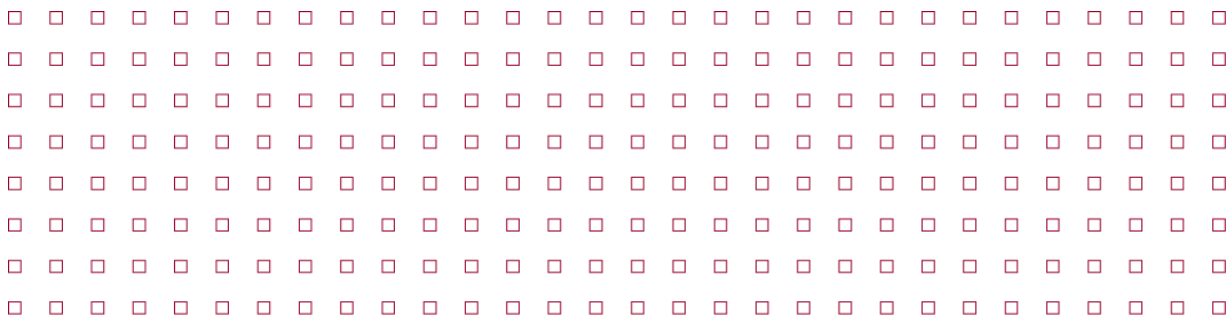


Prison Population Projections 2010 – 2016 England and Wales

Ministry of Justice
Statistics Bulletin

Published 10th August 2010



Contents

Key points	2
1. Introduction	4
2. Prison population June 2009 to January 2010	6
3. Modelling methodology and projection scenarios	7
4. Results	9
5. Caveats on prison population projections	12
Appendix A: Additional tables	13
Appendix B: Testing the validity of 2010-2016 prison population projections	16
Appendix C: Detail of models, scenarios and assumptions	17
Appendix D: Stakeholders consulted about scenarios	25
Contact Points for further information	26

Key points

This bulletin presents projections of the prison population in England and Wales from June 2010 to December 2016. The projections are based on assumptions about future sentencing trends and incorporate the anticipated impacts of selected policy and procedural initiatives.

As part of ongoing work to improve modelling and forecasting across the Ministry of Justice, the method used to generate this year's prison projections has been revised and updated. The new method uses a single model to create projections over the full time range. This model uses a theoretical model of convictions and ONS population projections to predict the monthly prison population.

Three projected scenarios have been modelled. These "no change", "increased sentencing" and "decreased sentencing" scenarios, reflect potential changes in sentencing behaviour and correspond to (though do not use the same assumptions as) the "medium", "high" and "low" scenarios used in the 2009 projections. Other impacts included in the projections, such as those of legislation and changing procedures are applied equally to all three scenarios.

The projected prison populations for the three scenarios are given in Table 1. By the end of June 2016, the prison population is projected to be 83,100 on the "decreased sentencing", scenario, 88,500 on the "no change" scenario and 93,600 on the "increased sentencing" scenario.

Table 1: Projected Prison Population (end June Figures)

Year	Sentencing trends		
	Increase	No change	Decrease
2011	88,000	87,100	86,100
2012	89,300	87,700	85,900
2013	90,800	88,400	85,700
2014	92,000	88,700	85,200
2015	92,800	88,600	84,200
2016	93,600	88,500	83,100

This year's central projection is lower than the central projection created in 2009, if 2009-based projections are revised to account for the withdrawal of End of Custody Licence (the original projections assumed the scheme would continue indefinitely). This is largely due to a recent flattening of the prison population, which has happened despite upward pressures from the withdrawal of End of Custody Licence in March 2010. The withdrawal of End of Custody Licence is estimated to have had an impact of increasing the prison population by 1,200. Between June 2009 and June 2010, the prison population increased by 1,500.

The assumptions informing these projections, and therefore the projections themselves, are subject to uncertainty. This is represented by the three scenarios, with each scenario being only as likely as the assumptions which inform it. These assumptions are based on extensive consultation (see Appendix D for a list of those consulted), and emerging data on them is being monitored. However, this publication does not predict which scenario is most likely to occur in the future.

These projections take no account of any impacts which might result from the recently published Ministry of Justice Structural Reform Plan¹. As such these projections provide a set of “baseline” scenarios against which the impacts of future changes can be assessed.

