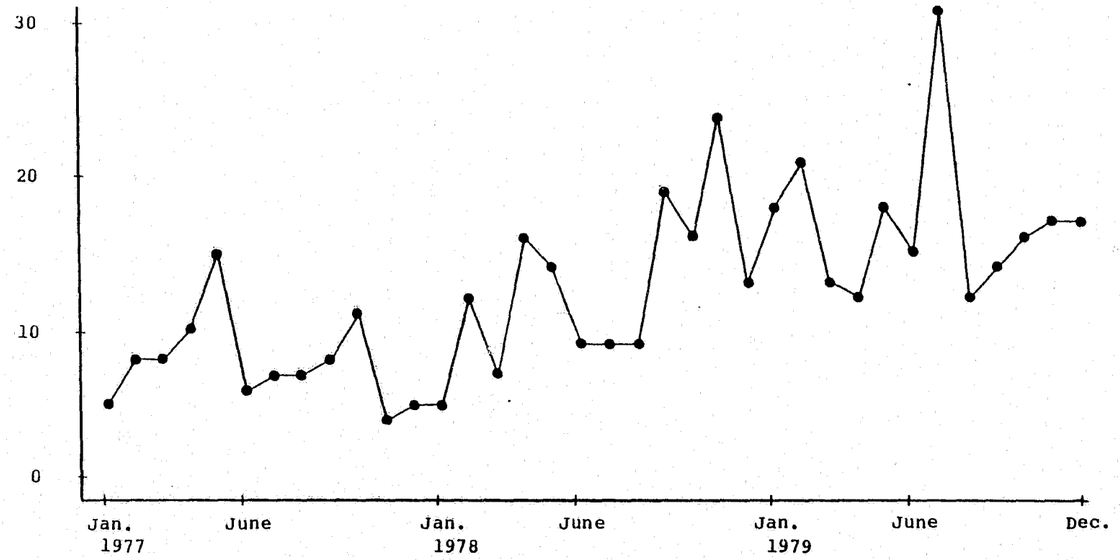

FIGURE VI.1 Jefferson County, KY: Incarcerations 1977 - 1979

PACF's contain numerious significant spikes. These patterns indicate a nonstationary times series so the previous evidence from visual inspection and simple regression is substantiated. Unlike steps required for ARIMA modeling, ISDE modeling does not need a series made stationary prior to coefficent estimation so differencing or other series transformations are unnecessary.

The plot and correlograms of the disposition series (not shown) display a general similiarity (upward trend) with those of the incarceration series. As is to be expected, though, the general level of the disposition series is higher than that of the incarceration series. Both series show a general upward trend over time and no obvious discontinuity is associated with the establishment of the Federally funded restitution project.

Moving to a consideration of the lagged cross correlations between disposition and incarceration series, Figure VI.3 does not provide useful information. While the highest correlation (r = .741) appears at zero lag, there are numerious other significant correlations at both positive (lagging) and negative (leading) lags. This is a pattern of correlations expected when one or more of the series is nonstationary. Because of nonstationarity some or all of the correlations in Figure VI.3 are presumed spurious and therefore both series must be prewhitened prior to the determination of the disposition series lag structure appropriate for intervention modeling (see Makridakis and Wheelwright, 1978:382-384). The prewhitened lagged cross correlations are shown in Figure VI.4 (prewnitening was accomplished through the application of least squares

FIGURE VI.2 Autocorrelation and Partial Autocorrelation Functions for Jefferson County Incarceration Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.386	IXXXXXXX+XX
2	0.413	IXXXXXXXX+X
3	0.276	IXXXXXXX +
4	0.305	IXXXXXXXX +
5	0.461	IXXXXXXXXX+X
6	0.297	IXXXXXX +
7	0.223	IXXXXX +
8	0.252	IXXXXX +
9	0.183	IXXXX +
10	0.110	IXX +
11	-0.035	XI +
12	-0.028	XI +

Ljung-Box Q (@ lag 9) = 40.0

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.386	IXXXXXXX+XX
2	0.310	IXXXXXXXX
3	0.060	IX +
4	0.120	IXXX +
5	0.341	IXXXXXXX+X
6	-0.002	I +
7	-0.126	XXXI +
8	0.111	IXXX +
9	-0.021	XI +
10	-0.252	XXXXXXI +
11	-0.243	XXXXXXI +
12	-0.014	I +

FIGURE VI.3 Lagged Cross Correlations for Jefferson County Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+
-10	0.136	+ IXXX +
-9	0.301	+ IXXXXXXXX+
-8	0.307	+ IXXXXXXXX+
-7	0.302	+ IXXXXXXXX+
-6	0.453	+ IXXXXXXXX+XX
-5	0.537	+ IXXXXXXXX+XXXX
-4	0.504	+ IXXXXXXXX+XXXX
-3	0.366	+ IXXXXXXXXX
-2	0.517	+ IXXXXXXX+XXXXX
-1	0.442	+ IXXXXXXX+XXX
0	0.741	+ IXXXXXXX+XXXXXXXXXX
1	0.423	+ IXXXXXXX+XXX
2	0.390	+ IXXXXXXX+XX
3	0.428	+ IXXXXXXXX+XX
4	0.404	+ IXXXXXXXX+X
5	0.308	+ IXXXXXXXX+
6	0.251	+ IXXXXXX +
7	0.131	+ IXXX +
8	0.171	+ IXXXX +
9	0.089	+ IXX +
10	0.025	+ IX +

FIGURE VI.4 Lagged Cross Correlations for Jefferson County Prewhitened Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0. .2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+---- ----+----+----+----+----+----+----+
-10	-0.215	+ XXXXXI +
-9	0.043	+ IX +
-8	0.024	+ IX +
-7	-0.122	+ XXXI +
-6	0.076	+ IXX +
-5	0.097	+ IXX +
-4	0.119	+ IXXX +
-3	-0.194	+ XXXXXI +
-2	0.045	+ IX +
-1	-0.122	+ XXXI +
0	0.498	+ IXXXXXXX+XXXX
1	-0.021	+ XI +
2	0.014	+ I +
3	0.124	+ IXXX +
4	0.134	+ IXXX +
5	-0.090	+ XXI +
6	0.079	+ IXX +
7	-0.101	+ XXXI +
8	0.049	+ IX +
9	-0.109	+ XXXI +
10	-0.243	+ XXXXXXI +

detrending on the input - disposition - series and applying this transformation to the output - incarceration - series). This figure clearly reveals the only significant relation between dispositions and incarcerations to occur at zero lag (r = .498). Therefore, initial model specification will only include non-lagged values of the disposition series.

Having inspected the series of interest and made observations regarding its univariate behavior and interrelation with dispositions, the identification stage of model specification proceeds. During the first stage all model variables except lagged values of the incarceration series were entered into a stepwise regression. The stepwise procedure used a backward/forward elimination technique in which variables were successively excluded from the model if they did not meet significance criterion ($p \leq .10$). In addition, at each step of the modeling process previous variables excluded from the model were again evaluated for inclusion. If during these subsequent steps they met inclusion criterion, they reentered the model. This process continued until only those variables significant at the $p \leq .10$ level were in the ISDE model.

