Office of the Federal Detention Trustee

FEDERAL PRISONER DETENTION
A METHODOLOGY FOR PROJECTING FEDERAL DETENTION POPULATIONS

John Scalia, Jr.
Statistician
Office of the Federal Detention Trustee

21 September 2004

ABSTRACT

The Office of the Federal Detention Trustee (OFDT) was established during fiscal year 2001. Consistent with its statutory authority, during fiscal year 2002, OFDT began to increasingly assume certain program management responsibilities from the United States Marshals Service in order to better manage, plan, and coordinate federal detention resources. One of OFDT's primary areas of responsibility is to formulate and manage budgetary resources to support the federal criminal detention program. Accordingly, OFDT assumed primary responsibility for monitoring and projecting the size of future detention populations. The OFDT population projection methodology relies on micro-simulation techniques to track and forecast the experiences of individual offenders. Statistically, the accuracy of population projections is dependent upon the size of the population projected, the variability in the data series, and the length of the forecast interval. Experts generally consider correctional population projection models with a 2% per annum error reliable. Unlike the projected of incarcerated populations, there is no clear and patent leading indicator of the number of persons to be admitted to the detention population. Absent a leading indicator, future arrest/booking cohorts have been estimated using time-series statistical techniques. Time-series models are based on the assumption that the past is prologue of the future. However, in an environment where the underlying trend can be substantially impacted by exogenous factors, time-series models will not produce reliable projections. In an effort to produce more reliable and valid projections of arrests/bookings, OFDT is working with the federal Bureau of Prisons and the Executive Office for U.S. Attorneys to (1) develop a methodology for measuring the impact of changes in law enforcement personnel on U.S. attorney workload, and (2) establish mechanisms for identifying and measuring the impact of U.S. attorney initiatives and changes in AUSA staffing levels on the detention population.

Key words: Detention, Population Projections, Queuing Theory, Micro-simulation

EXECUTIVE SUMMARY

The Attorney General has primary responsibility for the custody of persons who have violated federal laws. The functional responsibility for housing persons detained pending adjudication of offenses charged in the federal courts has been delegated to the United States Marshals Service (USMS). Similarly, the functional responsibility for housing persons convicted of federal offenses has been delegated to the federal Bureau of Prisons (BOP). Both agencies are responsible for (1) planning for budgetary and operational resources to support their programs and (2) ensuring the safe, secure, and humane confinement of offenders until such time that they are released or custodial responsibility is transferred. Following the establishment of the Office of the Federal Detention Trustee (OFDT) during fiscal year 2001 and consistent with the statutory directive, during fiscal year 2002, OFDT began to increasingly assume certain program management responsibilities from the USMS in order to better manage, plan, and coordinate federal detention resources.

One of OFDT's primary areas of responsibility is to formulate and manage budgetary resources to support the federal criminal detention program. Budgeting for detention is not an easy task. Federal criminal detention is influenced by a variety of factors that are largely beyond the control of the USMS and OFDT. For example, neither the USMS nor OFDT have a role in determining which offenders are prosecuted in the federal courts or in determining which offenders are ordered detained pending adjudication. By contrast, Immigration and Customs Enforcement (ICE) is better able to manage its population within the appropriated budget authority because detention and release decisions are administrative determinations unilaterally made by agency officials. Consequently, changes in federal law enforcement priorities and activity can substantially challenge the USMS's and OFDT's ability to manage the detention program within the appropriated budget authority.

Accordingly, projecting future detention trends and estimating budgetary resource requirements for the criminal detention program has historically been a difficult task. At the macro-level, impediments to accurately projecting the detention population include the dynamic nature of the federal criminal justice process; on-going changes in federal criminal law and policy; changes in federal law enforcement priorities; and events external to the criminal justice process such as unforeseen events that might cause mass illegal migration to the United States. At the micro-level, these macro-level impediments translate to volatility in (1) the number of federal arrests/bookings reported to the USMS, (2) prosecutorial priorities and declination criteria, (3) offender/offense characteristic necessitating pretrial detention, and (4) case processing time resulting from overburdened criminal justice resources. Accordingly, projecting the impact of systemic and/or short-term events or initiatives that will impact arrests/bookings is the greatest challenge in projecting the detention population.

Beginning with the fiscal year 2005 budget submission, OFDT assumed primary responsibility for monitoring and projecting the size of future detention populations. The methodology developed and employed by OFDT to project future detention populations is substantially similar to the methodology used by the BOP to project prison populations. Both methodologies rely on micro-simulation techniques to track and forecast the experiences of individual offenders.

Consistent with generally accepted practices, the theoretical reference point for the projection methodology is based in queuing theory. Through basic queuing theory, mathematical relationships between the size of the detention population, the number of persons taken into custody, and the time they spend in custody are derived. However, because the federal criminal justice process is highly dynamic, basic queuing theory is an incomplete solution to the problem of projecting detention populations. A more robust solution is based on a general understanding of population and cohort flows through the detention process and involves the technique of *micro-simulation*. Micro-simulation techniques represent the latest advancement in population projection methodologies. According to the General Accounting Office (GAO), 27 States and the BOP use micro-simulation techniques to project prison populations. The strength of micro-simulations rests with the use individual-level data (rather than classes or clusters of observations) to replicate the flow of individuals through the criminal justice process. Additionally, the individual-level data input into the process can be adjusted with specificity to simulate the effect of known or anticipated changes that will impact the detention population.

Statistically, the accuracy of population projections is dependent upon the size of the base population, the variability of the data series trend, and the length of the forecast interval. Independent of other factors, the projections of larger populations are more precise than smaller populations; increased variability in the underlying trend yields less precise projections; and longer forecast intervals result in greater uncertainty of future events. As part of a survey of experts in the field of prison population projection modeling, the GAO reported that these experts considered models with a 2% per annum error reliable. Accordingly, for a projection 2 years into the future, the tolerable error is ± ~ 4.04%. However, despite this generally accepted error range, 27% of these experts considered past projections produced by their model "low" and 11% considered past projections "high."

Prior to fiscal year 2003, the USMS had generally over-estimated the size of the detention population for budget formulation purposes. However, beginning in fiscal year 2003, the actual average daily prison populations (ADPs) began to exceed the projected ADPs. For fiscal year 2003 and 2004, the ADPs were underestimated by 4.9% and 9.8%, respectively. While a certain degree of statistical error is supposed for any population projection, the inaccuracy of the fiscal year 2003-2004 ADP is primarily attributable to increases in the number of arrests/bookings by the USMS that were not incorporated into the population projection. For example, the fiscal year 2004 budget was based on approximately 149,000 anticipated arrests/bookings by the USMS; the actual number of USMS arrests/bookings was approximately 174,000. These additional 25,000 arrests/bookings increased the ADP by approximately 5,000.

While the GAO reported that there were no generally accepted criteria for assessing or validating the validity and reliability of projection models, OFDT uses three methods to assess model results –

• evaluating the model results by continually re-calibrating the original projections with currently observed population statistics;

• monitoring the underlying *force metrics* (or the actual number of arrests/bookings, the detention rate, and time-in-detention) of the projected detention population; and

• using the methodology to retrospectively estimate past detention populations.

Regardless of the methodology used to project the future detention population, the primary weakness of current and past population projections rests with the projection of future arrest/booking cohorts. Unlike the projection of persons admitted to the incarcerated population, there is no clear and patent leading indicator of the number of persons to be admitted to the USMS detention population. For example, the BOP uses the change in the number of indictments filed by U.S. attorneys as a leading indicator for the change in future admissions to prison. Absent a leading indicator for new arrests/bookings, future USMS arrest/booking cohorts have been estimated using time-series statistical techniques. Time-series models are based on the assumption that *historic trends – and the factors that influenced those trends – are useful predictors of future events and the observed relationships will continue into the near future.* However, in an environment where the underlying trend can be substantially impacted by exogenous factors, time-series models will not produce reliable projections.

An alternative to using time-series models is to project future arrest/booking cohorts using budgetary and staffing resources for the various law enforcement agencies and the U.S. attorneys. For example, increased resources for law enforcement normally results in more persons referred to U.S. attorneys for possible prosecution; increased resources for U.S. attorneys normally results in more defendants brought to court; more judges increases the number of defendants whose cases are adjudicated; and, as a results of more adjudications, more offenders will be sent to prison. The GAO has reported success with using such models to account for the variance in persons processed at various stages of the criminal justice process. Accordingly, in an effort to produce more reliable and valid projections of arrests/bookings, OFDT is in the process of developing a methodology for measuring the impact of changes in law enforcement personnel on U.S. Attorney workload; and OFDT is working with the Executive Office for U.S. Attorneys to establish mechanisms for identifying and measuring the impact of U.S. Attorney initiatives and changes in AUSA staffing levels on the detention population.