¹ Structural Reform Plan: www.justice.gov.uk/publications/structural-reform-plan.htm

1. Introduction

This bulletin presents prison population projections for England and Wales from July 2010 to December 2016. The projections are produced to aid development, capacity planning and resource allocation within the Criminal Justice System (CJS) and the National Offender Management Service (NOMS). The latest published useable operational capacity (30th July 2010) is 87,947².

Three possible future scenarios have been agreed through a consultative process. The scenarios cover three possible future sentencing trends (future changes in custody rates³ and average custodial sentence lengths for determinate sentences). These scenarios also take into account drivers which impact equally on each scenario:

- views of future parole hearing frequency and expected outcomes for indeterminate sentences;
- the impact of changes to arrangements for release on licence for current prisoners sentenced under the Criminal Justice Act 1991, which were brought in through the Criminal Justice and Immigration Act 2008⁴; and
- the impact of the withdrawal of End of Custody Licence in March 2010.

As part of ongoing work to improve modelling and forecasting across the Ministry of Justice, the method used to generate this year's prison projections has been significantly revised and updated. The new method uses a single model to predict the monthly prison population for the entire projection period. The model takes into account the future size of the population of England and Wales (including the effects of migration) and the aging of the prison population. The new method also includes all prisoner types in a single model. Appendix C provides details of the methods used to produce the prison projections and the assumptions behind them.

² Prison Population and Accommodation Briefing:

www.hmprisonservice.gov.uk/assets/documents/10004B4820100730SPSWEBREPORT.doc

³ The custody rate is the proportion of those sentenced at court who are given an immediate custodial sentence.

⁴ Criminal Justice and Immigration Act 2008:

www.opsi.gov.uk/acts/acts2008/ukpga_20080004_en_1

These projections take no account of any impacts which might result from the recently published Ministry of Justice Structural Reform Plan. As such these projections provide a set of “baseline” scenarios against which the impacts of future changes can be assessed. The Structural Reform Plan includes reform of sentencing and penalties, the rehabilitation revolution and reform of the prison estate, all of which are likely to have an impact on the prison population.

2. Prison population June 2009 to January 2010

The use of immediate custody (as opposed to other disposal options) and the average custodial sentence length are the two major factors that influence the future prison population. The “Story of the Prison Population 1995 – 2009” - a Ministry of Justice publication - addresses the changes in the prison population since 1995⁵ and explains how these two factors, combined with key legislative and policy changes, influenced the prison population over this period. Tougher sentencing and enforcement outcomes and a more serious mix of offence groups coming before the court are the two factors that have caused the 66% increase in the prison population over this period.

In the past year the prison population has continued to rise, growing from 83,500 in June 2009 to 85,000 in June 2010 (see Table 2). Ministry of Justice statisticians estimate that around 1,200 of this growth was the impact of the withdrawal of End of Custody Licence (ECL). If ECL had continued, growth from June 2009 to June 2010 would have been at a similar rate to that seen from June 2008 to June 2009 (0.4%).

Table 2: Population in Custody Changes from 2004 to 2010

Year	Population in Custody		% Difference
	Start of Year	End of Year	
June 2004 to June 2005	74,500	76,200	2.3%
June 2005 to June 2006	76,200	78,000	2.4%
June 2006 to June 2007	78,000	79,700	2.2%
June 2007 to June 2008	79,700	83,200	4.3%
June 2008 to June 2009	83,200	83,500	0.4%
June 2009 to June 2010	83,500	85,000	1.8%

The projections published in 2009 estimated a value at 30 June 2010 of 83,900 for the “low” scenario, 84,900 for the “medium” scenario and 85,700 for the “high” scenario. Adjusting for the impacts of the withdrawal of End of Custody Licence gives a value of 85,100 on the adjusted “low” scenario, 86,100 on the adjusted “medium” scenario and 86,900 on the adjusted “high” scenario, so growth from June 2009 to June 2010 has been lower than implied by the low scenario.

⁵ Story of the Prison Population: www.justice.gov.uk/publications/prison-population-story.htm

3. Modelling methodology and projection scenarios

The method used for generating projections of the prison population in England and Wales has been revised and updated in order to produce projections for 2010-2016. The new method removes any need to align the results of parallel models.

At the core of the method is a single stock-flow model which is used to generate monthly prison population projections for the entire period for sentenced (including recall) and remand prisoners. This replaces a number of parallel models which were used to produce different time range sections of earlier projections.