For Jefferson County this modeling strategy yielded a regression equation having only two independent variables, the disposition series (DISPO) and a preintervention slope coefficent (PRETIME). Before moving to an interpretation of coefficents for this model, residuals for the estimated equation were subjected to tests for randomness. Figure VI.5 presents correlograms for the model. There are no significant spikes in either correlogram and the ACF Ljung-Box Q statistic suggests the residual series is white noise. For these reasons the two variable model is

FIGURE VI.5 Residual Autocorrelation and Partial Autocorrelation Functions for Jefferson County Fitted Intervention Model

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.126	IXXX
2	0.045	IX
3	-0.114	XXXI
4	-0.242	XXXXXXI
5	0.071	IXX
6	-0.154	XXXXI
7	0.012	I
8	0.084	IXX
9	-0.006	I
10	0.065	IXX
11	-0.117	XXXI
12	-0.078	XXI

Ljung-Box Q (@ lag 9) = 5.4

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.126	IXXX
2	0.029	IX
3	-0.125	XXXI
4	-0.221	XXXXXXI
5	0.145	IXXXX
6	-0.185	XXXXXI
7	-0.006	I
8	0.080	IXX
9	-0.016	I
10	-0.033	XI
11	-0.071	XXI
12	-0.055	XI

accepted as adequate and no lagged values of the incarceration series are used for the purpose of resolving potential OLS time series estimation problems.

Table III.1 presented the accepted intervention model. Note that only one intervention parameter is estimated as significant (PRETIME). This indicates that, prior to establishment of the Jefferson County Restitution Project, the trend in incarcerations (adjusted for the influence of the number of dispositions in any particular month) was increasing at the rate of .136 incarcerations per month. After the establishment of the restitution program, this positive trend ceased.

Since PSTTIME is estimated equal to zero, the delta parameter for intervention effect is -0.136. This is interpreted to mean that the estimated impact of intervention is to gradually lower the total number of youths incarcerated in Jefferson County. Extrapolating estimates for a year following project start-up, it is expected that in this year approximately eleven fewer youths will be incarcerated. Considering the number of youths processed and incarcerated over the 1977 - 1979 period, this decrease is consequential. Evidence suggests, then, that the impact of the Jefferson County Restitution Project conformed to OJJDP policy expectations by providing an alternative to incarceration.

A plotting of predicted versus actual incarceration series values (Figure VI.6) highlights this "flattening" of the incarceration trend. Though displayed in a two- rather than the more appropriate three-space, the moderation of trend is fairly obvious. A consistent increase prior to March of 1979 stops and fluctuations in series values after this point seem to oscillate about a mean value of about forteen incarcerations per month.

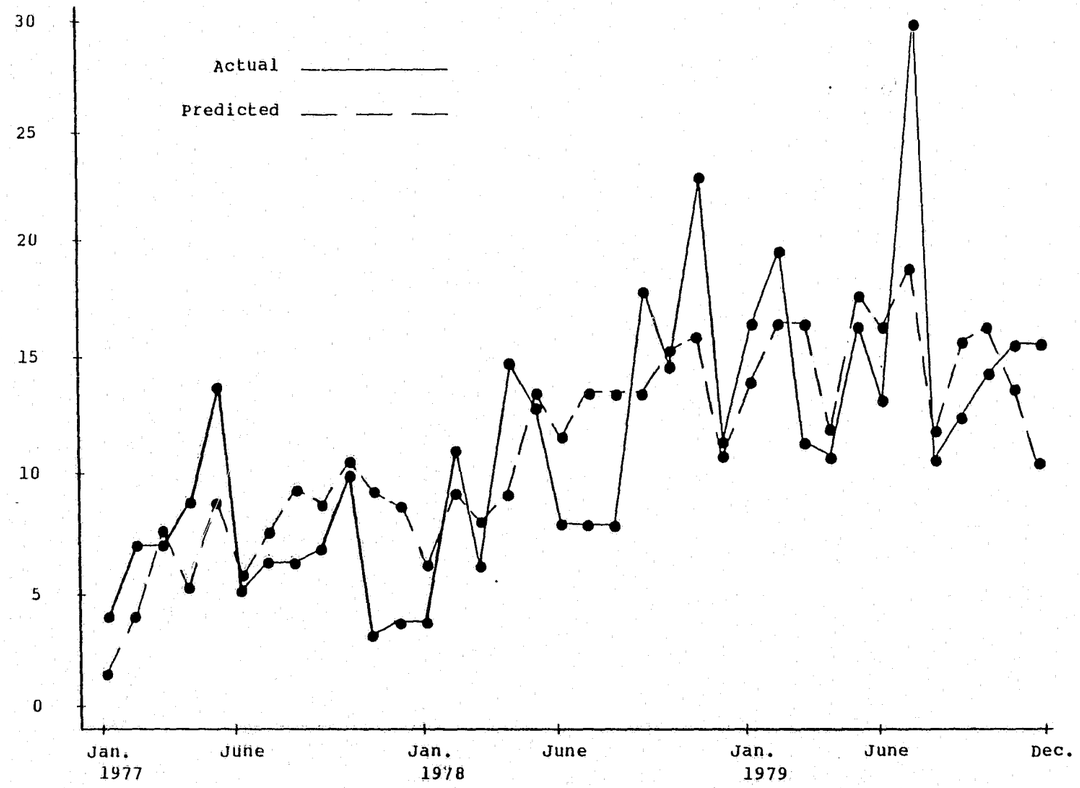

FIGURE VI.6 Jefferson County, KY: 1977 - 1979 Overlay
Plot of Predicted Versus Actual Incarcerations

VII. WAYNE COUNTY, MICHIGAN

The Wayne County restitution project began accepting referrals in April of 1979. During nine months of operation from project start-up through December, 1979, a total of two hundred seventeen youths were referred to this restitution project. This consitutes the second highest absolute number of youths referred to any of the projects discussed in this report. Wayne County also had the second highest average number of monthly referrals during this period (24.1).