TABLE OF CONTENTS

Figures

Tables

Decision makers must keep in mind that no one can tell exactly what will happen in the future. Forecasting the criminal justice future is not like forecasting rain, an undertaking in which scientists keep looking for more accurate methods. Criminal justice forecasts – at best – are guesses about the future based on the past. The validity of any projection is dependent on the reasonableness of the underlying assumptions and the persistence of those assumptions into the future.

Projecting detention trends and estimating budgetary resource requirements has historically been a difficult task for the Department of Justice. At the macro-level, impediments to accurately projecting the detention population include the dynamic nature of the federal criminal justice process; on-going changes in federal criminal law and policy; changes in federal law enforcement priorities; and events external to the criminal justice process such as unforeseen events that might cause mass illegal migration to the United States. At the micro-level, these macro-level impediments translate to volatility in (1) the number of federal arrests/bookings reported to the U.S. Marshals Service (USMS), (2) prosecutorial priorities and declination criteria, (3) offender/offense characteristic necessitating pretrial detention, and (4) case processing time resulting from overburdened criminal justice resources. Accordingly, projecting the impact of systemic and/or short-term events or initiatives that will impact arrests/bookings is the greatest challenge in projecting the detention population.

The Attorney General has primary responsibility for the custody of persons who have violated federal laws. The USMS is responsible for housing defendants ordered detained by the federal courts pending adjudication; and the Federal Bureau of Prisons (BOP) is responsible for housing offenders sentenced to a term of imprisonment following conviction for a federal offense. (With the creation of the Department of Homeland Security, responsibility for the housing illegal immigrants pending their removal from the United States or other disposition was transferred from the Department of Justice to the Department of Homeland Security.) In response to growing concerns regarding the federal detention program, Congress – through the fiscal year 2001 appropriation legislation – created the Office of the Federal Detention Trustee to centralize responsibility for detention in order to better manage, plan, and coordinate federal detention resources.

As part of its fiduciary responsibilities, OFDT assumed responsibility for monitoring the federal detention population and – beginning with the fiscal year 2005 budget submission – projecting the size of future detention populations.[1] These detention population projections are used to formulate the budgetary requirements to support the federal prisoner detention program and to plan for future detention space requirements. The methodology developed and employed by OFDT to project future detention populations is substantially similar to the methodology used by the BOP to project prison populations. Both methodologies rely on micro-simulation techniques to track and forecast the experiences of individual offenders. A significant difference between the methodologies is the availability of leading indicators describing the growth rate in future incoming cohorts. While the BOP can rely on the rate of change in indictments by U.S. Attorneys to project the rate of change in offenders committed to prison, the USMS has no clear and patent leading indicator for future federal arrestees. Accordingly, projections of future incoming cohorts are currently based on time-series statistical models.[2]

Population Projection Methodologies

Beginning in the 1970s correctional researchers started to develop methods for projecting prison populations. Generally, these methodologies were derived from the field of operations research. Using the principles of operations research, the projection methodologies essentially tracked the mathematical flow of offenders through

---

1. The detention population projected for the fiscal year 2006 budget submission was the first 2-year projection to be based on the current projection methodology. For fiscal year 2004, the U.S. Marshals Service provided the projection of the fiscal year 2004 detention population to be included in OFDT's budget submission for that year.
2. *But, See,* Improving the Population Projection Methodology, *infra.*

the justice process and the prison experience.[3] Prison populations were projected by relating the flow of offenders to *stocks* of existing prisoners, and by incorporating information on average length of stay in prison. These early models were later expanded by (1) dis-aggregating the flows and stocks into groups or clusters of interest (*e.g.*, race and crime categories), and (2) projecting changes in the incoming cohorts based on age-specific demographics.[4] These *dis-aggregated flow* models were primarily concerned with the transition rates from phase-to-phase in the criminal justice process.

Dis-aggregated flow modeling was later improved to yield the approach of *micro-simulation*. Micro-simulation models project prison populations by simulating the flow of *individual* offenders – rather than groups or clusters of offenders, as required by dis-aggregated flow models – as they are processed by the criminal justice system and enter and leave the prison system. Because these techniques rely on individual-level data, micro-simulations – by default – incorporate considerable detail from the administrative data on which they are based and are less dependent on transition rates. Further, micro-simulation data may be dis-aggregated into sub-populations to monitor changes in the future detention populations according to any relevant criteria. Additionally, the individual-level data can be adjusted with specificity to simulate the effect of known or anticipated policy or practice changes. By the end of the 1990s, 24 States and the BOP were using micro-simulations to project prison populations.[5]

Other projection methodologies rely exclusively on time-series extrapolation of population trends. Although these statistical methodologies often result in accurate short-term projections, their accuracy results from a fortuitous set of circumstances in which all If the factors generating a prison population remain constant or – if they vary – they combine to yield a constant rate of increase.[6] Further, regardless of whether time-series methodologies result in accurate or inaccurate projections, by their nature these models limit – or preclude – identification of the source(s) of the observed error.

In recent years, the scientific focus has shifted from the techniques of modeling to producing more accurate estimate of future populations. Most notably, the inquiry has shifted to the more immediate determinants of population change such as the projecting the size of future incoming cohorts and the reason for admission to prison, *i.e.*, new offenders *v.* parole/supervision revocations.[7]

Components of Future Detention Populations

Queuing theory has been used as a basis for projection prison populations for more than 30 years. Through queuing theory, the mathematical relationships incorporating size of the population, input rates, output rates, and time are derived.[8] Accordingly, basic queuing theory suggests that any population (P_t) in a queue can be expressed as the product of the size of the cohort entering the queue (C_t) and the length of stay of that cohort (T_t) in the queue. Therefore –

$$P_t = C_t T_t \qquad (1)$$

---

3. *See,* Stollmack, Stephen. "Predicting Inmate Populations from Arrest, Court Disposition, and Recidivism Rates." 10 JOURNAL OF RESEARCH IN CRIME AND DELINQUENCY 141 (1973). Because Stollmack provides a sound theoretical reference point for describing future correctional populations, the mathematical terms he identifies will used throughout this report.
4. *See,* Blumstein, Alfred, Cohen, Jacqueline, and Miller, H. "Demographically Disaggregated Projections of Prison Populations." 8 JOURNAL OF CRIMINAL JUSTICE 1 (1980).
5. *See,* Sabol. William J. "Prison Population Projection and Forecasting: Managing Capacity." Bureau of Justice Statistics (NCJ-172844) (1999); General Accounting Office. Federal and State Prisons. Inmate Populations, Costs, Projection Models. (GAO/GGD-97-15) (1997).
6. Gaes, Gerald G. Simon, Eric S. and Rhodes, William M. "20/20 Hindsight: Effectiveness of Simulating the Impact of Federal Sentencing Legislation on the Future Prison Population." THE PRISON JOURNAL (1993).
7. Austin, James. Cuvelier, Steve, McVey, Aaron. "Projecting the Future of Corrections: The State of the Art." 38 CRIME AND DELINQUENCY 285 (1992).
8. *See, e.g.*, Stollmack (1973) *supra* note 1.; Yablon, Marvin. "The Application of Queuing Models to Strategies for Reducing Prison Population Size." 16 JOURNAL OF CRIMINAL JUSTICE 183. (1998).

However, $P_t = C_t T_t$ has its limitations: (1) it assumes an initially empty queue; and (2) it assumes that the queue is in a state of equilibrium. Incorporating the existing population (P_0) into the ***Equation 1*** yields –

$$P_t = P_0 e^{-1/R_t} + C_t T_t (1 - e^{-1/T_t}) \qquad (2)$$

A state of equilibrium is achieved when the number of person entering the queue/population is equal to the number of persons exiting the queue/population. Under most circumstances, *a priori*, equilibrium is a faulty assumption as the criminal justice process is highly dynamic. Therefore, while $P_t = C_t T_t$ provides an theoretical reference point, as depicted in ***Figure 1b***, because the federal criminal justice process is a dynamic system, the detention population is in a state of flux – increasing or decreasing based on changing workload and characteristics of offenders processed – and cannot be expressed by $P_t = C_t T_t$.

In this dynamic environment process changes exist that routinely impact C_t and T_t. For example, the size of the incoming cohort (C) is dependent upon a variety of factors such as (1) the number of law enforcement officers available to make arrests, (2) the number of assistant U.S. attorneys available to prosecute criminal cases, (3) the priorities of the 93 U.S. Attorneys offices, and (4) the likelihood that an arrest/booking will result in a detention.[9] Similarly, length of stay (T) is dependent upon factors such as (1) the type/complexity of the cases prosecuted by the U.S. Attorneys, (2) the likelihood of the cases being disposed of by plea or trial, (3) the complexity of the sentencing process, and (4) systemic workload constraints resulting in increasing inefficiencies.