Inputs to the prisons stock-flow model are projections of future convictions which are predicted using ONS population projections combined with the Grove-MacLeod theory of re-offending^{6,7}. Using ONS population projections ensures that the size and make up of the future population of England and Wales, which is driven by aging, death and migration, as well as by the number of live births, is accounted for.

The stock-flow model monitors the size of the sentenced (including recall) and remand prison populations. This depends on the inflows defined above and the outflows, which are defined by average custodial sentence lengths for subsets of these populations. The model also contains a module which looks at the aging of the prison population over time.

For this publication, the results of the stock-flow model are supplemented with an estimate of the future non-criminal population, which is based on the average of published data from March to May 2010.

The models are based on data up to January 2010 from various sources including sentencing trends, prison receptions, discharges and populations, demographics and criminal histories of offending.

Three projected scenarios have been modelled as shown in Table 3. These “no change”, “increased sentencing” and “decreased sentencing” scenarios, reflect potential incremental changes in sentencing behaviour and correspond to (though do not use the same assumptions as) the “medium”, “high” and “low” scenarios used in the 2009 projections. The three scenarios also incorporate the impact of past legislative and procedural change – the withdrawal of End of Custody Licence and the legacy of retrospective changes to release arrangements. The scenarios modelled are not predictions of what will happen to the prison population and none of them reflect potential changes to the prison population as a result of the Structural Reform Plan.

⁶ Forecasting the Prison Population, Grove, P., MacLeod, J., Godfrey, D., OR Insight, v.11, 3-9

⁷ Home Office Occasional paper 80 - Modelling crime and offending: recent developments in England and Wales: rds.homeoffice.gov.uk/rds/pdfs2/occ80modelling.pdf

Table 3: Sentencing Scenarios⁸

Sentencing Trends	Percentage change in...							
	Custody Rate				Average Custodial Sentence Length			
	Adult		Young Adult		Adult		Young Adult	
	Male	Female	Male	Female	Male	Female	Male	Female
Increase	+1	+1	+1	+1	+0.5	+0.5	+0.5	+1
No Change	0	0	0	0	0	0	0	0
Decrease	-1	-1	-2	-1	-0.5	-0.5	-0.5	-0.5

The modelling methodology, projection scenarios and assumptions used are described in detail in Appendix C.

⁸ These are percentage changes in custody rate and average custodial sentence length, even though custody rate is also expressed as a percentage. They are not percentage point increases.

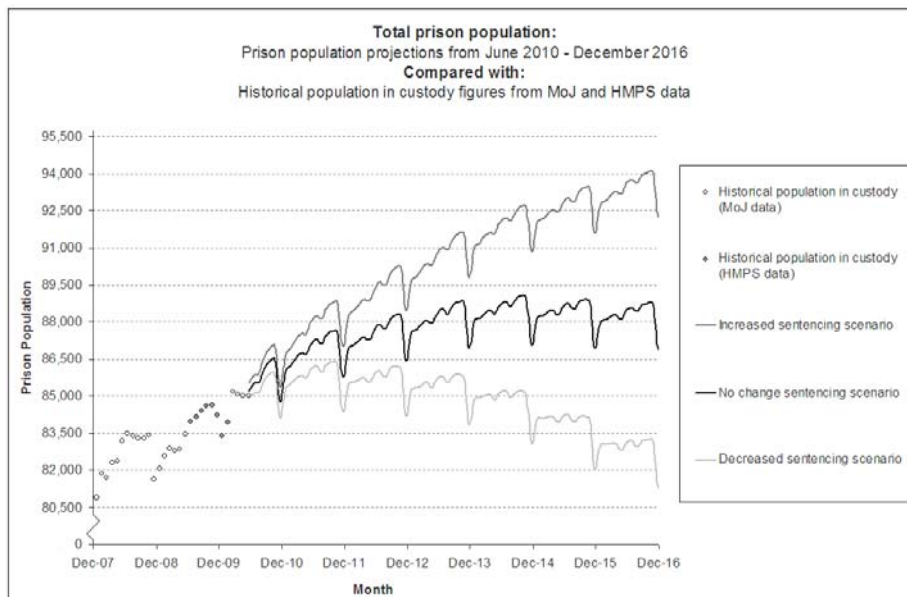
4. Results

The “no change” scenario projects that the prison population will rise to 78,00 by the end of June 2011 and to 88,500 by the end of June 2016. The “increased sentencing” scenario projects that the prison population will rise to 88,000 by the end of 2011 and to 93,600 by the end of June 2016. The “decreased sentencing” scenario projects that the prison population will rise to 86,100 by the end of June 2011 but fall to 83,100 by the end of June 2016. Chart 1 presents the projected scenarios with historical figures to show changes in the prison population since January 2008.