Figure VII.1 presents a plotting of Wayne County incarcerations from 1977 through 1979. This plot gives the distinct impression that the series fluctuated widely over this period about its mean value of 53.4 incarcerations per month (with a range from 20 to 79 incarcerations per month and standard deviation of 12.1). Unlike the rather clear patterns seen in Ada, ID and Jefferson, KY counties, though, it is doubtful whether any consistent trending behavior is exhibited. If the series is broken into pre and postintervention segments, one might suspect that the preintervention series displays a general downward slope while the postintervention segment of the series shows either no trend or a rather weak tendancy toward increasing. Evidence for these conclusions is rather difficult to substantiate at this point, however, given the high values in May, 1978 and March of 1979 for the preintervention series and the low July, 1979 value in the postintervention series. These values might constitute outliers or leverage points (see Belsley, Kuh, and Welsch, 1980) and so judgment should be reserved based upon such qualitative impressions. Though the series

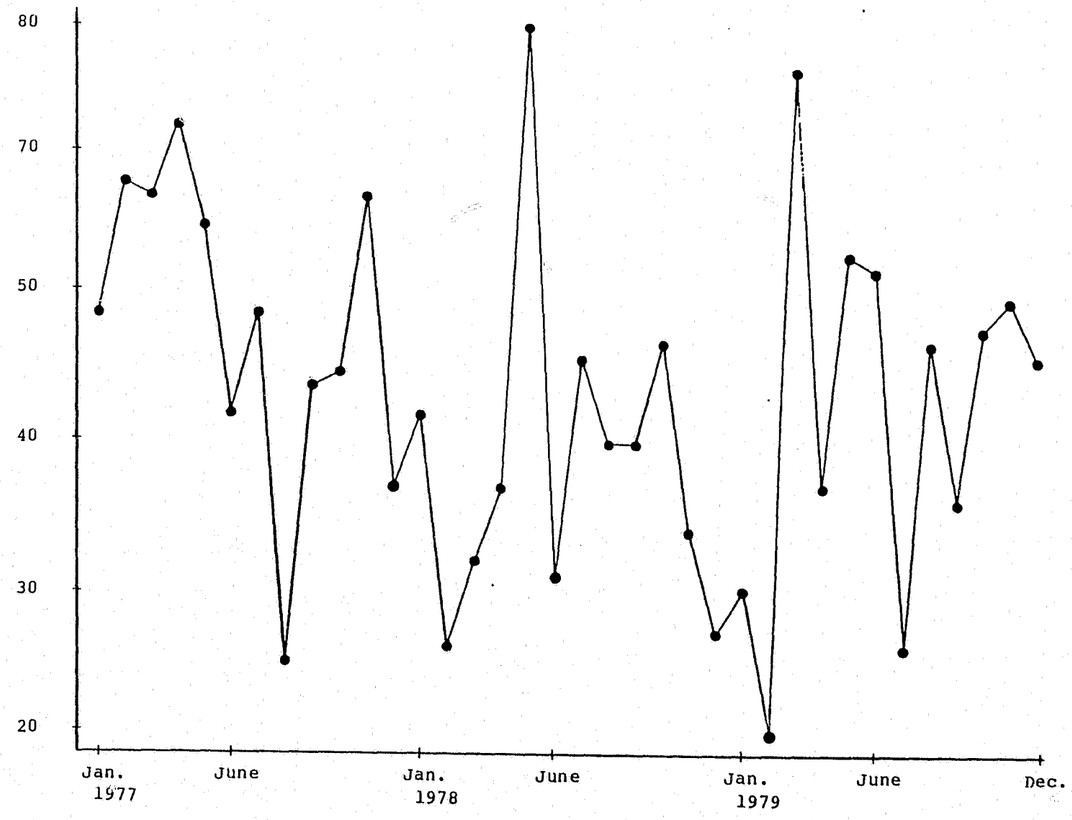

FIGURE VII.1 Wayne County, MI: Incarcerations 1977 - 1979

might indicate the restitution project to have had an impact directly opposite to that desired, this behavior could only reflect large increases or decreases in dispositions. The possible interrelationship between the incarceration and diposition series must be evaluated.

Prior to such an examination, however, the time dependent structure of the incarceration series is investigated. Incarceration series correlograms (Figure VII.2) do not provide any real resolution to the question of differential trends in the series. In fact, based upon ACF's and PACF's, it is decided that incarcerations constitute a random realization. There is one significant spike at lag ten of the partial autocorrelation function but this occurrance is not sufficent to override indications provided by the Ljung-Box Q statistic suggesting randomness. It should be noted, however, that the ACF's and PACF's perhaps contain intelligible oscillation so it might be possible to argue for the existence of pattern but that it is masked by pre and postintervention discontinuities. The correlograms for the disposition series (not shown) display oscillations rather similiar to those in incarceration series correlograms though they never reach statistical significance. The behavior of the series cannot be clearly described in terms of trend and the evidence for and against randomness is not entirely compelling.

Moving to a consideration of lagged disposition and incarceration cross correlations, Figure VII.3 demonstrates that the relation between the two series is synchronic (r = .664) and rather strong. While a significant correlation at positive lag ten exists and a few other correlations approach statistical significance, the strongest evidence suggests the

FIGURE VII.2 Autocorrelation and Partial Autocorrelation Functions for Wayne County Incarceration Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.020	+IX+
2	0.216	+IXXXXX+
3	-0.131	+XXXI+
4	-0.221	+XXXXXXI+
5	0.065	+IXX+
6	0.093	+IXX+
7	0.046	+IX+
8	0.121	+IXXX+
9	-0.253	+XXXXXXI+
10	0.194	+IXXXXX+
11	-0.134	+XXXI+
12	0.013	+I+

Ljung-Box Q (@ lag 9) = 9.3

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.020	+IX+
2	0.216	+IXXXXX+
3	-0.145	+XXXXI+
4	-0.278	+XXXXXXXI+
5	0.159	+IXXXX+
6	0.227	+IXXXXXX+
7	-0.114	+XXXI+
8	-0.010	+I+
9	-0.177	+XXXXI+
10	0.305	+IXXXXXXXX
11	-0.052	+XI+
12	-0.250	+XXXXXXI+

FIGURE VII.3 Lagged Cross Correlations for Wayne County Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+
-10	0.086	+ IXX +
-9	-0.244	+ XXXXXXI +
-8	0.053	+ IX +
-7	0.070	+ IXX +
-6	-0.043	+ XI +
-5	0.030	+ IX +
-4	-0.325	+XXXXXXXXI +
-3	-0.021	+ XI +
-2	0.279	+ IXXXXXXX+
-1	0.016	+ I +
0	0.664	+ IXXXXXXX+XXXXXXXXX
1	-0.089	+ XXI +
2	-0.064	+ XXI +
3	-0.187	+ XXXXXI +
4	-0.221	+ XXXXXXI +
5	0.154	+ IXXXX +
6	0.047	+ IX +
7	0.118	+ IXXX +
8	0.100	+ IXXX +
9	-0.170	+ XXXXI +
10	0.381	+ IXXXXXXXXX

incarceration and disposition series should be related contemporaneously. There is little reason to expect that the incarceration series might be a ten month leading indicator for dispositions and so any further consideration of this specification is dropped.

Having inspected the series of interest and made observations regarding its singular behavior as well as interrelation with the disposition series, the identification stage of model specification can proceed. During the first stage all model variables (except lagged values of the incarceration series) were entered into a stepwise regression. The stepwise procedure used backward/forward elimination techniques through which variables were successively excluded from the model if they did not meet significance criterion ($p \leq .10$). In addition, at each step of the modeling process variables previously excluded were again evaluated for suitability. If, in these subsequent steps, they met inclusion criterion, variables reentered the model. The process continued until only variables statisfying $p \leq .10$ were retained.