While $P_t = C_t T_t$ can serve as the theoretical reference point, as a practical matter the ideal projection methodology is less dependent upon mathematics and more dependent upon understanding population and cohort *flows*. While population and cohort flows can be traced using several methods, the most powerful method involves the technique of micro-simulation. Micro-simulation techniques replicate the *flow* of individuals through a process, *e.g.*, the criminal justice process, to determine the population. Because these techniques rely on individual-level data (rather than classes or clusters of observations), the models – by default – incorporate considerable detail from the administrative data on which they are based. These data may be dis-aggregated into sub-populations to monitor changes in the detention population according to any relevant criteria. Additionally, the individual-level data can be adjusted with specificity to simulate the effect of known or anticipated changes that may impact $C_t T_t$. For instance, for the fiscal year 2005-2006 projections, length of stay (T_t) was increased to replicate the observed increase in detention time between fiscal year 2003 and 2004. (*See*, Table 3, *below*.)

As described in ***Equation 2***, the future detention population is comprised of two components: (1) the existing detention population; and (2) future incoming arrest/booking cohorts and their expected length of stay. Using micro-simulation techniques, the existing population (P_0), or detainees held at the beginning of the reporting period, is reduced in future observation periods based on the actual or projected length of stay for detainees in that population (equivalent to $e^{-1/R}$, where R_t is the remaining time in detention).[10] (*See*, Figure 1a.)

Future incoming arrest/booking cohorts (C_{t+1}) are engineered from a historical arrest/booking cohort. This *prototype admission cohort* is selected to maximize (1) recency to ensure that the characteristics of persons

---

9. Though all "detentions" of more than a day impact the USMS detention population, for the purposes of this analysis, an arrestee is considered "detained" if he/she is held for more than 4 days.

10. Based on the assumption of equilibrium, R_t (remaining time to be served for the standing population) and T_t (time to be served by the incoming cohort) are equal. However, if the system is not in equilibrium, R_t and T_t are not equal – with R_t being greater than T_t. For a discussion of time-served in federal prison – including differences in length of stay for incoming, exiting, and standing cohorts, *See*, Sabol, William J. and McGready John. Time Served in Prison by Federal Offenders, 1986-97. Bureau of Justice Statistics. (1999) (NCJ-171682).

booked are representative of those currently being booked, and (2) completeness of information describing the an individual's detention experience, *i.e.*, length of stay. Accordingly, the prototype admission cohort generally

precedes the projected admission cohort by 1½ to 2 years. (*See*, Table 1, *below*.) To account for changes in the size of current/future cohorts, this *prototype admission cohort* is weighted, *i.e.*, a historical arrest/bookingmay represent more than one future arrest/booking or may not be represented in future populations, to reflect the anticipated change in the size of the arrest/booking cohort in the current and each

Components of the Federal Detention Population, Fiscal Year 2004

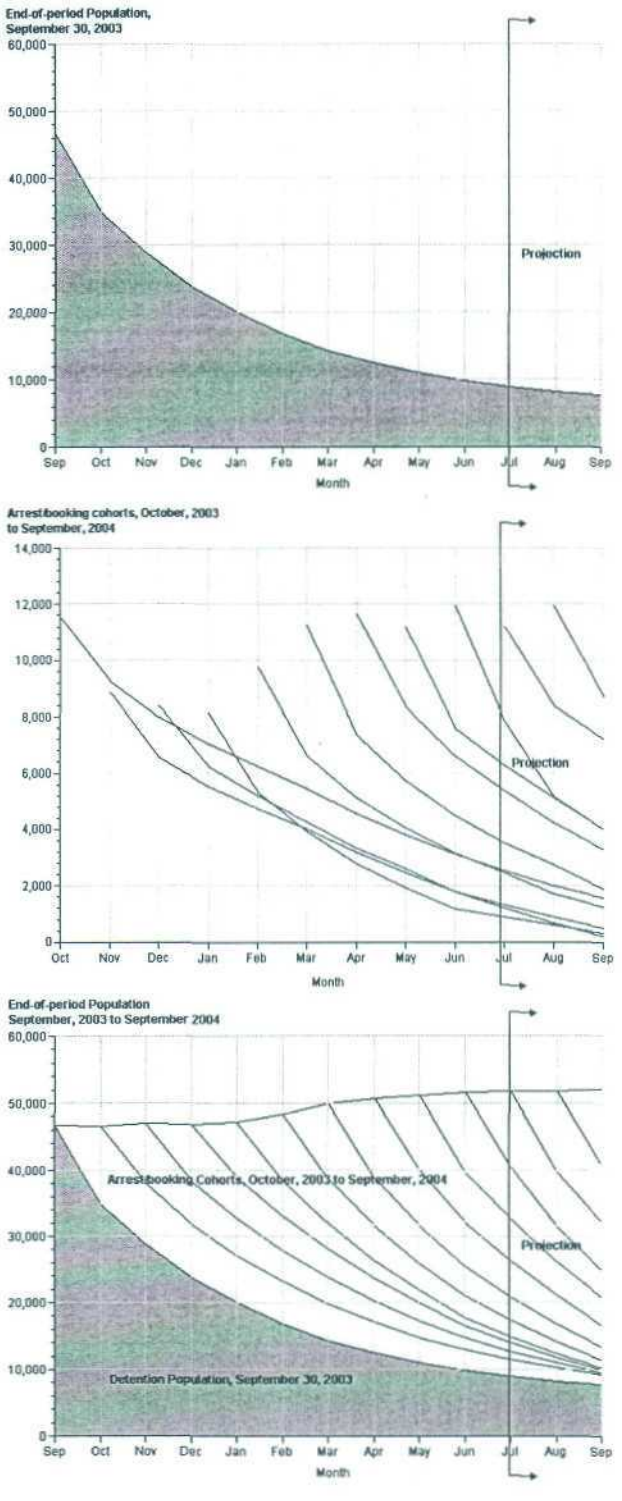


Figure 1 (a,b,c)

future period.[11] As with the end-of-period population, the size of successive arrest/booking cohorts ($C_t T_t$) is reduced in each future observation period based on (1) the likelihood that the representative individual was detained and (2) the representative individual's projected length of stay (equivalent to $1 - e^{-1/T}$).[12,13] (*See*, Figure 1b.)

By combining the existing detention population ($P_0 e^{-1/R}$) with future arrest/booking cohorts ($C_t T_t (1 - e^{1/T})$) through micro-simulation, the result is the detention population (P_t). (*See*, Figure 1c.)

As depicted in *Figure 1c*, 85% of the end-of-period detention (USMS) population is composed of admissions to detention during the prior 12-month period. By comparison, approximately 7% of the end-of-period prison (BOP) population is comprised of admissions to prison during the prior 12-month period.[14] A point of distinction between the detention and prison populations is the *velocity* of cohort movement. The velocity of detainee (USMS) movement is approximately 10-times greater than the inmate (BOP) movements, *i.e.*, the average length of stay for a detainee is approximately 6 months compared to 5 years for a prison inmate. Consequently, while mis-specifying the $C_t T_t$ parameters for the detention population can be substantial, the impact of mis-specifying these parameters on the prison population would be relatively less substantial. (The impact of mis-specifying the $C_t T_t$ parameters is described in the section ***Retrospectively Estimating the Size of the USMS Detention Population***).

Projecting Release Dates

Unlike prison populations, length of stay for detention populations is indeterminate. Persons arrested remain in the custody of the USMS until they are ordered released by a federal judicial officer and/or transferred to the jurisdiction of the Federal Bureau of Prisons to begin serving a determinate term of incarceration. Because the projection methodology relies on current USMS detainee movement data, actual length of stay is not known for all observations included in the data extract, *i.e.*, some detainees will have not been released from detention by the time the data extract was compiled. For the prototype admission cohort, time in detention is estimated for approximately 3% of persons arrested/booked by the USMS. Accordingly, in those instances where length of stay is unknown, length of stay is estimated based on observations of historical data.

For an observation in the end-of-period population (P_0), the length of stay is estimated by randomly assigning a *remaining time in detention* (R) from a reference table modeled after R for a historical population. (*See*, Figure 2.) For example, if the randomly assigned uniform deviate for a particular detainee is between 0.6432 and 0.7231, the additional time the detainee would be expected to remain in detention is 181 days.

