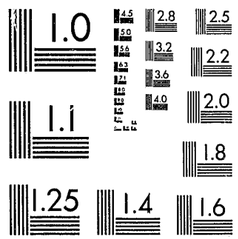

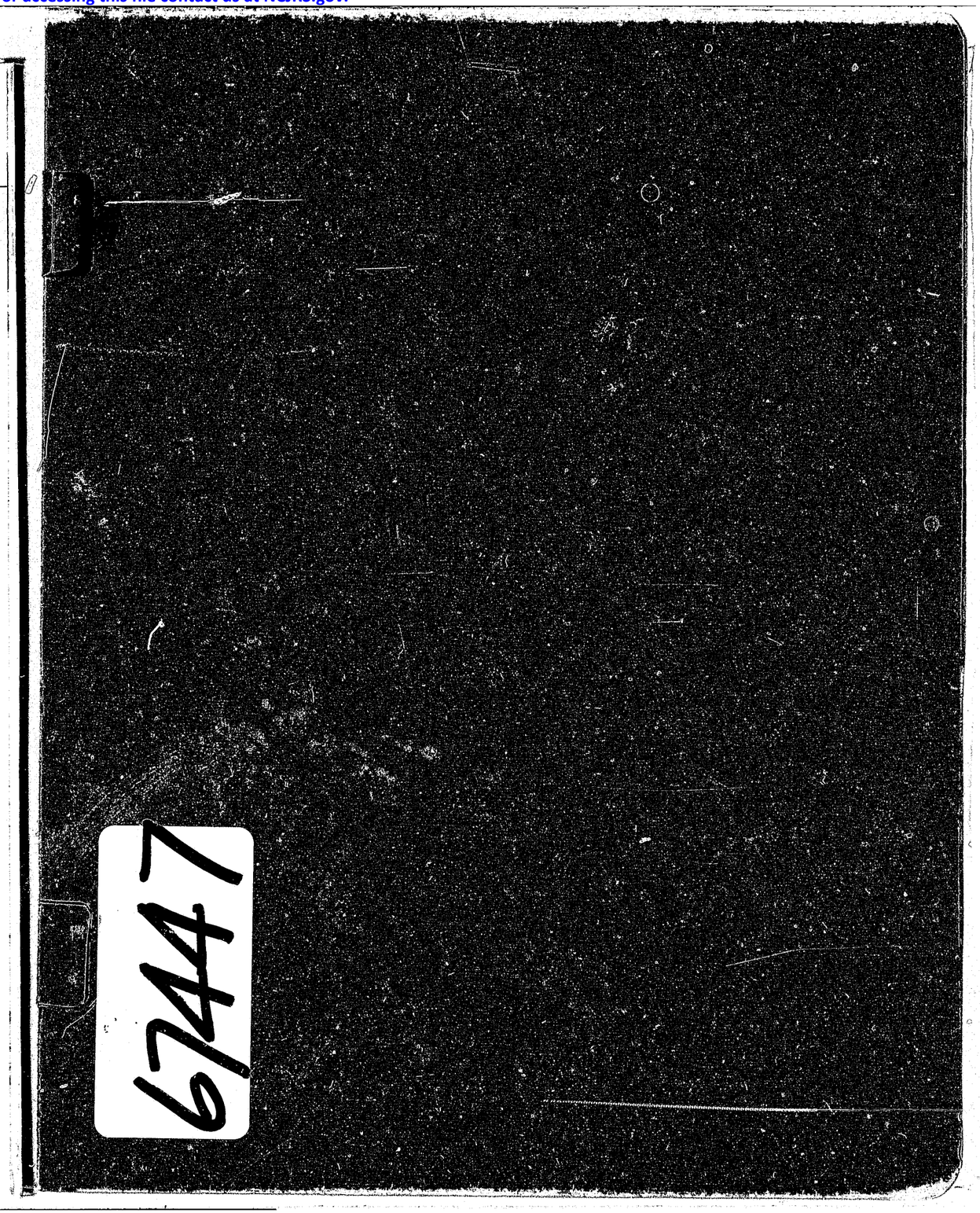

DEPARTMENT OF OFFENDER REHABILITATION

LOUIE L. WAINWRIGHT, SECRETARY

Research Study

A SURVEY OF POPULATION PROJECTION METHODOLOGIES IN THE STATES AND THE DISTRICT OF COLUMBIA

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FLORIDA DEPARTMENT OF OFFENDER REHABILITATION
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EXECUTIVE SUMMARY