This modeling strategy yielded a regression equation having three independent variables, the dispositon series (DISPO), PRETIME, and PSTTIME. Before interpreting estimated coefficents, however, model residuals were diagnosed. Figure VII.4 presents correlograms for these model residuals. There are no significant spikes in either correlogram and the Ljung-Box Q statistic suggests the residual series is white noise. Even though oscillatory behavior still persists in the residuals (similiar to that seen in the Belmont/Harrison residuals), for want of conclusive evidence it is decided that this three variable intervention model is

FIGURE VII.4 Residual Autocorrelation and Partial Autocorrelation Functions for Wayne County Fitted Intervention Model

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.121	+ IXXX +
2	0.092	+ IXX +
3	-0.167	+ XXXXI +
4	-0.047	+ XI +
5	-0.047	+ XI +
6	0.113	+ IXXX +
7	0.005	+ I +
8	0.009	+ I +
9	-0.229	+ XXXXXXI +
10	-0.102	+ XXXI +
11	-0.229	+ XXXXXXI +
12	-0.151	+ XXXXI +

Ljung-Box Q (@ lag 9) = 5.5

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.121	+ IXXX +
2	0.079	+ IXX +
3	-0.191	+ XXXXXI +
4	-0.012	+ I +
5	-0.005	+ I +
6	0.099	+ IXX +
7	-0.028	+ XI +
8	-0.022	+ XI +
9	-0.205	+ XXXXXI +
10	-0.050	+ XI +
11	-0.182	+ XXXXXI +
12	-0.195	+ XXXXXI +

adequate. Inclusion of lagged values of the dependent series is considered unnecessary.

Table III.1 presented the accepted intervention model. It is noteworthy that two intervention slope parameters are estimated as statistically significant. With PRETIME equaling -.362 and PSTTIME estimated as 2.170 the previous visual impression of a change in slope between the pre and postintervention series segments is validated. Prior to the establishment of the restitution program the trend in incarcerations (when contolling for the influence of dispositions) was negative. This trend turned positive after program start-up. The net estimated difference (the delta for slope coefficents) in trend between the pre and postintervention series is 2.532. Being a postive value, the interpretation of this quantity is that, contrary to policy expectations, the establishment of the restitution program is associated with a cumulative increase of approximately two and one-half youths incarcerated per month. If this cumulative increase in incarceration is extrapolated and summed over a one year period following project start-up, the "added" number of youths placed in detention is approximately one hundred ninty-seven. This is a considerable number of youths and leads to the conclusion that the impact of the Wayne County Restitution Program went contrary to OJJDP policy expectations. An explanation for this circumstance cannot be forwarded here, however, given the nature and scope of the data considered in this report. This issue would require a more in-depth investigation of judicial system dynamics over the 1977 - 1979 period.

It was mentioned at the beginning of this section that visual impressions leading to a conclusion that preintervention slope was negative while the postintervention slope was nonnegative might be a consequence of outliers. Inspection of the plot of actual versus predicted series values (Figure VI.5) attends to this concern. The ISDE model adopted mimics the incarceration series very well (as might be expected given an R^2 of .98). Predicted values generally track series turning points and pick up those observations identified earlier as possible outliers. On this basis it is decided that these observations are not extreme values and so do not exert undo leverage upon results. The interpretation presented in the previous paragraph is allowed to stand. There was a significant increase in incarceration trend associated with the establishment of Wayne County's Restitution Project from April through December of 1979.

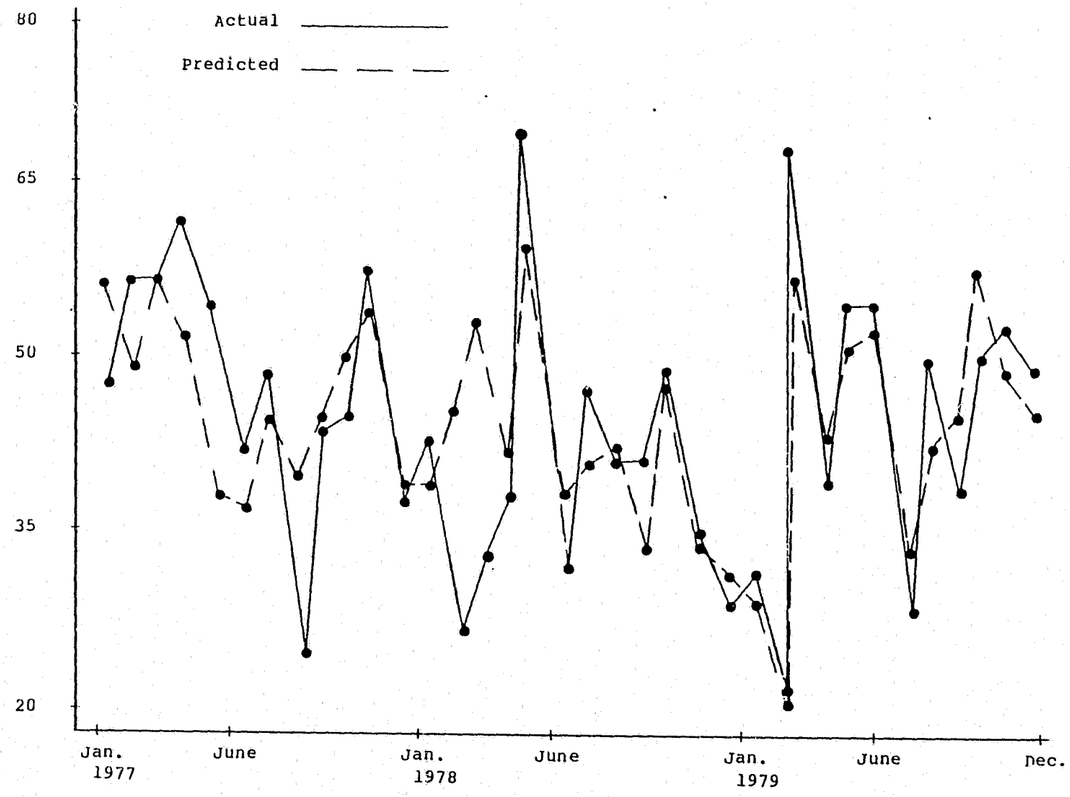

FIGURE VII.5 Wayne County, MI: 1977 - 1979 Overlay
Plot of Predicted Versus Actual Incarcerations

VIII. WASHINGTON, DC

The Washington, DC restitution project began accepting referrals in May of 1979. During the eight months from project start-up through December of 1979, a total of one hundred twenty-three youths were placed in this restitution project. This volume of referrals makes Washington, DC the third largest project discussed in this report. Washington, DC also had the third highest monthly referral average during this period (15.4).