Remaining Length of Stay Probabilities for End-of-Period Populations

Note: Probabilities based on actual release dates for the USMS detention populations held on September 30, 1999 and September 30, 2000.
Source: Office of the Federal Detention Trustee

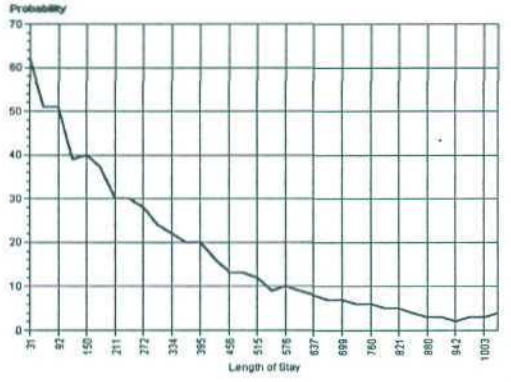
Figure 2

---

11. The weights of the arrest/booking cohort are determined using auto-regressive time-series statistical techniques. Currently, weights are assigned according to six geographic regions. (*See*, Appendix, Figure 1.)
12. In the context of criminal justice process, $C_t T_t$ should be expanded to include a separate term describing the probability of detention (D_t). As currently expressed D_t is implied in T_t based on the length of stay.
13. The likelihood of detention and/or the anticipated release date may be adjusted in the *prototype admission cohort* to reflect anticipated changes.
14. Statistic reflects only the federally sentenced population. Excluded are District of Columbia felony offenders serving a sentence in BOP facilities, criminal detainees under the jurisdiction of the U.S. Marshals Service, and aliens under the jurisdiction of U.S. Immigration and Customs Enforcement.

For observations in the arrest/booking cohorts (C_t), length of stay is assigned according to the same general pattern as depicted in ***Figure 2***. However, for these observations, *total length of stay* (***T***) is randomly assigned based on a *gamma* distribution with assigned parameters. (*See*, Figure 3.) The parameters assigned to the distribution are: (1) probability of detention (***D***), 61.6%; and (2) average length of stay (***T***), 176 days.

Length of Stay Probabilities for Arrest/Booking Cohorts



Not e:
Probabilities based on a sample of 1,000 observations.
Source: Office of the Federal Detention Trustee

Figure 3

Once ***R*** or ***T***, as applicable, is estimated, the release date is extrapolated from the actual admission date and ***R*** or ***T***.

Projecting the Size of Incoming Arrest/Booking Cohorts

The size of future arrest/booking cohorts (C_t) are projected using auto-regressive time-series statistical methods. Time-series techniques are *a-theoretical* statistical methods that extrapolate relationships from a series of data that is temporally ordered. Accordingly, these a-theoretical models are based on the assumption that *historic trends – and the factors that influenced those trends – are useful predictors of future events and the observed relationships will continue into the near future.*

Auto-regressive models define the current value of the series (C_t) by one or more prior values of the series (C_{t-1}, C_{t-2}, ... C_{t-p}) –

$$C_t = \delta + \gamma_t (\phi_1 C_{t-1} + \phi_2 C_{t-2} + \ldots + \phi_p C_{t-p}) + A_t \qquad (3)$$

C_t is a monthly aggregation of arrests/booking accomplished by the USMS. δ is the intercept, or most basically the average expected value of C_t; γ is a seasonal adjustment reflecting cyclical fluctuations related to the calendar; $\phi_{1...p}$ are regression coefficients representing the expected change in C_t attributable to C_t, C_{t-1}, ... C_{t-p}; A_t is model error; and p is the number of periods upon which the time series model is derived.[15] Typically, the greatest weight is given to more contemporaneous observations in the data series.

Accordingly, the size of a future arrest/booking cohort (C_{t+1}) is defined by the current number of arrests/bookings (C_t), lagged one period, and the expected forecasting error ($\hat{\varepsilon}_{t+1}$) –

$$C_{t+1} = \delta + \gamma_t (\phi_1 C_t + \phi_2 C_{t-1} + \ldots + \phi_{t+p} C_{t-p}) + \hat{\varepsilon}_{t+1} \qquad (4)$$

15. The seasonal adjustment is a multiplicative factor defined as $\gamma_t = \frac{C_{t-11} - C_{t-12}}{C_{t-11}}$.

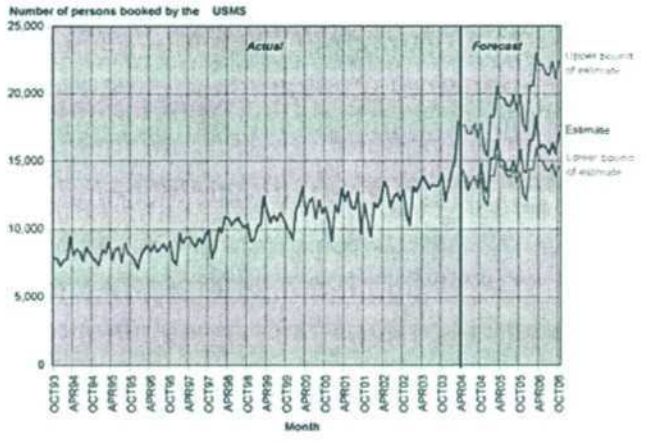
As part of the projection methodology, monthly arrests/bookings are dis-aggregated into six geographic regions. The six regions identified are: (1) North East, (2) Mid-Atlantic, (3) South East, (4) Mid-West, (5) South West, and (6) West. (*See*, Appendix, Figure 1.) Forecasts of future arrests/bookings are based on these regional data. Accordingly –

$$C_{t+1} = \sum_{i=1}^{6} C_{i,t+1} \quad (5)$$

where ***i*** represents each of the 6 regions modeled. The time-series model(s) for projecting arrest/booking may be dis-aggregated into any sub-population, *e.g.*, federal judicial districts and/or offense categories.

Figure 4 depicts monthly arrests/bookings accomplished by the USMS during the period October 1, 1994 through March 31, 2004 and projected arrests/bookings derived from the time-series models for the period April 1, 2004 through September 30, 2006. (Observe the replication of the April 2002 to March 2003 cohort and the March 2004 peak in the forecasted data.) Between fiscal years 1994 and 2003, average monthly arrests/bookings by the USMS increased an average of 5.1% per month. By comparison, the average monthly rate of increase during the forecast period, to include fiscal year 2004, is 7.6%, resulting in an estimated 190,874 arrests/bookings during fiscal year 2006.[16]

Persons arrested/booked by the USMS, October 1, 1994 to March 31, 2004 (with projections for April 1, 2004 through September 30, 2006)



Source: Office of the Federal Detention Trustee.

Figure 4

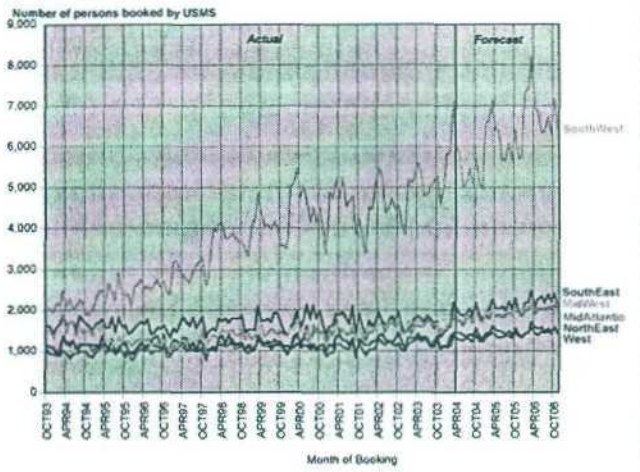
Figure 5 depicts monthly arrests/bookings accomplished by the USMS by region. (Observe the replication of the April 2002 to March 2003 cohort and the March 2004 peak in the forecasted data.) As depicted in Figure 5, arrest/bookings increased at the greatest rate (and number) in the South West region of the United States. Between fiscal years 1994 and 2003, monthly arrests/bookings in the South West increased an average of 10.2% per month. During the forecast period, arrests/bookings in the South West are expected to increase at approximately the same rate (10.3%), resulting in an estimated 80,358 arrest/bookings during fiscal year 2006.

The methods for projecting the size of future arrest/booking cohorts could be improved. The most basic shortcoming of time-series analysis is the total reliance on past trends to predict future levels of the series. A common method for circumventing this shortcoming is to rely on a leading indicator for the series. For example, as part of their projection methodology, the Federal Bureau of Prisons uses the change in indictments by U.S. attorneys as a leading indicator for the change in the future admissions to prison. Because court dispositions lag indictments by approximately 1 year, on average, the change in indictments is considered a reliable leading indicator of future prison admissions. However, because the detention occurs at the beginning of the criminal justice process, a patent leading indicator for future USMS arrests/bookings is less obvious.

16. The average rate of increase for fiscal years 2004, 2003, and 2002 is 10.1%, 7.6%, and 3.6%, respectively.

During 1990 the General Accounting Office (GAO) undertook an effort to develop a statistical model "that could assist Congress and federal agencies and departments to estimate the potential workload impact that budgetary decisions affecting one or more parts of the federal criminal justice system ... may have on other parts of the system ..."[17] As part of this effort, the GAO "tested the assumption that the amount of resources agencies dedicate to federal criminal law enforcement affects the workload they produce ... [downstream]." Accordingly, "more investigators normally result in more persons referred to U.S. Attorneys for possible prosecution; more U.S. Attorneys result in more defendants brought to court; and more judges increase the number of defendants whose cases are adjudicated.[18] An increase in defendants adjudicated will generally result in more defendants being sent to prison, possibly resulting in overcrowding and a need for additional prison capacity."[19] Key conclusions derived by GAO include (1) the number of persons received at one stage of the criminal justice process is an appropriate measure to use in assessing the impact of changes at later stages, and (2) the variance in the number of persons processed by the criminal justice system can be explained by the budget and staff resources provided to the system (or to a particular stage).

