



Oregon Inmate Population Forecast Methodology

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Foreword

The Office of Economic Analysis (OEA) issues the Oregon Corrections Population Forecast. Executive Order EO-95-06 and Oregon Revised Statute (ORS) 184.351 direct OEA to issue this forecast each April and October. The Oregon Department of Corrections (DOC) uses the forecast for planning and budgeting. This paper describes the methods used to produce the forecast.

One committee helps OEA with the forecast. The Corrections Population Forecasting Advisory Committee consists of members who know about the criminal justice system and trends that can affect DOC's population. Members are appointed by the Governor and serve four-year terms. The Committee helps OEA interpret current trends and set assumptions about the future.

Readers with questions about this paper or the forecast may contact the Senior Analyst on the contact link.¹

¹ <http://www.oregon.gov/DAS/OEA/Pages/corrections.aspx>

I. Overview

The Corrections Population forecast projects ten years into the future. It consists of state prison inmates that are serving time in a state correctional facility (prisoners who are transferred to other states, are missing, or are under the authority of the Oregon Youth Authority are excluded from the prison population count).

Oregon's sentencing laws underwent major revisions in 1989, 1995, 1997 and 2008. These changes affected whether felons went to prison or community corrections, and they affected sentence length.

The forecast is produced with a *flow* model. A flow model works by moving cases through various points in the criminal justice system. These points are intake, release, and revocation.

The population is calculated for the first day of each month. Using February 1 as an example, the equation to forecast the population is:

FEBRUARY 1 POPULATION = JANUARY 1 POPULATION + INTAKES DURING JANUARY – RELEASES DURING JANUARY.

Intakes are forecast based on recent intake trends, arrest trends, court case filings, demographics, forecasted population growth, and on the likelihood of re-offending after being placed on probation or post-prison supervision. Releases are calculated by using estimated lengths of stay and projected release dates for each offender group.

II. Forecast Elements

a. DATA SOURCES

These data sources are used in the forecast:

- DOC Corrections Information System (CIS) data.
- Oregon Criminal Justice Commission (OCJC), Felony Guidelines Sentencing Reports
- Oregon Office of Economic Analysis, Oregon population forecast by age.
- U.S. Census Bureau and the Oregon Population Research Center, Oregon historical population by age.
- Oregon Judicial Department (OJD), ORS Charge Counts

DOC provides reliable data from January 1994 to present on intakes to prison and community supervision. Some of the most important data elements for the forecast are listed below.

- Type of intake (prison, probation, local control, etc.)
- Major crime of conviction

- Date of intake
- Previous supervision status
- Actual or projected release date
- Birth date (age)
- Reason for intake (new conviction or parole or probation violation)
- Reason for release (revocation or successful completion)

b. OFFENDER GROUPS

The corrections population consists of several offender groups. They are defined below.

Measure 11

Measure 11 (ORS 137.700 and 707) was passed by Oregon voters and took effect in April 1995. It mandates minimum sentences for any of 21 violent crimes, ranging from 70 to 300 months. Measure 11 inmates must serve their entire sentence and are not eligible for credit for good behavior (called *earned time credit*). Juveniles aged 15 and older who are charged with a Measure 11 crimes are automatically waived into the adult justice system.

Repeat Property Offenders (RPOs)

ORS 137.717 took effect in July 1997. It established 13 or 19 month presumptive sentences for repeat property offenders (RPOs). The 1999 Legislative Assembly created the crime of Identity Theft (ORS 165.800) and added it to the list of crimes covered by RPO. The 2001 Legislative Assembly added Forgery 1 to the RPO list. In 2008, M57 made it easier for people to qualify for RPO sentencing and made the sentences longer. HB 3194 in 2013 lowered the sentences for ID theft.