Figure VIII.1 presents a plotting of juvenile incarcerations in Washington, DC from January, 1977 through December of 1979. A visual inspection of this series gives the impression of a series fluctuating in a seemingly random manner about its mean ($\overline{X}$ = 32.6, standard deviation = 9.07). Little structure in the sense of a clear trend can be discerned in this series. Also, the turns above and below the mean appear random rather than patterned. Segmenting the series into pre and postintervention portions, however, there does appear to be an immediate drop in series level associated with project start-up. This change in series level, though, is not out of character given preintervention fluctuations and so cannot be said to constitute firm evidence for a change in incarceration dynamics at this point. Judgment must be reserved on observations based upon such qualitative impressions.

The ACF and PACF's for the Washington, DC incarceration series provide mixed evidence regarding time dependence. If only the Ljung-Box Q test for lack of fit is considered, inference would conclude the series to be a random realization. At nine lags (N/4) this statistic indicates no systematic information contained in successively lagged and correlated

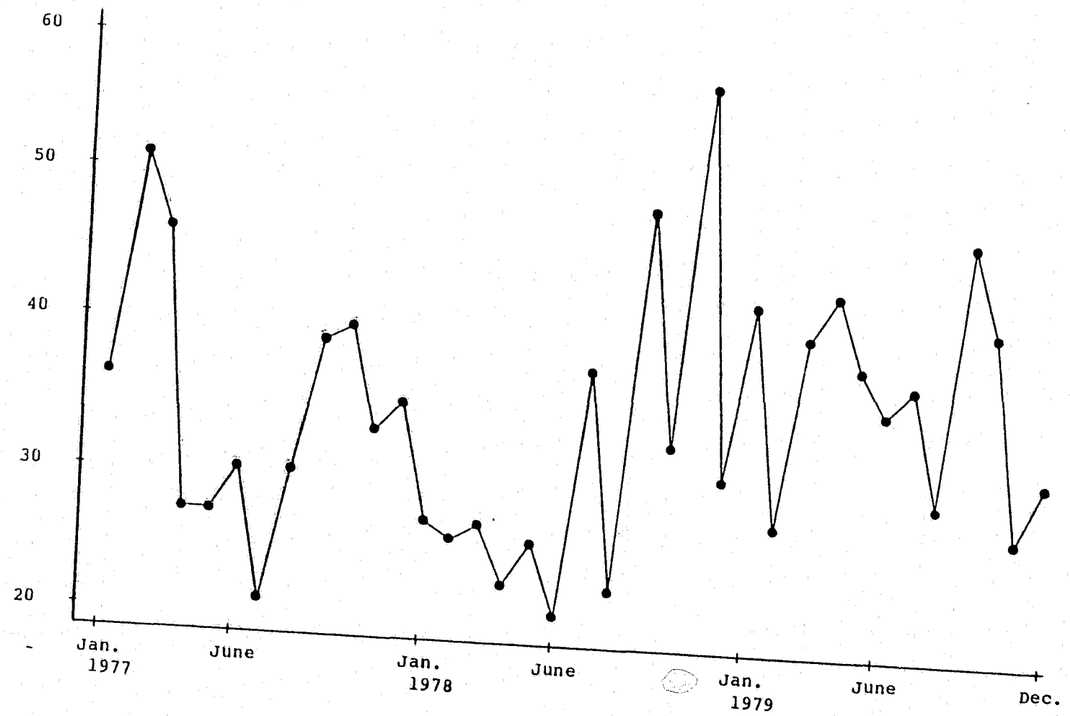

FIGURE VIII.1 Washington, DC: Incarcerations 1977 - 1979

series values. If the plot of autocorrelations and partial auto-correlations are inspected, however, a somewhat different impression is obtained. The pattern of correlations oscillate in a manner similiar to a dampened sine wave (with a significant ACF and PACF at lag 2) suggesting a second or higher order autoregressive process. Though this conjecture cannot be substantiated to any acceptable degree given such meager evidence, information does suggest that fluctuations observed in this series might prove nonrandom if a longer series realization were available. Unfortunately, such an extension of the series is impossible in the present case. For lack of strong evidence to the contrary and because of the less than critical status of this preliminary incarceration series inspection, it is deemed to be a random series. The disposition series (not shown) also displays similiar fluctuations about its mean value (174) with oscillating, but nonsignificant, ACF and PACF's and an insignificant Ljung-Box Q statistic.

Moving to a consideration of the lagged cross correlations between Washington, DC's disposition and incarceration series, Figure VIII.3 strongly indicates strong synchronic relation between tne incarcerations and dispositions (r = .596). Only at lag zero is there a significant correlation and in no other portion of the figure does a pattern appear suggestive of an intellegible lag structure. For this reason the incarceration and dispositon series will be related contemporaneously in the adopted initial model specification.

Having inspected the series of interest and made observations regarding its univariate behavior and interrelation with dispositions, the

FIGURE VIII.2 Autocorrelation and Partial Autocorrelation Functions for Washington, DC Incarceration Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.120	+ IXXX +
2	0.337	+ IXXXXXXXX
3	-0.154	+ XXXXI +
4	0.106	+ IXXX +
5	-0.210	+ XXXXXI +
6	0.095	+ IXX +
7	-0.080	+ XXI +
8	0.020	+ IX +
9	-0.013	+ I +
10	0.066	+ IXX +
11	0.005	+ I +
12	-0.042	+ XI +

Ljung-Box Q (@ lag 9) = 9.3

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
		+----+----+----+----+----+----+----+----+----+----+----+
1	0.120	+ IXXX +
2	0.327	+ IXXXXXXXX
3	-0.251	+ XXXXXXI +
4	0.054	+ IX +
5	-0.118	+ XXXI +
6	0.069	+ IXX +
7	0.036	+ IX +
8	-0.111	+ XXXI +
9	0.088	+ IXX +
10	0.032	+ IX +
11	-0.013	+ I +
12	-0.082	+ XXI +

FIGURE VIII.3 Lagged Cross Correlations for Washington, DC Incarceration and Disposition Series

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
-10	-0.064	+ XXI +
-9	0.083	+ IXX +
-8	0.109	+ IXXX +
-7	-0.042	+ XI +
-6	-0.040	+ XI +
-5	-0.217	+ XXXXXI +
-4	0.022	+ IX +
-3	0.013	+ I +
-2	0.246	+ IXXXXXX +
-1	0.177	+ IXXXX +
0	0.596	+ IXXXXXXX+XXXXXXX
1	0.074	+ IXX +
2	0.058	+ IX +
3	-0.224	+ XXXXXXI +
4	0.157	+ IXXXX +
5	-0.247	+ XXXXXXI +
6	0.037	+ IX +
7	-0.125	+ XXXI +
8	0.008	+ I +
9	-0.115	+ XXXI +
10	0.011	+ I +

identification stage of model specification proceeds. During the first stage all model variables except lagged values of the incarceration series were entered into a stepwise regression. The stepwise procedure used backward/forwards elimination techniques through which variables were successively excluded from the model if they did not meet significance criterion ($p \leq .10$). In addition, at each step of the modeling process previous variables excluded from the model were again evaluated for suitability. If, during these subsequent steps, variables met inclusion criterion, they reentered the model. This process continued until only those variables statistically significant at the $p \leq .10$ level were included in the intervention model.