Persons arrested/booked by the USMS, October 1, 1994 to March 31, 2004 (with projections for April 1, 2004 through September 30, 2006) by Region



Source: Office of the Federal Detention Trustee.

Figure 5

While the potential *supply* of arrestees is unbounded, the availability of criminal justice resources, *i.e.*, law enforcement officers, U.S. Attorneys, and federal judges, imposes a practical limitation on the number of persons that will be arrested and charged with a federal offense. Historically, the USMS has relied on the number of federal law enforcement officers (at the agency level) to forecast the arrests. Accordingly, based on the GAO's work, it might be possible to derive a leading indicator for future USMS arrests/bookings by observing the relationship between increases in authorized positions for law enforcement and/or assistant U.S. attorneys and USMS arrests/bookings. For example, as part of their analyses, GAO observed that each percentage point increase in staff resources provided to the Immigration and Naturalization Service (INS) resulted in a 2 percentage point increase in the number of referrals to U.S. Attorneys by the INS. Accordingly, based on the GAO model, the number of referrals to U.S. Attorneys (F_t) can be expressed as –

$$F_t = \sum_{i=1}^{i} \beta_i L_{i,t} + \varepsilon_t \qquad (6)$$

where $L_{i,t}$ represents resources for each federal law enforcement agency (i) at time t.[20] However, while the GAO model provides a starting-point, because it does not account for district- or regional-level variations in productivity,

17. General Accounting Office. Federal Criminal Justice System. A Model to Estimate System Workload. (GAO/GGD-91-75) (1991).
18. The federal courts do not have complete control of their workload. Accordingly, an increase in federal judges should not have an impact on the absolute number of defendants/cases adjudicated but rather the number adjudicated during a specified period. For example, if the number of indictments increased by 10% while the number of judges remained constant, the federal judiciary would be less efficient, *i.e.*, needing to hear more cases on a per judges basis, and case processing time would increase. By contrast, if the number of indictments remained constant but the number of judges increased, case processing time should decrease, *ceteris paribus*.
19. Observe that detention is not explicitly included in GAO's description of the criminal justice process nor in the graphic displayed on page 2 of the report.
20. The GAO explicitly modeled number of referrals without an intercept.

it is incomplete.[21] Law enforcement and prosecutorial productivity vary considerably judicial district. For instance, during fiscal year 2000, the 21,780 federal law enforcement officers stationed in judicial districts in the *South West* region referred 33,423 suspects in matters to U.S. Attorney offices; and the 574 assistant U.S. attorneys assigned to handle criminal matters in those offices filed 24,933 indictments. By contrast, the 10,717 federal law enforcement officers assigned to the *North East* region produced 16,773 suspects in matters; and the 674 assistant U.S. attorneys filed 10,090 indictments. This variance in productivity is based, in part, on factors such as types and complexity of the offenses/cases investigated and prosecuted.[22] Accordingly, ***Equation 6*** could be further refined to address these district- or regional-level variations in law enforcement and/or prosecutorial productivity –

$$F_t = \sum_{j=1}^{J} \sum_{i=1}^{I} (\beta_{i,j} L_{i,j,t}) (\theta_{j,t} U_{j,t}) + \varepsilon_t \qquad (7)$$

where U_t represents the number of assistant U.S. attorneys available to prosecute criminal matters at time t; and j represents each district or region represented in the model.[23]

Population Projection Process

The projection of the USMS detention population for budget submissions is typically conducted about 1½ years prior to the start of the fiscal year for which funding is being requested. For example, for the FY2006 budget submission, the projections were prepared by OFDT during April/May, 2004. To estimate the size and characteristics of future detention populations, historical USMS prisoner movement data are used. ***Table 1*** describes the data required by the projection methodology for each budget year forecasted.[24]

The projection methodology relies on four data tables from the USMS Prisoner Tracking System (PTS): (1) PRISONER, (2) FACILITY LOG, (3) FACILITY, and (4) STATUS LOG. The PRISONER, FACILITY LOG, and FACILITY files are combined to identify the existing (or end-of-period) detention population (P_0). The STATUS LOG file is used to create the *prototype admission cohort* and future incoming cohorts (C_t); length of stay (T_t) is included in this file. Using these data files, the projection methodology follows four general steps:

Table 1. USMS populations used to project detention space/budget requirements

Budget Year	Detention population used as initial starting point for projection	Arrest/booking cohort used as basis for future incoming cohorts
FY 2006	Mar. 31, 2004	Apr. 1, 2002 → Mar. 31, 2003
FY 2005	Mar. 31, 2004	Apr. 1, 2002 → Mar. 31, 2003
FY	Sep. 30, 2002	Oct. → Sep. 30, 2001
FY	Sep. 30, 2001	Oct. → Sep. 30, 2000
FY 2002	Sep. 30, 2000	1, 1998 → Sep. 30, 1999
FY	Sep. 99	Oct. 1, 1997 → Sep. 30, 1998
FY	Sep. 30, 1998	Oct. 1, 1996 → Sep. 30, 1997

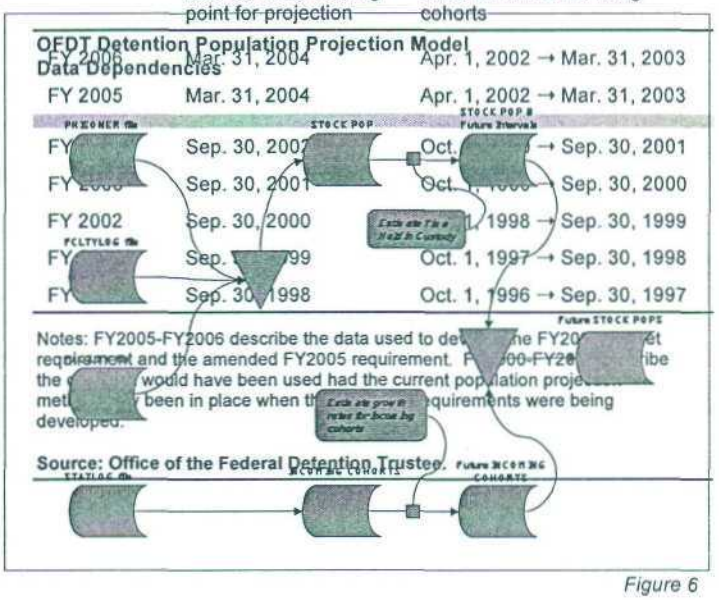


Figure 6

21. The GAO acknowledged that the model "obscures differences among the individual judicial districts." *See*, GAO (1991) at 60.
22. By comparison, the Federal Judiciary monitors caseload relative to the complexity of various types of cases presented to district court judges. The Federal Judicial Center developed case weights that reflect case complexity for federal district court judges. These case weights reflect the difference in average judge time demanded by different types of cases. The resulting *weighted filings index* is considered a superior statistical indicator of the burden imposed by a district's caseload. (See, Shapard, John E. "The 1987 District Court Case Time Study." Federal Judicial Center. (1990).)
23. Any statistical model developed to estimate future productivity would need to account for macro-level differences in district priorities.
24. FY2005 is the exception in that the projection that is reported is the most recent projection (prepared concurrent to the FY2006 projection) prepared in May, 2004. If the methodology had been followed, the data that would have been used is: Sep. 30, 2003 detention population; Oct. 1, 2001 → Sep. 30, 2002 arrest/booking cohort.

• **Step 1:** Tabulate the number of arrests/bookings reported to the USMS, on a monthly basis. Forecast the number of future arrests/bookings using time-series techniques.

• **Step 2:** Create replicates of future arrest/booking cohorts – based on growth rates established in *Step 1* – using historical arrest/booking cohorts. Forecast the movement of these future cohorts through the criminal justice process.

• **Step 3:** Model the movement of the existing detention population.

• **Step 4:** Combine the existing population with the future cohorts – at the individual observation level – to identify future end-of-period detention populations. (*See*, Figure 6)

Monitoring the Validity and Reliability of Detention Population Projections

As discussed by Gaes, Simon, and Rhodes (1993), there are four general criteria for assessing the validity and reliability or a forecasting methodology: (1) short-term accuracy, (2) long-term accuracy, (3) value for proactive policy analysis and planning, and (4) heuristic value.[25]

Short-term accuracy refers to forecasts of 1 year or less. The accuracy of these forecasts depends primarily on the timeliness with which the underlying data are updated. Unforeseen policy changes and new or expanded law enforcement initiatives raise the likelihood of an unanticipated short-term changes in the underlying processes, *i.e.*, C_t T_t. As Gaes, Simon, and Rhodes (1993) indicate, it is difficult – if not impossible – to plan for such unforeseen systemic changes in the short-term.