This document is a review of the work that has been done to date by the states in the field of inmate population projections. The results reported here are in response to a survey on projection methodology conducted by the Florida Department of Offender Rehabilitation. All of the other states and the District of Columbia received the Department's questionnaire. Responses were received from 44 of these jurisdictions. Below is a summary of the results:

STATES SURVEYED:	50
STATES RESPONDING TO THE SURVEY:	44 88%
RESPONDING STATES FURNISHING DOCUMENTS:	20 46%
RESPONDING STATES THAT PUBLISH PROJECTIONS:	32 73%
RESPONDING STATES THAT HAVE USED LINEAR REGRESSION:	21 48%
RESPONDING STATES THAT HAVE USED MULTIPLE REGRESSION:	7 16%
RESPONDING STATES THAT HAVE USED A SIMULATION MODEL:	6 14%

In its efforts to develop more satisfactory projections of the inmate population, the Florida Department of Offender Rehabilitation has conducted a survey of population projection methodologies and approaches in all of the other states and the District of Columbia. The response to the survey has been excellent, and the Department wishes to thank the states that have responded for their assistance.

This survey reveals a picture of tremendous diversity. Some states do not make any population projections, while others employ complex methodologies. In the first group are states of various size and character. One state responded laconically that "We provide custody for whomever the courts send us," another, in stating that it did not make projections, remarked that "We are (sic) decreased our population from over 2500 to 1700 in the past year."

By contrast several states have employed either multiple regression or a simulation model (only Florida at this writing has employed both).* There is a similar diversity in the time periods covered by those states that produce population

*Florida previously employed a simulation model to predict the total incarcerated population. The model currently employed utilizes the simulation technique to predict the release date for each offender. Admissions are predicted by a multiple regression equation, with population at risk and unemployment rate as factors. A detailed description of the techniques used by Florida can be found in "Inmate Population Projections - Short and Long Range Estimates," available from the Department upon request.

projections. In several states, long-range projections cover a period of five years or less, whereas in some other states periods of up to twenty-five years are covered (see Table 1).

Of the states that have responded to the Department's survey, it does not appear that there is any particular pattern as to the degree of sophistication found. Major states, or states with large incarcerated populations, do not necessarily make population projections in more depth than do small states, or states with few persons behind bars. For example, Ohio, Pennsylania, and Michigan, all populous states with large prison rolls, have used neither multiple regression nor simulation models, and have not projected for more than two years ahead. On the other hand, Idaho, a sparsely populated state with a low number of prisoners, has utilized a simulation model and has projected prison population over a fifteen year period.

Attempting to cull the significant findings from a survey of this sort is a difficult task for several reasons. First of all, the extent and quality of data varies widely among the states. This makes comparison difficult, even when two or more states are using similar methodologies. Secondly, conditions in the different jurisdictions vary a great deal. Some states are rural in nature while others are heavily urban; some are growing very rapidly while others are not; some have high rates of incarceration and some have low rates;

several have misdemeanants in their correctional facilities while many systems are limited to felons. With this sort of situation it is once again difficult to compare the approach of one state with that of another. The unemployment rate, for example, may be highly predictive in a state with an industrial economy, but far less useful in a primarily agricultural state. Thirdly, the more sophisticated methods for population projection have only been developed in the past few years. Thus, there has not been sufficient time to gauge their effectiveness or degree of accuracy.

It should be pointed out, however, that the objective of this survey was not to offer judgements or rankings of the efforts taking place in the different states. The purpose was rather to learn more fully what the states were doing in the area of population projections, and to describe and summarize our findings in a single document.