As exhibited in Table III.1, this strategy yielded a regression equation having only the two independent variables DISPO and PRETIME. Before interpreting the coefficents estimated, model residuals were subjected to tests for randomness. Figure VIII.4 presents the appropriate residual correlograms for the Washington, DC intervention model. There are no significant spikes in either correlogram and they generally appear (as would be expected) even more well behaved than those for the original incarceration series (Figure VIII.2). In addition, the Ljung-Box Q statistic evaluates these residuals as white noise. It should be mentioned, though, that there is still a discernable pattern in resicual ACF and PACF's. Nearly all of these values are negative in value. This could be indicative of some small trend remaining in model residuals (see Makridakis and Wheelwright, 1978:354-360) but, again, indications are too weak to support such an interpretation given the length of the series (the

FIGURE VIII.4 Residual Autocorrelation and Partial Autocorrelation Functions for Washington, DC Fitted Intervention Model

LAG	CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.026	+ IX +
2	0.011	+ I +
3	-0.227	+ XXXXXXI +
4	-0.040	+ XI +
5	0.058	+ IX +
6	-0.027	+ XI +
7	-0.044	+ XI +
8	-0.124	+ XXXI +
9	-0.079	+ XXI +
10	-0.047	+ XI +
11	-0.075	+ XXI +
12	0.073	+ IXX +

Ljung-Box Q (@ lag 9) = 3.6

LAG	PARTIAL CORRELATION	-1.0 -0.8 -0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0
1	0.026	+ IX +
2	0.010	+ I +
3	-0.228	+ XXXXXXI +
4	-0.029	+ XI +
5	0.070	+ IXX +
6	-0.085	+ XXI +
7	-0.064	+ XXI +
8	-0.097	+ XXI +
9	-0.100	+ XXXI +
10	-0.079	+ XXI +
11	-0.133	+ XXXI +
12	0.027	+ IX +

information provided is not coherent enough to confidently infer pattern). Therefore, the two variable intervention model is accepted as adequate.

Table III.1 presented the accepted intervention model. Note that only one intervention parameter is estimated as significant (PRETIME). This indicates that, prior to establishment of the Washington, DC Restitution Project, the trend in incarcerations (adjusted for the influence of the number of dispositions in any particular month) was cumulatively increasing at the rate of .281 incarcerations per month. After establishment of the restitution program, this increase ended.

Since PSTTIME is estimated equal to zero, the delta parameter for a change in slope is -0.281 (significant at $p \leq .05$). This is interpreted to mean that the estimated impact of intervention is to gradually and cumulatively lower the total number of youths incarcerated in Washington, DC (based upon preintervention expectations). Extrapolating these results for one year following project start-up, it is predicted that approximately twenty-two fewer youths will be incarcerated. Considering the number of youths processed and incarcerated over the 1977 - 1979 period, this decrease is certainly not inconsequential. Evidence suggests, then, that the impact of the Washington, DC Restitution Project conformed to OJJDP policy expectations by providing an alternative to incarceration.

It should be noted that this finding in Washington, DC closely resembles that found in Jefferson County, KY. Both sites provided evidence for a moderation in preintervention incarceration trends associated with the beginning of the restitution project. A side-by-side inspection of their respective plottings of predicted versus actual incarceration series

values (Figures VIII.5 and VI.6 for Washington, DC and Jefferson County, KY respectively), however, does not yield similiar impressions. For Jefferson County it was possible to detect the moderation of trend because of the obvious trend displayed in the two-dimensional graph. No such clear pattern is discernable for Washington, DC due to the generally fluctuating, rather than trending, behavior of the incarceration series. In order to fully visualize the mulivariate relation between incarcerations, dispositions, and time, a three-dimensional representation would be required. Nonetheless, the statistical evidence is clear. The establishment of the Washington, DC project is associated with a "flattening" of incarceration trend. OJJDP's policy expectations were met in this site.

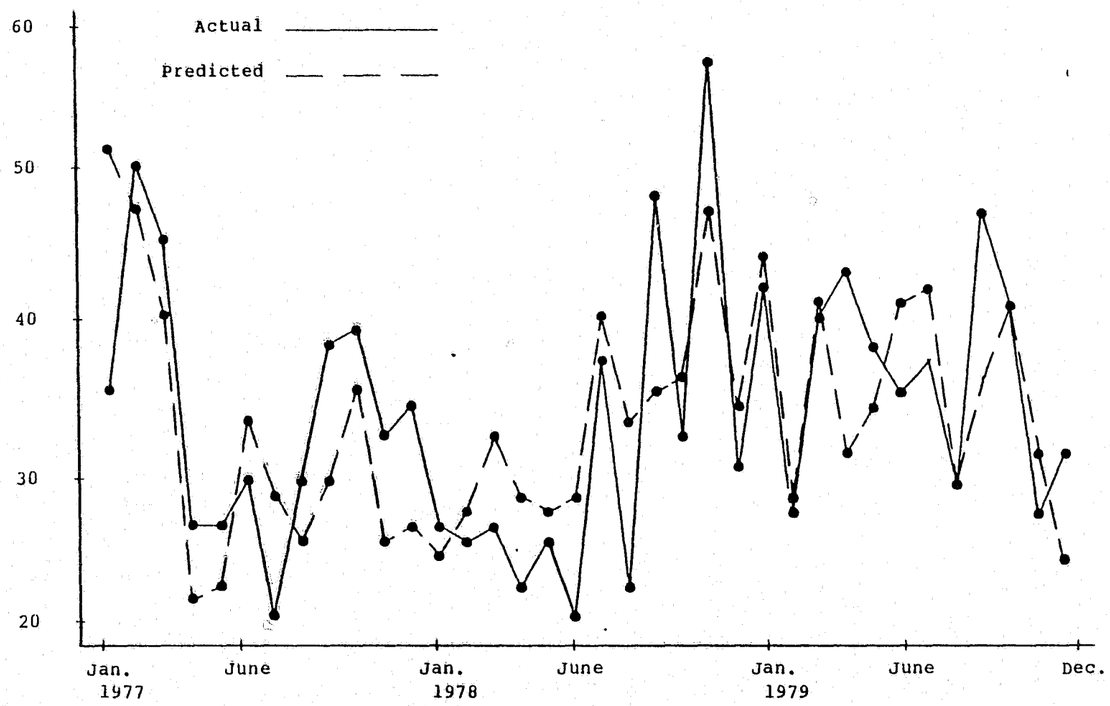

FIGURE VIII.5 Washington, DC: 1977 - 1979 Overlay
Plot of Predicted Versus Actual Incarceration

IX. SUMMARY AND CONCLUSIONS

During the second month of 1978 the Office of Juvenile Justice and Delinquency Prevention (OJJDP) began soliciting proposals for a major initiative entitled "Restitution by Juvenile Offenders: An Alternative to Incarceration." As the title indicates, one of the major policy expectations held out for this initiative was a reduction in the number of youthful offenders incarcerated. To this end, the federally sponsored restitution programs were established with the intention of serving youths who normally would be incarcerated in the absence of such programs.