Long-term accuracy refers to forecasts of more than 1 year. The accuracy of these forecasts is dependent upon the model's capability to incorporate the impact of anticipated changes in policy or practice that may impact the population. Because they permit manipulation of individual-level data, micro-simulation techniques provide the most appropriate tools for incorporating policy changes into population projections.

Value for proactive policy analysis and planning refers to the utility of the forecasts to inform policy and/or operational matters. With respect to the detention population projection model, the value of the model is inferred from its utility in the budget formulation process (in the long-term), monitoring expenditures (in the short-term), and capacity planning/population management (short- and long-term). While the population projections of the USMS detention population have historically been used for budgeting and financial management purposes, neither the USMS or OFDT has used the population projections for short- or long-term population management or capacity planning. In this context, short- and long-term population projections provide a basis for managers to identify regional- or district-level imbalances in the available detention capacity and the anticipated needs – particularly peak space requirements – and to plan accordingly.

Heuristic value refers to the extent to which the projection methodology provides insights into the underlying processes, *i.e.*, an auto-evaluative mechanism. (See, ***Retrospectively Estimating the Size of the USMS Detention Population***).

Accuracy of Projections. As part of a GAO study assessing federal and state inmate populations, costs, and projection models, the GAO surveyed experts in the field of prison population projection modeling to determine the criteria for assessing or validating the reliability of population projection models.[26] Based on this survey, the

---

25. Gaes, Gerald G., Simon, Eric S., and Rhodes, William M. "20/20 Hindsight: Effectiveness of Simulating the Impact of Federal Sentencing Legislation on the Future Prison Population," THE PRISON JOURNAL (1993).
26. General Accounting Office. Federal and State Prisons. Inmate Populations, Costs, and Projection Models. (GAO/GGD-97-15) (1997).

GAO found that there were no generally accepted criteria for assessing or validating the models. However, the experts did agree that the models were considered reliable if the projections were within 2% of the actual population at a 1-year interval.[27] The GAO further cited the publishers of the CORRECTIONS COMPENDIUM who reported approximately 62% of federal and state corrections agencies considered their past population projections to be "accurate"; 27% considered past "low"; and 11%, considered past projections "high."

Persons under the custodial jurisdiction of the USMS, October 1, 1994 to March 31, 2004 (with projections for April 1, 2004 through September 30, 2006)

Figure 7

Statistically, the accuracy of projections is dependent upon the size of the base population, the variability of the data series trend, and the length forecast interval. Independent of other factors, the projections of larger populations are more precise than smaller populations; increased variability in the underlying trend yields less precise projections; and longer forecast intervals result in greater uncertainty of future events. Using time-series techniques, confidence intervals for the detention population projection and the incoming arrest/booking cohort can be estimated. Based on these methods, the 95% confidence interval for the fiscal year 2005-2006 detention population is approximately 2.2% of the projected average daily population. (*See*, Figure 4, *above*.) Accordingly, for a projection 2 years into the future, the detention population is projected with a range of ± ~ 4.45%. Therefore, for the fiscal year 2006 budget submission, the detention population is 62,946 ± ~2,800.

Because of the increased variability in the data series trend, projections of the incoming arrest/booking cohort are less precise. The 95% confidence interval derived for the incoming arrest/booking cohort is approximately 7.9% of the projected arrest/bookings. (*See*, Figure 4, *above*.) Accordingly, for a 2-year projection 2 years, USMS arrest/bookings are projected with an range of ± ~ 16.49%. Therefore, for the fiscal year 2006 budget submission, the total number of USMS arrests/bookings is 190,874 ± ~ 31,475.

Historically, USMS projections of the detention population have been estimated with a lesser degree of precision: between 2000 and 2004, the average variance between the budgeted detention population, *i.e.*, included in the USMS annual budget submission, and the actual population was ± 6.20% (or ± 3.05% on an annual basis). (*See*, Table 3, below.) Limited data describing the current OFDT projection methodology suggests a greater degree of precision, in the short-term, *i.e.*, 1 year: ± 1.06%. (*See*, Appendix, Table 1.) As OFDT gains more experience with the current projection methodology, the accuracy of projections can be assessed in the long-term. (***See, also, Retrospectively Estimating the Size of the USMS Detention Population.***)

Validity of Projections. Butts and Adams (2001) suggest that "[t]he success of a forecasting process should not be determined by its predictive accuracy. A projection that turns out to be wrong is not necessarily an invalid projection. An invalid projection is one in which the differences between the projected population and the actual population cannot be explained."[28] This assessment, however, is inadequate comfort to the statistician whose projection results in inadequate funding for his agency.

---

27. In principle, acceptable error rates would increase exponentially in subsequent years, *e.g.*, based on the 2% standard, at the 3-year interval the acceptable error rate would be approximately 6.1%.
28. Butts, Jeffrey, and Adams, William. "Anticipating Space Needs in Juvenile Detention and Correctional Facilities." Office of Juvenile Justice and Delinquency Prevention (NCJ-185234) (2001).

One method for evaluating the validity of the projection methodology and the resulting projections is to monitor the *force metrics* of the population, or the values of C_t, D_t, and T_t. By monitoring these individual components, the validity of the data underlying future cohorts can be assessed. If these parameters are inaccurately estimated, the population projection is, by default, invalid. Because the size of the detention population is overwhelming governed by the incoming cohort, mis-specifying C_t, D_t, or T_t can have a substantial impact on the projections of future populations. For example, an incorrect estimation of C_t by 2,500 yields a change in the detention population of approximately 1,300; an incorrect estimation of T_t by 4 days yields a change in the detention population of approximately 1,600; and an incorrect estimation of D_t by 1 percentage point yields a change in the detention population of approximately 800. This variation is within the 95% confidence intervals for the projection.

Consistent with the heuristic value of the projection methodology, as defined by Gaes, Simon, and Rhodes (1993), comparisons of the projected and actual force metrics would assign priorities on how to improve the model to improve its accuracy. For example, the force metrics would identify which component (C_t or T_t) is the primary source of the observed error. And, further dis-aggregation of C_t and T_t would indicate whether the error is district- or offense-based. ***Table 2*** describes the force metrics of detention population for fiscal years 1994 through 2003, to include projections for fiscal years 2004 through 2006.

Reliability of Projections. The reliability of the model results is evaluated on a monthly basis using the *chain rule of forecasting*. The chain rule of forecasting uses simple time series methods to re-calibrate the original projections with real-time population statistics. To assess accuracy and reliability, the original projection is compared with the re-calibrated projection. To account for the seasonality in the 12-month data series, the re-calibrated projection (P'_{t+1}) reflects the month-to-month change in the population, 1 year earlier. Therefore –

$$P'_{t+1} = P_t \left(\frac{P_{t-11} - P_{t-12}}{P_{t-11}} \right) \qquad (8)$$

Appendix, Table 2 describes the application of ***Equation 8*** to the fiscal year 2005 through 2006 monthly population projections, based on changes in the fiscal year 2004 population from June through September, 2004. As a practical matter, the data underlying ***Appendix, Table 2*** is updated on a monthly – or more frequent basis – to account for changes in the detention population. These re-calibrated projections are used in the short-term for estimating funds availability to support federal prisoner detention and to allocate available budgetary resources.

Alternative formulae have been – and are used – to re-calibrate the population projections. The USMS Prisoner Services Division uses a simple average methodology to re-calibrate. Accordingly, based on the USMS method the re-calibrated projection (P'_{t+1}) reflects the average rate of increase observed during the current reporting period. Therefore –

$$P'_{t+1} = P_t \left(\frac{\sum_{i=-1}^{t-n} P_{t-i} - \sum_{i=-12}^{t-n} P_{t-i}}{\sum_{i=-12}^{t-n} P_{t-i}} \right) \qquad (9)$$

where ***t-n*** is the interval since the beginning of the reporting period, *e.g.*, if the current month is February, ***t-n*** would be 5. ***Equation 9*** is deficient primarily because it does not appropriately account for the seasonality implicit in the data series/underlying process. The validity of this method could be increased if ***n*** reflected a full 12-month period. As current derived, ***n*** reflects only observations in the reporting period that have actually occurred. By basing the average rate of increase on a full 12-month period, all seasonal shocks would be incorporated into the re-calibrated projection. However, because the growth rate in the detention population varies month-to-month, over time, ***Equation 9*** will result in less stable estimates of P'_{t+1}.