All Other Prison Inmates

Most offenders are sentenced under Sentencing Guidelines (ORS 137.010). Sentencing Guidelines were established in 1989. They establish a range of punishment based on the crime of conviction and the offender’s criminal history. This range is called the *presumptive sentence*. The Court may impose a sentence below the presumptive range if there are mitigating facts. A sentence above the presumptive range can be imposed if a jury finds there were aggravating facts. A sentence outside of the presumptive range is called a *departure*.

A Sentencing Guidelines sentence can be reduced only by credit for time already served, and by earned time credit (ETC). If the Court allows it, an inmate can earn time credit for good behavior. The maximum available ETC is 20 percent of the sentence (HB3508 extended it to 30 percent for certain crimes for a limited period). Some Sentencing Guidelines inmates are eligible to participate in alternative incarceration programs (AIP). An inmate who successfully completes such a program can earn a reduction of more than 20 percent.

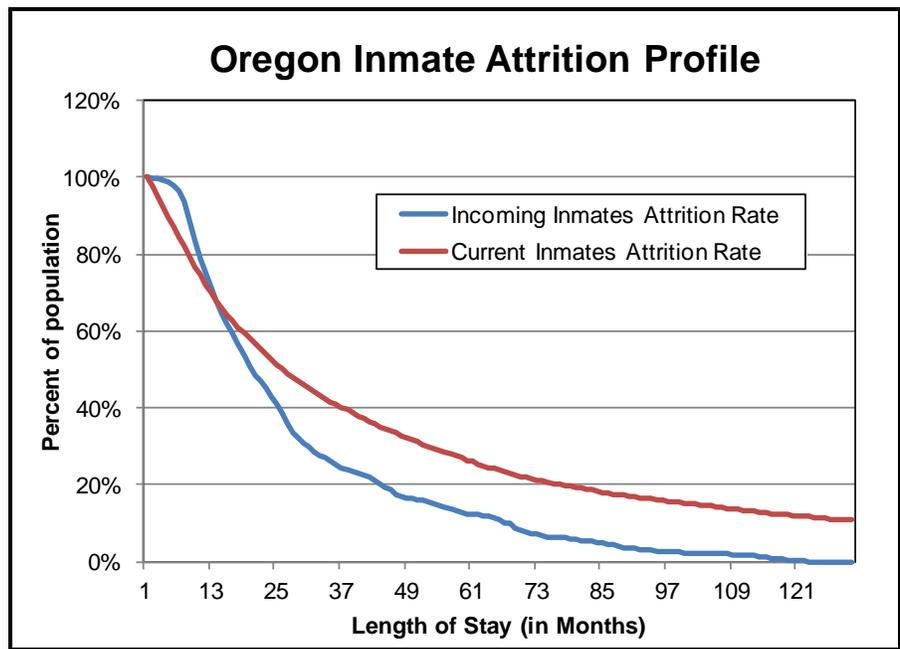
III. Creating the Forecast

a. MODELING CURRENT INMATE POPULATION

The inmate forecast uses a model which simulates inmates entering prison, their length of stay in prison, and final release. The primary driver of the forecast in the short term is the release rate of the existing prison population. In the long term, new intakes drive population trends. The rate of intakes and releases results in turnover of about half the inmate population every two years.

The length of stay (LOS) for inmates is critical in modeling releases from prison. The fundamental information for estimating an inmate's length of stay – the inmate's sentences – is known for most current inmates. With sentence information, releases can be modeled in a simulated fashion. It is important to note that the length of an inmate's stay is not a simple fixed number of months that is known when they enter prison. Standard upper and lower bounds are computed by DOC based on how the inmate's sentences combine, but deviation both within and without the bounds must be handled statistically. The long term prison population depends primarily on future intakes (number and lengths of stay). In contrast to releases, future prison intakes cannot be mechanically determined based on any current information. The baseline (before accounting for law changes) intakes are forecasted based on the historical trend. The trend integrates demographics, criminal justice practices, and other factors which influence intakes and sentence lengths. The forecast assumes future intakes will be similar to what is observed in trends from the recent past.