Appendix A contains tables for annual projected end of June populations, average financial year populations and total monthly populations for each scenario. Further breakdowns show the sentenced population by gender, the remand population by gender and the non-criminal population.

Tests on the validity of the current projections have been performed. These are discussed in Appendix B.

Chart 1: Projected monthly Prison Population (all scenarios)⁹



⁹ The preferred data for historical figures is MoJ monthly population in custody figures, however, due to technical problems relating to the supply of data for statistical purposes no figures were released between July 2009 and February 2010. As an alternative we have used HMPS population in custody figures during this period. The December 2009 HMPS figure is higher than might be expected as it was recorded on the 18th of December rather than at end of month.

Chart 1 shows a rise in all three scenarios until 2011 (end June figures). From this point, the decreased sentencing scenario remains stable until 2012, before falling each year to 2016. The no change sentencing scenario continues to rise past 2011 until 2014, where it stabilises to 2016. Finally, the increased sentencing scenario increases every year to 2016. These trends reflect the cumulative impacts of the various sentencing, legislative and procedural assumptions that are used to generate the projections. The seasonal pattern reflects the dip in the prison population which is always seen around the Christmas period.

For the no change sentencing scenario, the custody rate and average custodial sentence length for determinate sentences are assumed to be constant going forward. Therefore, the early growth under this scenario (from current population levels) is likely to stem from the legacy effect of previous sentencing policy on average custodial sentence lengths and the increase in the indeterminate sentenced population (IPPs). The difference between the increased, no change and decreased sentencing scenarios directly reflects the different sentencing trend assumptions used in these scenarios to generate the projections. Full details of these scenarios can be found in Appendix C.

Chart 2: Comparing 2009 and 2010 projections (January 2008 – December 2016)

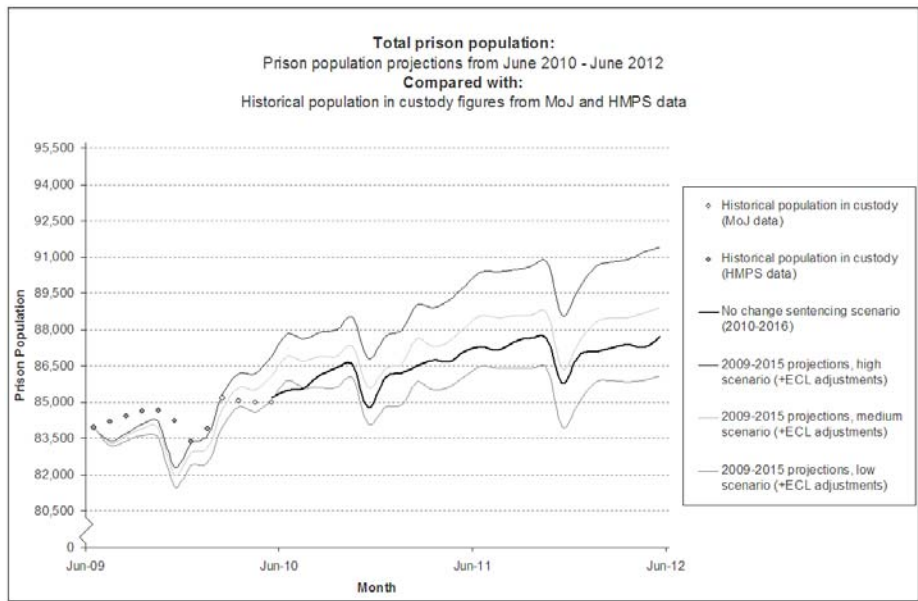


Chart 2 plots the no change sentencing scenario projection against the historical actual data and the three scenarios from the 2009-based prison population projections, “high”, “medium” and “low” scenarios. When comparing these figures it is important to note that in this chart the 2009-2015 projections have been adjusted for the withdrawal of the End of Custody License scheme (an additional 459 prisoners in March 2010 and an additional 1200 prisoners per month thereafter).