As is often the case with service delivery programs, however, identification of the appropriate target population proved difficult. OJJDP clearly preferred the target population to consist of youths who would have been incarcerated if not referred to a restitution project but no initiative-wide criteria were advanced to facilitate identification. To aid the reader of this report, the Institute of Policy Analysis' five alternative standards for referrals have been outlined in the appendix. In addition, Table I.1 noted the percentage of cases in each site meeting or exceeding each of the standards. This allows the reader to determine the appropriateness of referrals in each site according to his or her own criteria.

The particular statistical model used for the determination of intervention effects draws upon the philosophy of time series decomposition methods. The actual modeling strategy followed used an iterative process for specification of the intervention and covariate terms while residual analysis was used to establish the proper lag structure (and whether it

was necessary) for inclusion of the incarceration series in the model. The results of the modeling process were displayed in Table III.1.

As Table III.1 clearly shows, the estimated intervention effect in three of the five sites (Belmont/Harrison Counties, Jefferson County, and Washington, DC) unambiguously reduced incarceration through a reduction in postintervention slope. In Ada County the effect was mixed. The estimated level of the series increased coincidental with the establishment of the restitution program but the slope of the incarceration series dropped considerably. The total effect of these mixed indicators, however, was to reduce the expected number of youths incarcerated. Only one of the five sites (Wayne County) exhibited an increase in the slope of incarcerations at the point of intervention. This was the only site where the net effect of intervention was to increase the number of youths incarcerated. Table IX.1 provides a slightly different way for viewing the effects of the restitution programs. In column one the extrapolated expected twelve month effect of the intervention is presented. This amount is scaled by the standard deviation of the observed series to produce a standardized estimate of intervention effect over a year in column three.

Discretion and caution should be used during the interpretation of these standardized effects. Each is dependent upon the linear extrapolation of trends observed over a short period of time. This technique may yield estimates which are more or less valid depending upon factors such as the length of horizon the series has beyond intervention and possible floor effects. For example, the twelve month extrapolation for Ada County

TABLE IX.1 Summary of Estimated and Standardized* Twelve Month Quasi-Experimental Effects

SITE	12 Month Impact	Incarceration Series Standard Deviation	Standardized Intervention Effect
Ada County, ID	-298	7.6	-39.1
Belmont/Harrison Counties, OH	-19	2.2	-8.8
Jefferson County, KY	-11	5.9	-1.9
Wayne County, MI	+197	12.1	+16.3
Washington, DC	-22	9.1	-2.4

*Standardization is achieved through division of twelve month estimated impact by the standard deviation of the incarceration series.

begins to exhibit floor effects. Ada County began accepting referrals in April of 1979 so the period for which postintervention data exists is only nine months long. This means that a twelve month expected impact must forecast beyond the observed horizon three months. Inspection of the plot of observed versus predicted incarceration series values (page 34) shows a clear bottoming out of estimates starting in November of 1979. Extrapolations much beyond this point will obviously run into negative predicted values. For this reason the Ada County estimate in Table IX.1 is considered to be an overestimate. During the discussion of the Belmont/Harrison site it was noted that in this case too floor effects would soon be encountered.

The reason the Belmont/Harrison twelve month impact is not felt to be an overestimate, however, has to do with the month in which the project began. Starting in Febuary as it did, the Belmont/Harrison model must therefore only extrapolate one month beyond observed data. This provides more confidence in the estimate.

Even taking into account problems associated with floor effects and horizon length, the standardized effect estimates do give a reasonable ranking of the magnitude of change experienced in these sites. The impact in Ada County was far and away the largest. It is doubtful that any adjustments made for the problems noted would change this fact. The second largest impact took place in Wayne County where the results run counter to OJJDP policy expectations. In all but one site the magnitude of change exceeded two standard deviations.

Speaking in terms of the five sites considered in this report it is hard to escape the conclusion that restitution programs do have an effect upon incarceration rates. Further, given the downturn in four of the five sites, the general result is that restitution programs reduce incarcerations. This finding is in line with the expectations expressed in the program announcement for the juvenile restitution initiative. This conclusion cannot, however, be extended to cover the initiative as a whole. As noted in Section II of this report the five sites studied were unique in their ability to provide information of sufficent quality for time series analysis. It is not known in what other manners (if any) they differ significantly from the other sites in the initiative and the extremely small number of sites considered given the number of jurisdictions

participating (88) make generalizations impcssible.

APPENDIX A

I. SERIOUS OR REPEAT OFFENDERS

Seriousness Category	# of Priors/Concurrents						
	0	1	2	3	4	5	6+
Victimless	▨	▨	▨	▨	▨	▨	▨
Minor Offenses	▨						
Minor Proprty.	▨						
Minor Persnl.	▨						
Moderate Prop.							
Serious Prop.							
Very Ser. Prop.							
Serious Persnl.							
Very Ser. Pers.							

II. SERIOUS OFFENDERS

Seriousness Category	# of Priors/Concurrents						
	0	1	2	3	4	5	6+
Victimless	▨	▨	▨	▨	▨	▨	▨
Minor Offenses	▨	▨	▨	▨	▨	▨	▨
Minor Proprty.	▨	▨	▨	▨	▨	▨	▨
Minor Persnl.	▨	▨	▨	▨	▨	▨	▨
Moderate Prop.							
Serious Prop.							
Very Ser. Prop.							
Serious Persnl.							
Very Ser. Pers.							

III. SERIOUS AND/OR REPEAT OFFENDERS

Seriousness Category	# of Priors/Concurrents						
	0	1	2	3	4	5	6+
Victimless	▨	▨	▨	▨	▨	▨	▨
Minor Offenses	▨	▨	▨				
Minor Proprty.	▨	▨	▨				
Minor Persnl.	▨	▨	▨				
Moderate Prop.	▨						
Serious Prop.							
Very Ser. Prop.							
Serious Persnl.							
Very Ser. Pers.							

In each diagram, the shaded area indicates referrals that would not be appropriate, given the criteria used in that unofficial standard. Unshaded areas represent combinations of seriousness of referral offenses and prior/concurrent offenses that would be appropriate under the criteria specified by that particular standard.

These standards are not being proposed for adoption or for official use.