Modeling the prison population relies on both the number of intakes each month and how long each will stay (LOS is needed to establish release timing). The forecast handles this by simulating the full distribution of lengths of stay; in other words, the forecast tracks the number of intakes broken down by LOS in one month increments up to 10 years in a flow model. The total time in months adding up all the individual lengths of stay for intakes is termed 'intake volume', and is measured in bed-months. For example, if intakes



Graph 1

occurred at a fixed level of 10,000 bed-months per month for many years, the prison population size will eventually equal 10,000 beds. That would represent a steady-state population level where intakes exactly equal releases every month.

The approach assumes that, absent law changes (i.e., the baseline case), prison intakes are a statistical rate function of the number of people in Oregon (by gender and age). The approach first establishes historical average lengths of stay by age and gender grouping. The number of intakes for each grouping is determined by the Oregon demographic forecast (forecasted growth of Males ages 18-39). Finally, the population-adjusted number for each grouping is applied to the length of stay for the group to estimate the future intake volume.

So there are two flow models that are made that integrate into one to create the final baseline forecast. First is the present inmate population; second is the future inmate intake. Graph 1 illustrates how these two populations attrition out over time.

Other Variables That Affect LOS

There are other variables that affect the LOS of an inmate:

- Parole (for criminals who were sentenced before 1989)
- Death
- Resentences
- Move to other states
- Alternative Incarceration Programs (aka AIP or boot Camp)

Some of these variables are small enough to be excluded from the model due to its negligible effects. Others are not. The main method of calculating these variables is not by creating individual variable adjustments but rather a meta-adjustment for all of them except for a few examples. Once the initial calculation has been made for the LOS, it does not perfectly match the actual LOS that is seen in the data when the projected LOS is benchmarked with historical data. The variables above are the main reasons for this dichotomy. Therefore the analyst must project back into the data the LOS estimates and create add factors that adjust for these variables until the actual historical data aligns with your historically projected calculation.

The death estimation is hard to predict. But if the data states that prisoner X has an estimated length of stay of over ten years (since the forecast goes for only ten years anything past ten is moot) and the prisoner is 78 years old, there is a high probability that the prisoner will not last to 88. There is a small calculation done to estimate these deaths.

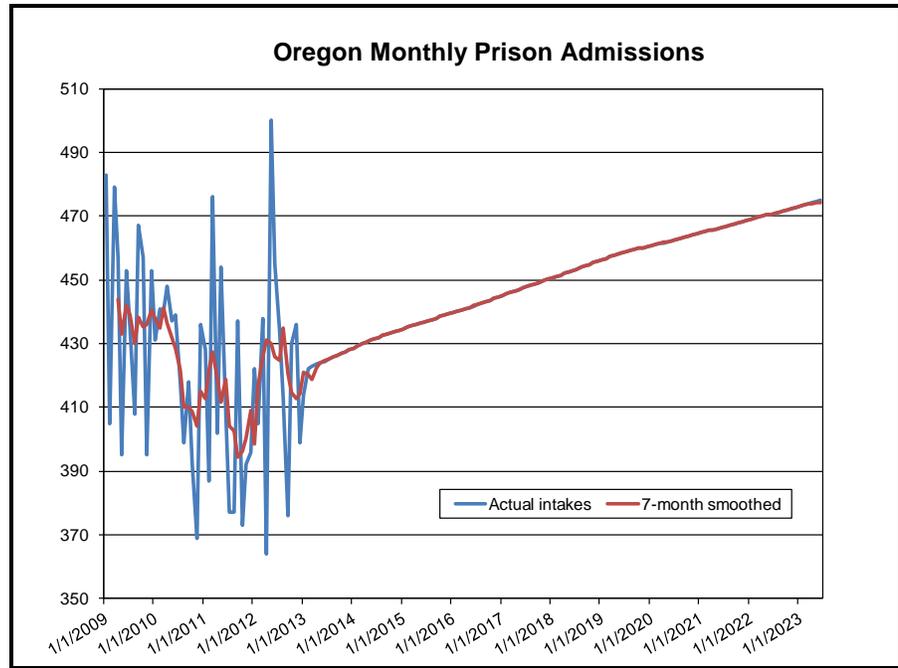
Alternative incarceration is a variable that the legislative branch can manipulate, recently there was an add factor to the model to adjust to new legislation that pit more prisoners in the program, thus lowering the number of prison beds.

b. CREATING FUTURE INMATE INTAKE FLOW MODEL

Prison intakes are the major determinant of the long term prison population size, so it is valuable to have factors which are predictive of future intakes.