The 2010-2016 “no change” scenario tracks between the “low” and “medium” scenarios of the adjusted 2009-based projections. Although based on similar assumptions, a completely different modelling technique has been used to produce the 2010-based projections, yet the central projection still lies within the boundaries of the previous projections. A comparison of end of June figures from the 2009 and 2010 projections can be found in Appendix A. The lower level of the new projections can be attributed to the lower than predicted overall growth observed between June 2009 and June 2010. This is largely due to a recent flattening of the prison population, which has happened despite upward pressures from the withdrawal of End of Custody Licence in March 2010.

5. Caveats on prison population projections

The projections presented here are a set of scenarios which reflect the impact of three possible trends in sentencing behaviour, combined with the impacts of changes to legislation which took place before May 2010. No attempts have been made to incorporate the effects of the Structural Reform Plan or any other new proposals, as the details of these have yet to be announced. These projections therefore provide a set of “baseline” scenarios against which the impacts of future changes can be assessed.

Even without new policy change, the actual future prison population may be not the same as any of these “baseline” scenarios suggest. Changes to criminal justice processes, which are not modelled here, could influence the numbers of offenders being brought to the point of sentence or the way that offenders are managed. Changes to sentencing behaviour may also be different to those modelled here. Both sentencing behaviour and criminal justice processes, as well as policy decisions, can respond to a multitude of environmental factors, such as high profile criminal cases and public debate, which cannot be anticipated.

Assumptions for modelling and scenario development were captured through a consultative process that included all major stakeholders (see Appendix D). The assumptions are based on analysis (where reliable data is available) and on expert judgement from policy makers, key deliverers and system influencers. The assumptions are therefore likely to be more robust for those measures and processes that have a well-defined boundary than those that do not.

Data used in the model has been derived from various sources, including sentencing trends, prison receptions, discharges and populations, demographics and criminal histories of re-offending. Due to technical problems relating to the supply of data for statistical purposes some of this data was unavailable for July 2009 to February 2010. This means certain data has been estimated from past or closest equivalent data.

At the total level, the projections for March, April, May and June 2010 are within 0.2% of published data (MoJ Population in Custody). The ways in which expert judgement, data estimation and underlying statistical modelling variation each contribute to these have not been separately estimated.

Appendix A: Additional tables¹⁰

Annual tables of overall projected prison population

Table A1: Projected prison population (end of June figures)

Year	Sentencing trends		
	Increase	No change	Decrease
2011	88,000	87,100	86,100
2012	89,300	87,700	85,900
2013	90,800	88,400	85,700
2014	92,000	88,700	85,200
2015	92,800	88,600	84,200
2016	93,600	88,500	83,100

Table A2: Average projected prison population (financial year figures)

Year	Sentencing trends		
	Increase	No change	Decrease
2010/2011	86,200	85,700	85,200
2011/2012	88,200	87,100	85,800
2012/2013	89,600	87,700	85,600
2013/2014	91,000	88,300	85,300
2014/2015	92,100	88,500	84,700
2015/2016	92,900	88,400	83,700

Table A3: Comparison of 2009 based (old, adjusted for the withdrawal of End of Custody Licence (ECL)) and 2010 based (new) "no change" projections¹¹ (end of June figures).

Year	Sentencing trends		
	2009+ECL	2010	Difference
2011	88,100	87,100	-1.1%
2012	88,900	87,700	-1.3%
2013	88,800	88,400	-0.5%
2014	89,200	88,700	-0.6%
2015	89,900	88,600	-1.4%

¹⁰ All figures are rounded to the nearest hundred. Components may not sum due to rounding.

¹¹ The 2009 "high" scenario is not directly comparable with the 2010 "increase" scenario; and the 2009 "low" scenario is not directly comparable with the 2010 "decrease" scenario. These are not shown.