A noteworthy finding of the survey is that there is widespread displeasure with the linear regression technique when the data base used is the previous inmate population. Although a couple of states report this method to be reliable, more have serious doubts about it. The D.C. Department of Corrections, for example, stated that "the accuracy of these projections is less than ideal." In its Population Report, a descriptive analytical report issued every quarter, it was said of these linear projections that "some are labeled as not acceptable in the report each quarter." Nevada, to cite another example,

remarked that "current intake exceeds predictions by 350%."

The displeasure with the variety of linear regression that uses past inmate population is related to the efforts in many of the states to develop improved methodologies, for it is widely recognized that the past growth in inmate population does not determine the rate of future growth. Although there may be a relationship between past and future growth, both are determined by other factors.

Recognition of this in several states is reflected by the use of a multiple regression methodology. This methodology has the potential for offering more accurate predictions than a linear method that utilizes past inmate population as the sole data base. The goal in multiple regression is to determine which combination of factors has the greatest predictive ability. Different states use a different set of factors.

Illinois uses the same factors that Florida uses in its short-range projections for admissions: unemployment and population at risk. Colorado predicts both new court commitments and the total incarcerated population by means of multiple regression equations. The factors used for the prediction of new court commitments are: 1) the unemployment rate for the preceding quarter, 2) the average percentage of yearly commitments received each quarter, and 3) the population at risk. The factors used to predict the total incarcerated population are: 1) the percentage of all commitments received three quarters earlier with an indeterminate

minimum sentence, 2) the parole revocation level during the quarter, and 3) the number of commitments projected for the quarter.

Wisconsin likewise employs multiple regression, but uses a different set of factors. Wisconsin utilizes a set of three very diverse factors, which include: 1) age specific census data, 2) economic factors such as employment and income, and 3) arrest rates and conviction data. Texas is another state that uses three factors in its multiple regression equation: 1) new receives per annum (indicating all transactions, not just actual persons received), 2) paroles per annum, and 3) discharges per annum. New Mexico uses yet another combination of factors: 1) intake statistics over the past decade, 2) state population change, and 3) critical age groups in the work force. The factors used by Arizona in its equation are: 1) number of admissions, 2) typical length of sentences, and 3) the pattern of parole decisions. South Carolina includes: 1) the number of parolees, 2) economic variables, and 3) the population at risk. Table 2 lists the factors employed by those states utilizing multiple regression.

The degree of success reported by the states that have used the multiple regression technique is not all that encouraging. New Mexico, for instance, reports less reliability for this method than for linear regression. Wisconsin states that the technique has produced "no improvement over linear admissions model," while the comment from Texas is that the

reliability of multiple regression has been "inadequate due to change (legislative) in parole assumptions." Colorado remarked that their projections utilizing multiple regression have turned out to be conservative, and attributed the discrepancy between the projected and actual population to the passage of mandatory sentencing legislation.

A few states have approached population projections through use of a simulation model. The purpose of such a model is to reproduce the workings of the criminal justice system, or of a part of that system. For example, the model employed by Georgia attempts to simulate the movement of offenders through the prison system. In order to do this, actual release policy was studied. Since sentence length and the amount of time actually served differ considerably, the distribution of time actually served for each different sentence length was examined for 18,000 inmates that had been released over a three year period. It then became possible to estimate how many inmates currently incarcerated would still be in prison for each successive quarter. The same process was followed for the expected future admissions. The method used for predicting admissions was an extremely simple one. A "low track" of admissions was based on the assumption that admissions would only grow at the same rate as the state population, while the "high track" assumed that the recent rate of very high growth in admissions would continue. A point midway between the two tracks was chosen

as the best estimate.

Virginia also uses a simulation model. In this state, the inmate population is divided into four groups. These four groups are: 1) misdemeanants, 2) felons currently confined in the State institutions, 3) convicted felons in local jails, awaiting admission to the State system, and 4) felons expected to be committed during the projection time frame.