Currently, the way the calculation is created to generate the future intakes is by looking at the last year of intakes by month and modeling a pattern of intakes by age cohort and LOS of those cohorts. The model then integrates the projected growth in those age cohorts (this data is provided from the demographic forecast) and forecasts future intakes (and LOS of those intakes) by projecting the current distribution by the anticipated growth. This data is then benchmarked to the historical data to identify any mistakes in the model or add-factor adjustments that may be needed to create a closer match.

The final number of the inmate population equals the sum of different groupings which are calculated in this fashion: current cohort of inmates with an estimated LOS of 6 months equals last month's cohort of inmates with an estimated LOS of 7 months plus the projected inmate intake cohort of 6 months.



Graph 2

c. FORECAST=BASELINE + MODEL ADD-FACTORS

The Oregon Prison Population Forecast consists of an amalgam of up to 5 forecast models. Four of them are in the baseline growth model which is: the sum of the female inmate forecast; male person crime inmate forecast; male property crime inmate forecast; and male statutory crime inmate forecast. In addition to these four, an additional new law impact add-factor may be added to the model if there have been recent law changes.

The reasoning for the bifurcation is derived from the forecast methodology. The baseline model is derived purely from empirical historical DOC data that the modeler can base their forecast from. The new law impacts forecast is an estimation of the effects on the inmate population a new law would have. There is no historical data to base these estimations from so the estimations usually have a higher error rate than the baseline.

d. CREATING THE BASELINE

As mentioned above, the baseline is the sum of four distinct forecasts (female inmate forecast², male person inmate forecast, male property inmate forecast, and male statutory inmate forecast) which have distinct growth rates, intake patterns and average length of stay.

All four models use the exact same LOS analysis and intake trends analysis that is iterated above to create the four separate forecasts.

e. MODEL ADD-FACTORS (NEW LAW IMPACTS)

New law impact estimates are outside the baseline model and have a different methodology. The original estimate for any law change add factor is derived from the Oregon Criminal Justice Commission (CJC) official impact estimate that is published in any House Bill or Measure that would have an effect on the prison population. If the bill or measure goes into effect, that impact estimate is integrated into the model. One thing to point out is that the impact estimate is only integrated after it has been passed. It does not matter what probability the new law has of being passed, the OEA will not use it in the forecast model until the law goes into effect due to “current law” assumption that the forecast assumes.

No law that has less than one year of historical data is integrated into the baseline model. Yet, the original CJC estimates are not always used for the whole period. After there is solid prison data that show the effects of the law (this takes a bit of time after it is passed since the actual prosecution, conviction and sentencing of any given law can have a lag of a few months before it appears in the prison data) the prison analyst conducts a preliminary analysis to calculate if the CJC estimate overestimated or underestimated the law. The prison analyst also talks to prosecutors and judges in the *Corrections Population Forecasting Advisory Committee* to understand how they are implementing the new law. If the prison analyst deems that the original CJC impacts estimate needs to be revised, it is done in the next forecast.

f. SEASONAL ADJUSTMENT COMPONENTS

The Oregon DOC prison data has an observed seasonality in the data but parsing that seasonality is quite difficult. Some reasons for this difficulty are that the data is strewn with non-seasonal fluctuations, especially the data over the past five years due to the 30 percent earned time credit (HB3508), implementation of M57, suspension of M57 and resumption of M57. These and other factors put noise in the data making it difficult to parse out the true nature of the seasonal oscillation. Therefore the current monthly adjustments are a hybrid of e-views historical seasonal adjustments, historical analysis (with add factors), and intuition.