IV. REPEAT OFFENDERS

Seriousness Category	# of Priors/Concurrents						
	0	1	2	3	4	5	6+
Victimless	▨	▨	▨	▨	▨	▨	▨
Minor Offenses	▨						
Minor Proprty.	▨						
Minor Persnl.	▨						
Moderate Prop.	▨						
Serious Prop.	▨						
Very Ser. Prop.	▨						
Serious Persnl.	▨						
Very Ser. Pers.	▨						

V. CHRONIC AND VERY SERIOUS OFFENDERS

Seriousness Category	# of Priors/Concurrents						
	0	1	2	3	4	5	6+
Victimless	▨	▨	▨	▨	▨	▨	▨
Minor Offenses	▨	▨	▨	▨	▨	▨	
Minor Proprty.	▨	▨	▨	▨	▨	▨	
Minor Persnl.	▨	▨	▨	▨	▨	▨	
Moderate Prop.	▨	▨	▨				
Serious Prop.	▨	▨					
Very Ser. Prop.	▨						
Serious Persnl.	▨						
Very Ser. Pers.	▨						

FIGURE A.1 Five Unofficial Standards for Assessing the Appropriateness Of Referrals[1]

TABLE A.1 ALTERNATIVE STANDARDS FOR APPROPRIATE REFERRALS[1]

Definition
I. SERIOUS OR REPEAT OFFENDERS: (a) Victimless offenses are not appropriate; (b) Youths with one or more prior/concurrent offenses are appropriate; (c) Youths whose referral offense is at the "moderately serious" level or above are appropriate.
II. SERIOUS OFFENDERS: All youths whose immediate offense is at or beyond the moderately serious property category are appropriate. Those in the victimless or minor categories are not appropriate.
III. SERIOUS AND/OR REPEAT OFFENDERS: (a) Victimless offenses are not appropriate; (b) Youths with three or more prior/concurrents are appropriate; (c) Youths whose referral offense is at or beyond the "serious property" category are appropriate; (d) Youths whose referral offense is at the "moderate property" category are appropriate only if they have one or more prior/concurrent offenses.
IV. REPEAT OFFENDERS: (a) Victimless offenses are not appropriate; (b) All other youths are appropriate if they have one or more prior/concurrent offense.
V. CHRONIC AND VERY SERIOUS OFFENDERS: (a) Victimless offenses are not appropriate; (b) The following combinations qualify a referral: minor offenses plus six or more priors/concurrents; moderate property plus three or more priors/concurrents; serious property plus two or more priors/concurrents; very serious property, serious personal, and very serious personal plus one or more priors/concurrents.

[1]These standards are not being proposed for adoption or official use. Rather, the purpose of the standards is to apply each to the initiative referrals in order to assess the characterisitcs of the target population. No judgment are being made about whether the initiative is or is not serving the intended population.

NOTES

1. The expected results of the initiative and other information can be found in the program announcement, "Restitution by Juvenile Offenders: An Alternative to Incarceration," OJJDP, LEAA, Department of Justice, Washington, DC, February 15, 1978. Also see A. L. Schneider and P. R. Schneider, "Policy Expectations and Program Realities in Juvenile Restitution," Institute of Policy Analysis, September, 1979.

2. For a more comprehensive treatment of the conceptual and empirical problems facing the assessment of restitution program impact upon incarceration rates see P. R. Schneider and A. L. Schneider, "The National Juvenile Restitution Evaluation: Experimental Designs and Research Objectives," Institute of Policy Analysis, September, 1979.

3. For further discussion of target population problems in OJJDP status offender and diversion programs, see M. W. Klein, "Deinstitutionalization and Diversion of Status Offenders: A Litany of Impediments," in N. Morris and M. Tonry (eds.), Crime and Justice, 1978, University of Chicago Press, 1979.

4. Documentation of these standards is contained in P. R. Schneider, A. L. Schneider, W. R. Griffith, and M. J Wilson, "Two-Year Report on the National Evaluation of the Juvenile Restitution Initiative: An Overview of Program Performance," Institute of Policy Analysis, June, 1982.

5. For elaboration see P. R. Schneider and A. L. Schneider, "Continuation Proposal for the National Evaluation of Juvenile Restitution Programs," Institute of Policy Analysis, September, 1978.

6. For a brief but excellent introduction to time series decompostion see S. Makridakis and S.C. Wheelwright, Forecasting Methods and Applications, 1978:88-91. A criticism of this perspective and statement of an alternative methodology for time series analysis can be found in G. E. P. Box and G. M. Jenkins, Time Series Analysis: Forecasting and Control, 1966:301.

7. The rationale and statistical model used here has much in common with certain applications of analysis of covariance techniques. See A. R. Wildt and O. T. Ahtola's small book, Analysis of Covariance for an explanation of the manner in which ANCOVA can function to increase the precision of effect estimation.

8. In order to assess the contribution of the various model components, it must be understood that in the presence of lagged endogenous variables the estimated model coefficents cannot be straightforwardly interpreted. That is, in neither the pre nor postintervention segments of the series do observations lie on and about the plane described by $a_iX_i + b_jX_j +$

cDISPO. The influence of the stochastic component $\Sigma\phi_i Y_{t-i}$ assures this fact. To demonstrate, consider the following simple intervention model containing no exogenous series which is

[1] $Y_t = a_1 + b_3 t + \Sigma\phi_i Y_{t-i} + e_t$

prior to intervention and

[2] $Y_t = a_2 + b_4 t + \Sigma\phi_i Y_{t-i} + e_t$

thereafter. In contrast to the previous notation used, the dummy variables X_1 and X_2 have been dropped from the formulation in order to reduce the number of terms and for the same reason X_3 and X_4 have been replaced by the time index (t).

Consider [2]. Its expected value is

$$E(Y_t) = a_2 + b_4 t + \Sigma\phi_i Y_{t-i}$$

which is a rather uneventful conclusion as what is desired is a representation in trend and level alone. Therefore, if it is assumed that $E(Y_t) = A + Bt$, this information can be used to gain either

$$E(Y_t) = a_2 + b_4 t + \Sigma\phi(A + B(t-i))$$

or the more helpful

$$A + Bt = a_2 + b_4 t + \Sigma\phi(A + B(t-i))$$

now, if the coefficents for t and 1 are equated it becomes possible to solve for A and B as

$$Bt = (\Sigma\phi)Bt + b_4$$

and

$$A = \Sigma\phi(-i)B + (\Sigma\phi)A + a_2$$

Rearrangement and simplification yields the steady state solutions for the slope and trend for this model.

[3] $B = b_4/(1 - \Sigma\phi)$

[4] $A = (a_2 - B(\Sigma i\phi))/(1 - \Sigma\phi)$

Returning to [1] and [2], though significance tests evaluate the hypothesis $a_1 = a_2$, should significant differences be found, one cannot directly determine the impact magnitude by forming the quantitiy $a_1 - a_2$ if

lagged values of the dependent variable are used in the equation. Upon determining the steady state solutions for the intervention model when required, the interpretation of the coefficents is the same as that used for standard regression coefficients.

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