Since the number of misdemeanants is very small, and has remained stable for some time, it is assumed that this population will continue to show little change. For felons currently confined, an expected release date is projected, based on trends in time served for the given sentence. Distinctions are made among expected release date, minimum discharge date, and the full sentence term. The expected date of release is likewise projected for each felon awaiting admission to the prison system. The number of felons expected to be committed--the admission figure--is determined by the projected state population, felony arrests, and commitment rates. This group is divided into seventeen categories that reflect expected sentence upon commitment. Each group is further split into one consisting of inmates expected to be paroled, and another of inmates expected to be directly discharged. After all four groups of inmates have been analyzed, the total population can be determined by adding expected new commitments to the current population, and subtracting the

number of expected releases.

North Carolina has perhaps developed the most complicated series of models that attempts to simulate the workings of the correctional system. Four different models of varying degrees of complexity have been developed.

The first is a simple flow model. In this model the prison population is partitioned into a small number of categories, represented by the nodes of a network, with each category corresponding to a custody class or group of classes. The flows between the categories are determined on the basis of flow-conservation equations.

The second is a general Markov deterministic population model. In this model, a subdivision of the population into various categories (such as custody levels) is combined with a detailed representation of transfers between these categories by means of a matrix of transition probabilities.

The third model developed, a systems-dynamics model, is one in which the system is modeled in continous time. Population levels are represented as continous variables, with flows governed by functional relations that can show time-delay and feedback effects.

The fourth model in question is the most complex: a discrete event digital simulation of the system, in which the progress of inmates through the system is tracked. Statistics are gathered on inmate characteristics such as age, sex, custody classification, crime category, sentence length, history of infractions, and so on.

The models were developed so that the effect of alternative policies on the correctional system could be assessed. The policies in question involved: 1) parole policy and the effect of an elimination of paroles, 2) sentence length, and 3) the transfer of inmates between custody levels.

Although some of the models developed by North Carolina become very complicated in the effort to trace an inmate's progress through the system, these models do not address themselves to another important input into the correctional system, the number and rate of admissions.

If the North Carolina methodologies emphasize what happens to an inmate once he enters the correctional system, the Maryland technique is primarily directed towards predicting the probability of an offender entering the system in the first place. Maryland planners have recognized the well-known weaknesses of the linear regression technique that relies on past inmate populations as the data base. As a result, they have developed the "arrest/demographic" technique to help provide more accurate projections.

Although this method does make use of length of sentence data in making projections, the technique applied here appears to be rather unsophisticated. The main thrust of the Maryland technique involves the prediction of admissions through an examination of arrest and population trends.

In this technique an analysis is made of current arrest rates for specific crime types as a function of the age, sex and race of the state's population. An assumption is made that current arrest rates for specific crime types and demographic groupings of the population will remain more or less constant for several years. Thus, any change in the number of arrests would be the result of changes in the total population of the state and/or its demographic composition over time. For example, if the arrest rate for non-whites is several times higher than for for whites in particular crime categories, it is assumed that this differential will continue. If the population projections show that the non-white segment is expected to increase, the number of arrests can be adjusted accordingly.

An analysis is also made of the current probabilities of being convicted and sentenced to a correctional institution for a specific crime type. Once again it is assumed that this probability will remain reasonably constant (until 1985). The objective of this simulation model is to trace the progress of an offender through the criminal justice system.

Since crime rates do not necessarily translate into potential prisoners, the starting point is arrests. Inmate intake is seen as equivalent to "the number of adult apprehensions times the product of several intermediate 'offender'flow probabilities or percentages (e.g., the probability given arrest of going to trial, the probability given trial of being

convicted, the probability given conviction of being sentenced to a State Correctional facility)."

One noteworthy feature of Maryland's technique is that the analysis of arrest rates and the probability of incarceration is broken down into specific crime types. This should allow the criminal justice planner the opportunity to gauge the impact on prison populations of a sharp rise in arrests and convictions for one particular crime, even when the trend elsewhere is downward.

So far, we have briefly covered those states reporting use of either multiple regression, or a simulation model. A different approach has been taken in Indiana. The correctional planners in that state have remarked:

> In the analysis of potential projection methodologies it quickly became apparent that traditional mathematical models, such as trend analysis, classical forecasting, and time series would not incorporate the effects of many of the factors which are presently causing major increases in the correctional population. Many of these factors cannot be quantified in a statistical manner, but instead must be viewed from a qualitative perspective.