These seasonal adjustments were then benchmarked with historical forecasts to analyze its accuracy and make further adjustments. The final version of the seasonal adjustment is in table 1.

² Due to the small size of the female population in the Oregon prison system, the error ranges and marginal benefit of creating three crime class categories was deemed unacceptable.

One will notice that not only is there a seasonal adjustment but also a daily one. The reasoning behind a daily adjustment is that the prison forecast is not an estimate of the monthly average, rather an estimate of the population on the first of the month. Prison population naturally oscillates ± 50 beds depending on the day week or holiday. For example, a Friday has a high of about 20-25 beds above the normal bed count while Monday is below the normal bed count. Since the forecast predicts the bed count on the first day of the month, seeing which day of the week it will fall on, (an official holiday also affects the count) and making a small automatic adjustment can improve short-term accuracy.

Month	Month Adj	Day	Day Adj
January	-90	Sunday	-6
February	-63	Monday	-6
March	-18	Tuesday	-13
April	12	Wednesday	6
May	23	Thursday	3
June	41	Friday	22
July	40	Saturday	-6
August	52		
September	30		
October	28		
November	-9		
December	-46		
Sum	0	Sum	0

Table 2

The seasonal adjustment was created to synthesis the oscillation ex-post. Therefore any intake trends that demonstrate seasonality are relegated to this adjustment and growth is maintained in a smooth nature.

For the sake of semantics, this adjustment is called “seasonally adjusted forecast” when in theory it should be called the raw forecast and the raw forecast should be called the seasonally adjusted forecast. Seasonal adjustment usually takes the oscillating seasonality of historical data sets and smoothes it. This one takes forecasted data and implements oscillation.