Annual tables of subgroups within the overall projected prison population

Table A4: Projected sentenced prison population by gender (end of June figures)

Year	Sentencing trends					
	Increase		No change		Decrease	
	Sentenced Population					
	Male	Female	Male	Female	Male	Female
2011	69,900	3,600	69,100	3,600	68,100	3,500
2012	71,300	3,700	69,700	3,600	68,000	3,500
2013	72,700	3,700	70,400	3,600	67,900	3,500
2014	74,000	3,800	70,900	3,600	67,500	3,400
2015	74,900	3,800	70,900	3,600	66,700	3,400
2016	75,700	3,900	70,900	3,600	65,800	3,300

Table A5: Projected remand and non-criminal prison population (end of June figures)¹²

Year	Remand		Non-criminals
	Male	Female	
2011	12,400	900	1,200
2012	12,300	900	1,200
2013	12,300	900	1,200
2014	12,200	900	1,200
2015	12,100	900	1,200
2016	12,000	800	1,200

¹² Note that these projections are the same under all three projected scenarios.

Monthly tables of overall projected prison population

Table A6: Monthly values of the overall projected prison population (end of month figures)

Month	Sentencing trends		
	Increase	No change	Decrease
Jul-10	85,800	85,500	85,100
Aug-10	86,000	85,600	85,200
Sep-10	86,600	86,100	85,700
Oct-10	86,900	86,400	85,900
Nov-10	87,100	86,500	85,900
Dec-10	85,400	84,800	84,100
Jan-11	86,700	86,000	85,300
Feb-11	86,900	86,200	85,500
Mar-11	87,200	86,500	85,700
Apr-11	87,500	86,700	85,900
May-11	87,500	86,700	85,700
Jun-11	88,000	87,100	86,100
Jul-11	88,300	87,300	86,200
Aug-11	88,200	87,100	86,000
Sep-11	88,600	87,500	86,300
Oct-11	88,800	87,700	86,400
Nov-11	88,800	87,600	86,300
Dec-11	87,000	85,800	84,400
Jan-12	88,300	86,900	85,500
Feb-12	88,500	87,100	85,500
Mar-12	88,700	87,300	85,700
Apr-12	88,900	87,400	85,700
May-12	88,900	87,300	85,600
Jun-12	89,300	87,700	85,900
Jul-12	89,600	87,900	86,000
Aug-12	89,500	87,700	85,800
Sep-12	90,000	88,100	86,100
Oct-12	90,200	88,300	86,200
Nov-12	90,200	88,300	86,100
Dec-12	88,500	86,400	84,200
Jan-13	89,700	87,600	85,300
Feb-13	89,900	87,700	85,300
Mar-13	90,100	87,900	85,500
Apr-13	90,400	88,100	85,500
May-13	90,300	87,900	85,400
Jun-13	90,800	88,400	85,700
Jul-13	91,000	88,500	85,800
Aug-13	90,900	88,300	85,500
Sep-13	91,400	88,700	85,800

Month	Sentencing trends		
	Increase	No change	Decrease
Oct-13	91,600	88,800	85,900
Nov-13	91,600	88,800	85,800
Dec-13	89,800	86,900	83,800
Jan-14	91,000	88,100	84,900
Feb-14	91,200	88,200	84,900
Mar-14	91,400	88,300	85,000
Apr-14	91,600	88,500	85,100
May-14	91,600	88,300	84,800
Jun-14	92,000	88,700	85,200
Jul-14	92,200	88,800	85,200
Aug-14	92,100	88,600	84,900
Sep-14	92,500	89,000	85,200
Oct-14	92,700	89,100	85,200
Nov-14	92,700	89,000	85,100
Dec-14	90,900	87,100	83,100
Jan-15	92,000	88,200	84,100
Feb-15	92,200	88,200	84,100
Mar-15	92,400	88,400	84,200
Apr-15	92,500	88,500	84,200
May-15	92,400	88,300	83,900
Jun-15	92,800	88,600	84,200
Jul-15	93,000	88,800	84,300
Aug-15	92,900	88,500	84,000
Sep-15	93,300	88,800	84,200
Oct-15	93,500	88,900	84,200
Nov-15	93,400	88,800	84,000
Dec-15	91,600	86,900	82,000
Jan-16	92,800	88,000	83,100
Feb-16	92,900	88,100	83,000
Mar-16	93,100	88,200	83,100
Apr-16	93,300	88,300	83,100
May-16	93,200	88,100	82,800
Jun-16	93,600	88,500	83,100
Jul-16	93,800	88,600	83,200
Aug-16	93,600	88,400	83,000
Sep-16	94,000	88,700	83,200
Oct-16	94,100	88,800	83,200
Nov-16	94,100	88,700	83,200
Dec-16	92,300	86,900	81,300

Appendix B: Testing the validity of 2010-2016 prison population projections

The figures in this bulletin are not predictions of the prison population and should not be taken as such. However, comparing them with the actual figures allows us to test the strength of the projections.