The factors included in the analysis are: societal attitudes and conditions, population and economic conditions, crime and arrest rates, implications of the new State Criminal Code, past and present utilization of probation and other community alternatives, and parole policies.

It should not be assumed that the largely qualitative multi-factor approach used by Indiana necessarily represents a less advanced stage of population projection methodology. In some respects precisely the opposite may be the case. An

excellent example is furnished by the discussion on population and economic factors. The correctional planners in Indiana believe, as do other planners elsewhere, that the depressed economic conditions will give way to a more favorable situation. They point out, however, that "the unemployment rate for the 20-29 age group will not significantly improve over the next five years. This situation will be especially true of minority groups." Thus a very considerable improvement in the aggregate economic indicators may have little effect since the improvement would not be filtering down to the most crime prone segments of the general population.

One possible weakness of Indiana's approach is that there is a tremendous range between the low and high projections (low: 5,014; high: 10,028). These projections are for 1981 and there is no comment as to which projection, the low or high, is more plausible.

New York also uses a multi-factor approach, although the factors involved are somewhat different than those used by Indiana. Oregon likewise employs a variant of the multi-factor approach. In that state, the size of the population at risk (males 15-29) is studied, and cycles of "public sentiment" are analyzed. Let us quote the Oregon report, since the approach is somewhat unorthodox:

> We believe we see a pattern: without regard to details of law or events, public sentiment appears to control the percentage of the risk group which must at any given moment be under state felony control, and the percentage of those under control who will be confined. Every 20 years, public sentiment shifts and a new and higher percentage is established. It takes from five to seven years for the new level to be reached, and it thereafter

> remains fairly constant for the remainder of the twenty year cycle. At all times, however, the level actually noted is modified in direct relation to two factors: Oregon rates of unemployment, and U.S. Military strength as a percentage of the national risk group.

Most of the other states that carry out population projections employ some variant of demographic analysis. New Jersey, for instance, breaks down the state into "catchment" areas and determines the expected prison population for each area. The projected population for the entire state is studied, as well as the confinement rate for certain subgroups of the population. In particular, the confinement rate for males aged 10-44, and for non-white males in the same age bracket, is examined.

Rhode Island offers projections based upon: 1) the highest incarceration rate per 100,000 for 1970-77, 2) the average of the highest and the lowest rate for 1970-77, and 3) the average rate of increase from 1970-77.

New Hampshire analyzes these factors: 1) projected population for each county in the state along with an age breakdown, 2) the anticipated conviction rate, based on historical data, 3) the relative distribution of offenses, and 4) detailed information relating personal factors to criminal record.

Utah studied the ratio of the average prison population to the population of the state, going back as far as 1900. War years were excluded, and fifty people were added to the projections for 1985 and 1990 on the assumption that Utah's low incarceration rate would move closer to the national average.

Nebraska analyzed the S-shaped growth curves of the prison population and compared the incarceration rates at different points with the expected growth of the population at risk (defined as the age group from 20-29). This state also analyzed the lag between admission and release (found to be two years), and projected total population by assuming that this pattern would continue.

Iowa analyzed the growth in the population at risk group (males aged 15-29), and also the expected growth in the crime rate. Several projections were offered, reflecting varying degrees of optimism.

Minnesota analyzed the commitment rate to state institutions along with the growth in the population at risk. Total population was projected using these factors along with that of sentence length.

Most of the states reported that there were constraints involved in the process of making population projections. Although lack of money, political interference, and the lack of inter-agency cooperation were reported occasionally, several other constraints were cited much more frequently. These were the lack of sufficient data of high quality, the absence of specially trained staff, and policy changes. More states mentioned "insufficient data" as a constraint than any other difficulty.