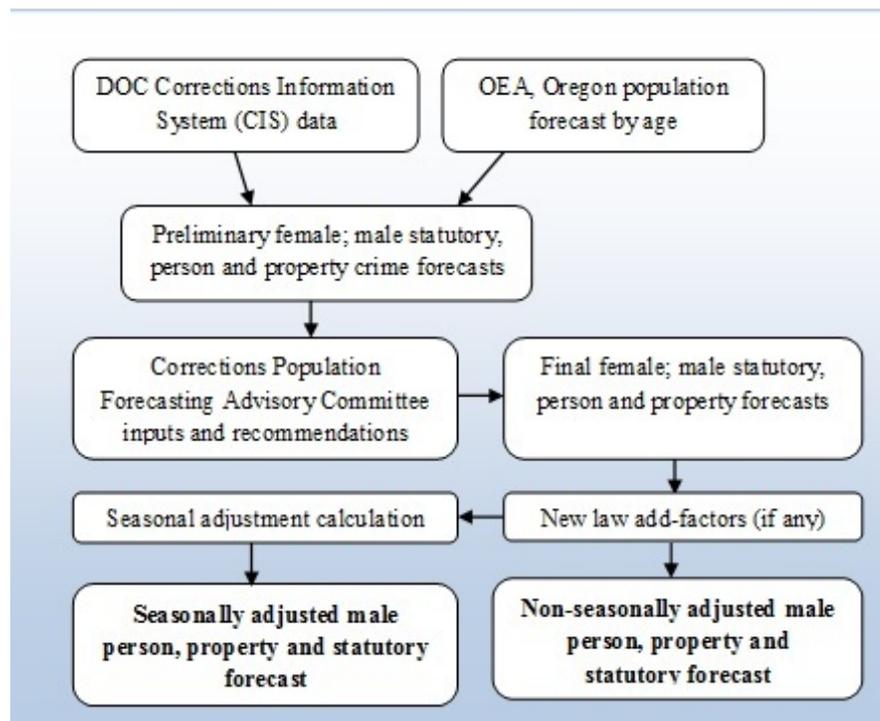
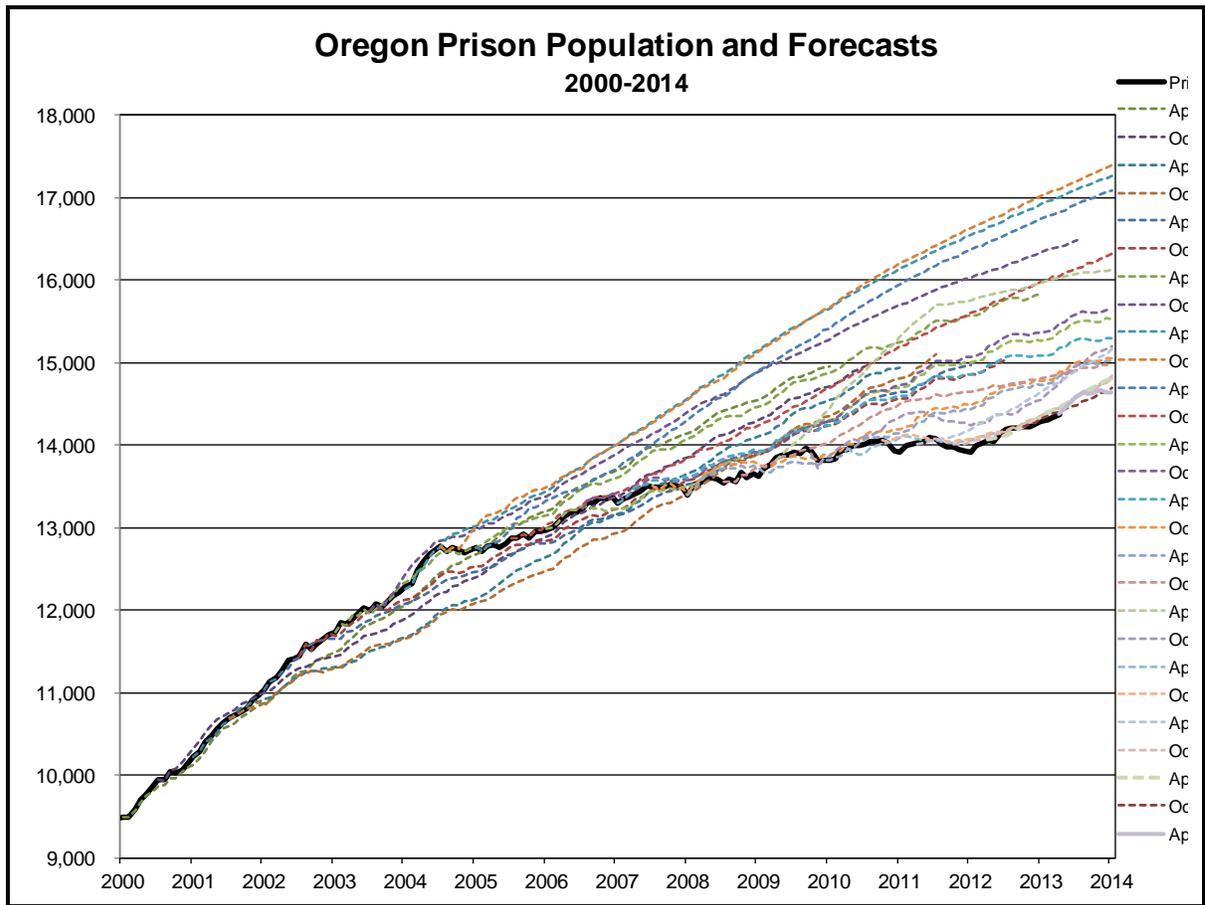


Figure 1

IV. Model Performance



Graph 3

The current model has been used since the April 2013 Forecast. The previous model was in place from October 2008 till October 2012 and the current model is derived from the previous one with a few updates that integrate the seasonal adjustment and individual crime types for male inmates.