As the model used data up to January 2010, we can compare our projections with the actual prison population in subsequent months. Table B1 shows average and maximum percentage difference between the projected and published population figures¹³ in March, April, May and June 2010.

Table B1: Average and maximum deviation of central projection from published figures:

Population breakdown	Average % deviation	Largest % deviation
Total prison population	-0.1	-0.2
All sentenced male	-1.0	2.1
All sentenced female	1.8	2.5
Male remand	0.3	0.9
Female remand	6.8	11.1

The “no change” projected prison population is in line with recent published actual population figures, deviating no more than -0.2% (200 in 85,000). Similarly, the total projected sentenced population (i.e. those people on a determinate or indeterminate sentence, together with the recall population) deviates from published figures no more than -1.0% on average for males (1.8% for females) and -2.1% at worst (1,400 in 68,000) (2.5% for females (90 in 3,500)).

The average projected male remand population does not deviate significantly from the published figures – on average the difference is 0.3% and at worst it is 0.9% (100 in 12,000), but the projected female remand population does deviate significantly from published figures (6.8% on average and 11.1% at worst (80 in 750)). The female remand population is both small and volatile and is therefore difficult to model. Past projections have not provided greater accuracy for this population. For example, the projections published in 2008 predicted a central value for end June 2009 which was higher than published figures by 11%.

¹³ Population in custody figures: www.justice.gov.uk/publications/populationincustody.htm

Appendix C: Detail of models, scenarios and assumptions

The updated modelling approach

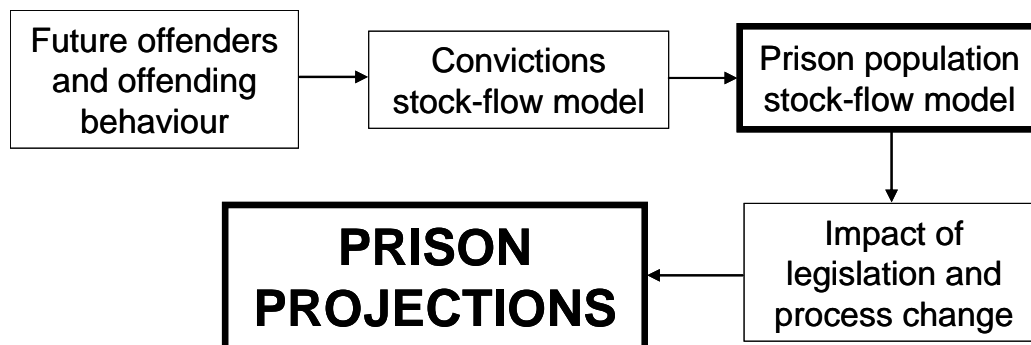
The method used for generating projections of the prison population in England and Wales has been revised and updated. A single stock-flow model is now used to generate prison population projections for the entire period, so there is no need to align the results of multiple models. This model is similar to the long-term prison projection model used for earlier projections, but it generates monthly projections, models the aging of the prison population and includes all prisoner types.

The short-term prisons projection model is not used because it cannot produce reliable projections into the distant future (more than 24 months) and because some of the time series data it relies on (prison receptions, sentence length and time served data) is unavailable for July 2009 to February 2010.

Overview of the modelling approach

Central to the updated modelling approach is the prison population stock-flow model. Projections of future convictions are fed into this model and outputs from this model are manipulated to account for the impact of changes in legislation and process on the prison population, as shown in Figure C1.

Figure C1: Prison projections modelling system with key components shown in bold



Producing convictions projections

Numbers of future offenders are predicted using the Grove-MacLeod theory of re-offending. This asserts that offending can be modelled on the assumptions that:

- within offender groups (which are defined by gender and re-offending behaviour), the fraction of the population who will be convicted of at least one offence remains constant over time; and
- that, having been convicted, the probability of being convicted again remains constant within each offender group, irrespective of number of previous convictions.

The Grove-MacLeod theory was originally developed using Offender Index data from 1953, 1958, 1963 and 1968. It has been shown to provide an effective model for offending in England and Wales^{14,15}. We have applied the theory (which has been further developed by modelling males and females separately) to Police National Computer data from 2009¹⁶ to derive parameters which show:

- the fraction of each offender group who are predicted to be convicted at least once (the Criminality Fraction);
- the Probability of First Conviction¹⁷ and the Average Time to First Conviction; and
- the Probability of Reconviction and the Average Inter-conviction Time for further offences.