Table 2. Components of the USMS Detention Population, Fiscal Year 1994-2006

Fiscal Year	Number of persons booked by the USMS	Proportion detained greater than 4 days[1]	Average time held in detention[1,2] (in days)	Average Daily Detention Population	Average Growth Rate: Number of persons booked by the USMS	Average Growth Rate: Average time held in detention	Average Growth Rate: Average Daily Detention Population
Actual							
1994	97,607	80.0%	219.7	18,282	—	—	—
1995	98,542	82.8%	218.7	20,652	1.0%	(0.5)%	13.0%
1996	99,898	86.4%	213.6	23,375	1.4%	(2.3)%	13.2%
1997	107,289	86.9%	205.0	25,263	7.4%	(4.0)%	8.1%
1998	120,219	87.7%	201.2	28,692	12.1%	(1.9)%	13.6%
1999	126,832	87.3%	200.0	32,119	5.5%	(0.6)%	11.9%
2000	134,901	85.5%	200.3	34,907	6.4%	0.2%	8.7%
2001	137,405	85.3%	194.2	37,124	1.9%	(3.0)%	6.4%
2002	142,315	84.9%	181.1	40,308	3.6%	(6.7)%	8.6%
2003	153,118	80.1%	150.4	44,448	7.6%	(17.0)%	10.3%
Projections							
2004[3]	168,584	84.3%	164.1	50,588	10.1%	9.1%	13.8%
2005	175,259	84.0%	166.4	56,452	4.0%	1.4%	11.6%
2006	190,874	84.1%	165.6	62,946	8.9%	(0.5)%	11.5%

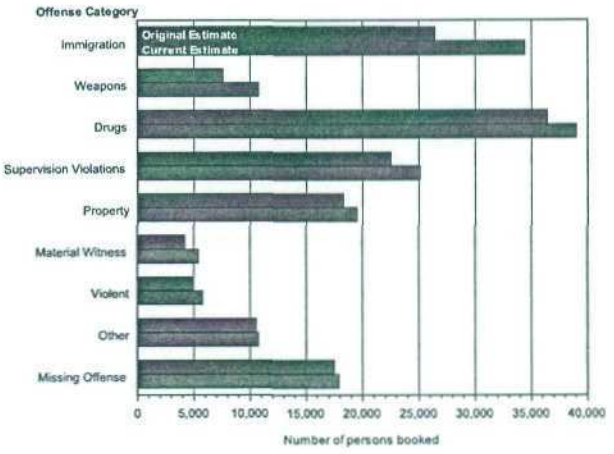
Notes:
1. Statistics reflect the cohort of persons booked during the reporting period; the detention experience of these persons may carry-over into one or more subsequent reporting periods.
2. Includes only those persons held in detention more than four days. 18 U.S.C. § 3142(f) requires that the detention hearing be conducted within 5 days of the defendant's initial appearance. For those persons detained 4 days or fewer, including those not detained, the average time held in detention ranges between 1 and 2 days.
3. Statistics for fiscal year 2004 are based on actual data received from the USMS through March 31, 2004 and projected data from April 1-September 30, 2004.

Source: Office of the Federal Detention Trustee.

Retrospectively Estimating the Size of the USMS Detention Population

A method of evaluating the validity of the projection methodology is to use the methodology to retrospectively estimate the size of the detention population using data that would have been available at the time the projection would have been made. For example, available data through fiscal year 1999 would be used to project the fiscal year 2002 detention population. (*See*, Table 1, *above*.) Accordingly, more recent observed trends in the underlying force metrics would not be considered. For example, rates of increase in the incoming arrest/booking cohort and changes in time-in-detention observed post fiscal year 1999 are not considered in the projection of the fiscal year 2002 population. It should be noted that more intensive monitoring of the detention population and incorporation of this "real-time" information into the projection methodology would improve the reliability and accuracy of any projections of the detention population.

Persons arrested (Original and Current Estimates) by the U.S. Marshals Service, by offense at arrest, Fiscal Year 2004.



Data Sources: U.S. Marshals Service, Detention Population Projection Report (April 2003); U.S. Marshals Service, Prisoner Tracking System database, March 31, 2004 Extract; Office of the Federal Detention Trustee, Detention Population Report (May 2004).

Figure 8

Based on this analysis, the current projection methodology would have generally over-estimated the size of the detention population. While the number of arrests/bookings by the USMS increased at a greater rate than the methodology would have been anticipated during the fiscal year 2000-2004 period, because of the disproportionate increase in the number of arrests/bookings for immigration offenses and supervision violations, time-in-detention for the entering arrest/booking cohorts substantially declined. Additionally, the proportion of those arrested/booked who were detained for more than 4 days slightly decreased. The combined impact of the decrease in detention time and the detention rate more than compensated for the mis-estimation of the incoming cohort. During the fiscal year 2000-2004 period –

• Arrests/booking by the USMS increased by 25 percent. This increase is largely attributable to an increased emphasis on (1) immigration enforcement (representing 26.8% of the increase), (2) weapons/firearms offenses (16.7%), and drug offenses (18.8%). Additionally, 23.6% of the increase could be attributed to increases in the federal supervision revocations. (*See*, Figure 7.)

Table 3. Comparison of projected and actual average daily detention populations

	Budget Year	Projected Average Daily Population, *Current Model*	Projected Average Daily Population *Budget Request*(a)	Actual Average Daily Population(b)
Forward projections	FY 2006	62,946	62,946	---
	FY 2005(c)	56,452	50,001	---
Retrospective projections	FY 2004	49,695	45,274	49,712
	FY 2003	47,803	42,373	44,448
	FY 2002	45,694	41,854	40,308
	FY 2001	46,399	39,788	37,124
	FY 2000	38,421	37,101	34,907

Notes: FY2005-FY2006 describe the data used to develop the FY2006 budget requirement and the amended FY2005 requirement. FY2000-FY2004 describe the data that would have been used had the current population projection methodology been in place when those budget requirements were being developed.
(a) DOJ, Justice Management Division, Budget Summary (Annual).
(b) USMS, Jail Utilization Report (Annual).
(c) The ADP for the FY2005 Budget Request was adjusted, as part of the FY2006 submission, to reflect the more recent population projection of 56,452.

Source: Office of the Federal Detention Trustee.

• The proportion of those arrested/booked who were detained for more than 4 days decreased from 85.5% to 84.3%.

• Time-in-detention for the entering arrest/booking cohorts decreased from an average of 200.3 days to 164.1 days.

Based on these observed changes, had the current projection methodology been used to project the fiscal year 2004 detention population, it would have yielded an average daily population estimate of 49,695. (*See*, Table 3.) The average daily population observed during fiscal year 2004 was 49,600. A difference of + 95. Despite the *prima facie* accuracy of the model, a decomposition of the projected and actual populations suggests that the estimates of the force metrics generated by the projection methodology are unreliable. The current model yielded 144,684 new arrests/bookings by the USMS; a detention rate of 81.9%; and an average time-in-detention of 185.6 days. (*See*, Table 4.) By contrast, the observed force metrics were: 168,584 new arrests/bookings; a detention rate of 84.3%; and an average time-in-detention of 164.1 days. Consequently, the projection methodology performed equally poorly at projecting estimates of new arrests/bookings and time-in-detention. However, the under-estimate of new arrests/bookings was offset by an overestimate of time-in-detention and the detention rate.

By contrast, the average daily population originally projected by the USMS for fiscal year 2004 was 45,274.[29] The projected force metrics were: 148,697 new arrests/bookings; a detention rate of approximately 84% (estimated, not reported in analytical results provided to the USMS); and an average time-in-detention of approximately 145 days (estimated, not reported in analytical results provided to the USMS). Accordingly, the prior methodology underestimated both the size of the incoming cohort and time-in-detention.

For both methodologies, if more reliable data describing the future force metrics of the detention population were available, the population projection methodologies would be more accurate. For instance, when the force metrics are manipulated within the current methodology to reflect the observed metrics, the current methodology resulted in population projections that

Table 4. Retrospective projection of the USMS Detention Population: Components of the USMS Detention Population Projections

			"Force" Metrics		
Budget Year		Projected Average Daily Population, *Current Model*	Number of persons booked by the USMS	Proportion Detained greater than 4 days[1]	Average time held in detention[1,2] (in days)
Forward projections	FY 2006	62,946	190,874	84.1%	165.6
	FY 2005	56,452	175,259	84.0%	166.4
Retrospective projections	FY 2004	49,695	144,684	81.9%	185.6
	FY 2003	47,803	144,338	84.9%	188.9
	FY 2002	45,694	136,310	86.7%	190.3
	FY 2001	46,399	133,156	86.1%	200.1
	FY 2000	38,421	117,516	85.6%	193.8

Notes:
(1) Statistics reflect the number of persons booked during the reporting period; the detention experience of these persons may carry-over into one or more subsequent reporting periods.
(2) Includes only those persons held in detention more than 4 days. 18 U.S.C. § 4142(f) requires that the detention hearing be conducted within 5 days of the defendant's initial appearance. For those person detained 4 days or fewer, including those not ordered detained, the average time held in detention ranges between 1 and 2 days.