Graph 3 and Table 3 illustrate how actual prison populations have compared to prison population forecasts. Forecast accuracy³ has changed significantly over time. Early in the 2000's, growth in Oregon's prison population was coming in significantly faster than was predicted. At that time, the forecast called for a moderation in the rapid prison population growth that had been seen since the passage of Measure 11. This expected moderation was in keeping with slower migration trends into the state and the maturity of Measure 11. Most of the serious criminals that were sentenced before Measure 11 was passed had served their time, aside from those who received very long sentences even in absence of the new rules.

³ For a more in-depth discussion on this subject, please refer to our [forecast accuracy analysis document](http://www.oregon.gov/DAS/OEA/Pages/corrections.aspx) at <http://www.oregon.gov/DAS/OEA/Pages/corrections.aspx>.

After under predicting the prison population for several forecast rounds, the baseline population forecast and Measure 11 impact estimates were revised upward significantly in the middle of the 2000's. In hindsight, these forecast adjustments were particularly poorly timed, coming just before the nationwide decline in crime rates and moderation in Oregon's prison population growth. This vintage of population forecasts has proven to be less accurate than any produced before or since (excluding those that reflect major law changes).

From 2006 to 2008, forecasts of prison population became increasingly accurate as the moderation of population growth became clear in the data and was reflected in the outlook. The baseline (net of new policy impacts) prison population forecast has been stable since this time.

The passage of Measure 57, which increased sentences for repeat property offenses and other crimes, led to a marked increase in the prison population forecast beginning in April 2009. In later forecasts, the initial

impact estimates for Measure 57 were revised downward for two reasons. First, intakes and sentences associated with Measure 57 crimes during 2009 were observed to be smaller than expected in the initial impact estimates used in the voter's pamphlet. Also, implementation of Measure 57 was halted by policymakers until January 2012, leading to a sharp decline in the near-term population forecast.

All told, for the period from 2000 to 2012, the near-term prison population forecast has been reasonably accurate. Excluding the impact of major law changes (such as the suspension of M57 in 2010), when looking two years into the future, the forecast has remained within 4% of the actual prison population. On average, the two-year-ahead forecast has overstated near-term population growth by 0.90 percent (135 inmates) and the one-year-ahead forecast has averaged 0.56 percent (81 inmates).

Forecast Release Date	Forecast Deviations		
	1 Year Forecast	2 Year Forecast	5 Year Forecast
Apr-00	-64	-218	44
Oct-00	79	-205	-75
Apr-01	-218	-518	-328
Oct-01	-334	-521	-517
Apr-02	-141	-397	-184
Oct-02	-105	-280	-60
Apr-03	-75	94	633
Oct-03	159	440	1,096
Apr-04	310	467	1,448
Oct-04	547	524	1,625
Apr-05	285	454	1,627
Oct-05	3	236	1,002
Apr-06	-107	74	809
Oct-06	74	195	1,041
Apr-07	178	206	922
Oct-07	135	-77	529
Apr-08	-111	4	480
Oct-08	41	347	N/A
Apr-09	761	1,474	N/A
Oct-09	121	310	N/A
Apr-10	47	71	N/A
Oct-10	68	35	N/A
Apr-11	261	396	N/A
Oct-11	-23	N/A	N/A
Apr-12	-95	N/A	N/A

Table 3

Appendix A: Corrections Population Forecasting Advisory Committee

Honorable Julie Frantz (Chair)
Kristin Wings-Yanez
John Haroldson
Greg Hazarabedian
Craig Prins
Donald Rees
Colette Peters
Jeffery Wood
Diana Simpson

Multnomah County Chief Criminal Judge
Board of Parole & Post-Prison Supervision
Benton County District Attorney
Public Defender Services of Lane County
Criminal Justice Commission Executive Director
Multnomah County Deputy District Attorney
Director Department of Corrections
Director Marion County Community Corrections
Benton County Sheriff