In summary the survey has generated a picture of the diversity of methods and approaches currently employed. Several states do not perform any population projections,

while others have developed methods of considerable sophistication and complexity. Certain common features are apparent in those states that do perform projections. In the area of inmate length of stay, there is an attempt to determine the actual amount of time served by inmates as opposed to the official sentence length. In trying to predict admissions, population at risk and the unemployment rate are used more frequently than other factors. It will be noted that the age group included in "population at risk" varies considerably: in one state it is males 15-29, in another, males 18-34, and so on. No particular reasons are given as to why certain ages rather than others are included. Many of the states claim that unemployment is a reliable predictor of admissions, but a few states dispute this claim. In a case like this it is difficult to tell whether a prediction is valid or invalid everywhere or whether the special conditions found in different states are decisive.

It is similarly difficult to judge the merit of a particular prediction methodology. If a high degree of accuracy is reported for a given state over a period of several years, that may or may not indicate generalized value for the methodology. The way in which to determine the comparative merit of methodologies presently available--quite apart from the issue of developing better techniques--may well be to test a specific methodology, using data for several decades, in a single state. Those that pass this test with the greatest degree of success

could then be tried in other states. If nothing else, a procedure of this sort would enable correctional planners and researchers to understand more fully the extent to which conditions bearing on prison population in the states are similar or dissimilar.

POPULATION PROJECTIONS PERFORMED BY THE STATES

STATE	Projections Published	Linear Regression	Multiple Regression	Simulation Model	Short-term Projections Years	Long-term Projections years
Alabama	x	x			3	
Alaska					2	
Arizona	x	x	x		4	
Arkansas		x				
California	x			x	2	10
Colorado	x	x	x		-	5
Connecticut		Projections not performed				
Delaware		Projections not performed				
D.C.	x	x		x	6 mos	1
FLORIDA	x	x	x	x	3	25
Georgia	x			x	6	6
Hawaii	x	x			6 mos	3
Idaho	x	x		x	5	15
Illinois	x	x	x		1-2	10
Indiana	x					4
Iowa	x					10
Kansas		Insufficient Data				
Kentucky		x			2	5
Louisiana		No Response				
Maine		No Response				
Maryland	x	x		x	1	5
Massachusetts	x	x			2	4
Michigan	x				2	
Minnesota				x		
Mississippi		Projections not performed				
Missouri		No Response				
Montana	x					24
Nebraska	x	x			1	20
Nevada	x	x			2	4
New Hampshire	x					25
New Jersey	x				4	9
New Mexico	x	x	x		2	5-8
New York					2	5
North Carolina	x				3	
North Dakota					3	10
Ohio	x	x			1	
Oklahoma	x	x			2	5
Oregon	x				5	24
Pennsylvania	x	x			1	2
Rhode Island	x				7	18
South Carolina	x					10
South Dakota		No Response				
Tennessee					5	
Texas	x	x	x		3	10
Utah	x	x			3	13
Vermont		No Response				
Virginia	x	x		x	5	5
Washington	x	x			2	6
West Virginia	x				3	3
Wisconsin		x	x		2	5
Wyoming		No Response				

TABLE 2

FACTORS USED IN MULTIPLE REGRESSION BY STATES EMPLOYING THIS TECHNIQUE

Florida	1. Population at Risk	2. Unemployment Rate	
Illinois	1. Population at Risk	2. Unemployment Rate	
Colorado	(admissions) 1. Unemployment rate for preceding quarter	2. Average percentage of yearly commitments received each quarter	3. Population at Risk
	(total population) 1. Percentage of all commitments received three quarters earlier with an indeterminate minimum sentence	2. Parole revocation level during this quarter	3. Number of commitments projected for the quarter.
Wisconsin	1. Age specific census data	2. Economic factors such as employment and income	3. Arrest rates and conviction data
Texas	1. New receives per annum	2. Paroles per annum	3. Dischares per annum
New Mexico	1. Intake statistics over the past decade	2. State population change	3. Critical age groups in the work force
Arizona	1. Number of admissions	2. Typical length of sentences	3. Pattern of parole decisions
South Carolina	1. Number of paroles	2. Economic variables	3. Population at risk

TABLE 3

SUMMARY OF SURVEY RESULTS

STATES SURVEYED:	50
STATES RESPONDING TO THE SURVEY:	44 88%
RESPONDING STATES FURNISHING DOCUMENTS:	20 46%
RESPONDING STATES THAT PUBLISH PROJECTIONS:	32 73%
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