Source: Office of the Federal Detention Trustee

29. The requirements for the fiscal year 2004 budget submission was formulated by the USMS and provided to OFDT. The USMS contracted for the projection of future detention populations. The current methodology developed by OFDT supercedes the prior methodology employed by the USMS contractor.

were equal to actual observations.[30] As reported in the external evaluation of the projection methodology, unlike other methods that could be employed to project the detention population (including the method used by the USMS contractor), the current methodology provides all of the tools necessary to identify the source of the error in the projection – to the district level – and to incorporate that "learned" information into the projection methodology.[31]

Table 3 provides a comparison of (1) the projected average daily population as retrospectively projected using the current OFDT projection methodology, (2) the projected average daily population as reported in the FEDERAL PRISONER DETENTION ACCOUNT budget submissions, and (3) the actual average daily population for fiscal years 2000 through 2004; and current projections for fiscal years 2005 through 2006. As indicated in **Table 3**, the current projection methodology would have consistently over estimated the size of the USMS detention population had it been employed during the prior budget formulation cycles.

Table 4 describes the force metrics of the fiscal year 2000 through 2004 detention populations, as retrospectively projected, and the current projections for fiscal years 2005 through 2006. A comparison of **Table 2** and **Table 4** indicates that the current projection methodology consistently underestimates the size of the incoming arrest/booking cohort and overestimates the detention rate and time-in-detention are consistently overestimated.

30. The methodology used by the USMS contractor would, in no doubt, yield projections of the same accuracy under circumstances where the force metrics are fully known.
31. Gaes, Gerald G. "A Report to the Office of the Detention Trustee on its Detention Forecasting Model: Analysis and Recommendations." May 3, 2004.

References

Austin, James. Cuvelier, Steve, McVey, Aaron. "Projecting the Future of Corrections: The State of the Art." 38 CRIME AND DELINQUENCY 285 (1992) 2

Blumstein, Alfred, Cohen, Jacqueline, and Miller, H. "Demographically Disaggregated Projections of Prison Populations." 8 JOURNAL OF CRIMINAL JUSTICE 1 (1980). 2

Butts, Jeffrey, and Adams, William. "Anticipating Space Needs in Juvenile Detention and Correctional Facilities." Office of Juvenile Justice and Delinquency Prevention (NCJ-185234) (2001). 12

Gaes, Gerald G. Simon, Eric S. and Rhodes, William M. "20/20 Hindsight: Effectiveness of Simulating the Impact of Federal Sentencing Legislation on the Future Prison Population." THE PRISON JOURNAL (1993). 2, 10

Gaes, Gerald G. "A Report to the Office of the Detention Trustee on its Detention Forecasting Model: Analysis and Recommendations." May 3, 2004. 16

General Accounting Office. Federal and State Prisons. Inmate Populations, Costs, Projection Models. (GAO/GGD-97-15) (1997). 2, 11

General Accounting Office. Federal Criminal Justice System. A Model to Estimate System Workload. (GAO/GGD-91-75) (1991). 8

Sabol. William J. "Prison Population Projection and Forecasting: Managing Capacity." Bureau of Justice Statistics (NCJ-172844) (1999). 2

Sabol, William J. and McGready John. Time Served in Prison by Federal Offenders, 1986-97. Bureau of Justice Statistics. (1999) (NCJ-171682). 3

Shapard, John E. "The 1987 District Court Case Time Study." Federal Judicial Center. (1990). 9

Stollmack, Stephen. "Predicting Inmate Populations from Arrest, Court Disposition, and Recidivism Rates." 10 JOURNAL OF RESEARCH IN CRIME AND DELINQUENCY 141 (1973). 2

Yablon, Marvin. "The Application of Queuing Models to Strategies for Reducing Prison Population Size." 16 JOURNAL OF CRIMINAL JUSTICE 183. (1998). 2

APPENDIX

Regions of the United States

Note: Regions generally based on categorizations by the U.S. Census Bureau. (*See*, Statistical Abstract of the United States, annual.) SouthWest region created to accommodate the significance of this area to USMS operations and detention population projections. Not Shown: Alaska (West), Hawaii (West), Guam & Northern Mariana Islands (West), Puerto Rico (SouthEast), Virgin Islands (SouthEast).

Appendix, Figure 1

Appendix, Table 1. Comparison of Original Projections and Actual Population/Re-calibrated Projections, Fiscal Years 2004-2006

Projections (Budget)				Actual			Difference (Projections -> Actual)		
Total	Month	Contract	BOP	Total	Contract/IGA	BOP	Total	Contract	BOP
44020	ADP	31216	12804	44,448	33,047	11,354	428	1831	-1450
8.9%	Growth, 02->03	9.7%	10.1%	10.3%	14.1%	0.0%			
47151	Oct-2003	35986	11165	46,630	35,206	11,424	-521	-780	259
47359	Nov-2003	36075	11284	47,047	35,485	11,562	-312	-590	278
47184	Dec-2003	35710	11474	46,920	35,330	11,590	-264	-380	116
47826	Jan-2004	36352	11474	47,193	35,608	11,585	-633	-744	111
49052	Feb-2004	37491	11561	48,356	36,746	11,610	-696	-745	49
49360	Mar-2004	37807	11553	50,033	38,293	11,740	673	486	187
49335	Apr-2004	38090	11245	50,676	38,856	11,820	1341	766	575
49551	May-2004	38290	11261	51,261	39,259	12,002	1710	969	741
49628	Jun-2004	38350	11278	51,666	39,568	12,098	2038	1218	820
49719	Jul-2004	38486	11233	51,673	39,527	12,146	1954	1041	913
50462	Aug-2004	39233	11229	51,454	39,356	12,098	992	123	869
51676	Sep-2004	40184	11492	52,200	39,700	12,500	524	-484	1008
49025	ADP	37671	11354	49,592	37,745	11,848	567	73	494
11.4%	Growth, 03->04	20.7%	-11.3%	11.6%	14.2%	4.3%			
				09/27/2004					
54471	Oct-2004	42,871	11600	52,306	40,306	12,000	-2165	-2565	400
54999	Nov-2004	43,399	11600	52,773	40,773	12,000	-2226	-2626	400
53409	Dec-2004	41,809	11600	52,631	40,631	12,000	-778	-1178	400
54428	Jan-2005	42,828	11600	52,937	40,937	12,000	-1491	-1891	400
55468	Feb-2005	43,868	11600	54,242	42,242	12,000	-1226	-1626	400
57582	Mar-2005	45,982	11600	56,123	44,123	12,000	-1459	-1859	400
58219	Apr-2005	46,619	11600	56,844	44,844	12,000	-1375	-1775	400
57628	May-2005	46,028	11600	57,500	45,500	12,000	-128	-528	400
57595	Jun-2005	45,995	11600	57,955	45,955	12,000	360	-40	400
57946	Jul-2005	46,346	11600	57,962	45,962	12,000	16	-384	400
57684	Aug-2005	46,084	11600	57,717	45,717	12,000	33	-367	400
57991	Sep-2005	46,391	11600	58,554	46,554	12,000	563	163	400
56,452	ADP	44,852	11,600	55,629	43,629	12,000	(823)	(1,223)	400
15.1%	Growth, 04->05	19.1%	2.2%	12.2%	15.6%	1.3%			
58,425	Oct-2005	46,825	11600	58,672	46,672	12,000	247	-153	400
59,486	Nov-2005	47,886	11600	59,197	47,197	12,000	-289	-689	400
60,207	Dec-2005	48,607	11600	59,037	47,037	12,000	-1170	-1570	400
60,473	Jan-2006	48,873	11600	59,380	47,380	12,000	-1093	-1493	400
61,889	Feb-2006	50,289	11600	60,844	48,844	12,000	-1045	-1445	400
63,874	Mar-2006	52,274	11600	62,954	50,954	12,000	-920	-1320	400
65,026	Apr-2006	53,426	11600	63,763	51,763	12,000	-1263	-1663	400
65,007	May-2006	53,407	11600	64,499	52,499	12,000	-508	-908	400
63,911	Jun-2006	52,311	11600	65,009	53,009	12,000	1098	698	400
65,849	Jul-2006	54,249	11600	65,017	53,017	12,000	-832	-1232	400
65,904	Aug-2006	54,304	11600	64,742	52,742	12,000	-1162	-1562	400
65,304	Sep-2006	53,704	11600	65,680	53,680	12,000	376	-24	400
62,946	ADP	51,346	11,600	62,400	50,400	12,000	(647)	(947)	400
11.5%	Growth, 05->06	14.5%	0.0%	12.2%	15.5%	0.0%			

Notes:
Shaded areas represent projected data points. Shaded areas under "Actual" represent re-calibrated projections based on prior actual data. (*See*, Equation 8.)
The number of available federal beds is fixed and pre-determined. Actual usage may, however, vary on a monthly basis.
The difference between the projected population and the actual population/re-calibrated population is a contra-indicator, *i.e.*, a negative difference indicates that the original projection is higher than the actual population and a positive difference indicates that the actual population is higher than the original projection.

Source: Office of the Federal Detention Trustee.