The six offender groups are defined by gender and by common Probabilities of Reconviction and Average Inter-conviction Times (or high Rates of Reconviction), as shown in Table C1. There is no need for a group with a low Probability of Reconviction and low Average Inter-conviction time to effectively model the data.

¹⁴ Forecasting the Prison Population, Grove, P., MacLeod, J., Godfrey, D., OR Insight, v.11, 3-9

¹⁵ Home Office Occasional paper 80 - Modelling crime and offending: recent developments in England and Wales: rds.homeoffice.gov.uk/rds/pdfs2/occ80modelling.pdf

¹⁶ 2009 parameters were used because they should represent the most recent system behaviour and because they provide more accurate aggregate convictions projections than the parameters from other recent years.

¹⁷ Reflecting the onset age of criminal responsibility and the rising probability that criminal behaviour will result in a conviction as individuals age from juveniles to adults, the Probability of First Conviction rises from zero before age 10 to a constant adult value at age 18

Table C1: Offender groups needed to model convictions

Gender	Probability of Reconviction	Average Inter-conviction Time	Average Reconviction Rate
Male	High	Low	High
	High	High	Low
	Low	High	Low
Female	High	Low	High
	High	High	Low
	Low	High	Low

A stock-flow model is used to produce convictions projections based on these theoretical parameters and on ONS population projections¹⁸. The advantage of using population projections over projections of live births (which were used for earlier publications) is that they account for the effects of migration, as well as births and deaths, on the size of the population and on its gender and age composition.

Figure C2 shows how the stock-flow model works.

Population cohorts (90 cohorts, each with a single, nominal date of birth) enter the model. Criminality Fractions are then used to define the fraction of each cohort which falls into each of the six offending groups and which will be convicted at least once. Criminality Fractions are also used to define the fraction of each cohort which will never be convicted.

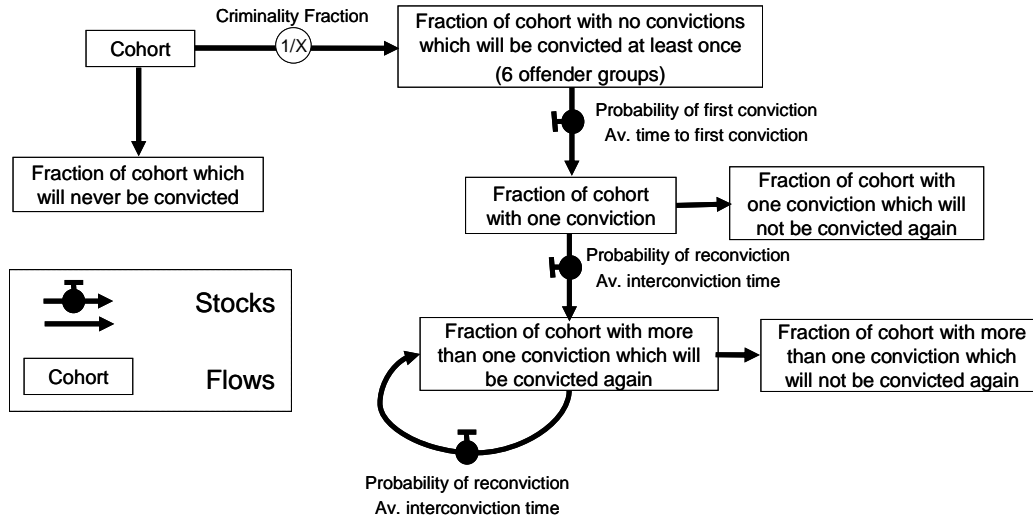
Cohorts flow from the stock representing the fraction of the cohort that will be convicted at least once into the stock representing the fraction with one conviction. The rate at which this happens is based on both the Probability of First Conviction (calculated from the age of the cohort) and the Average Time to First Conviction.

Following first conviction, offenders may or may not be convicted again. The Probability of Reconviction is used to calculate the proportion of the cohort that has received a conviction that will go on to receive another conviction. The Average Inter-conviction Time is used to determine the rate at which this happens.

After this, offenders may or may not be convicted a further number of times, looping through the stock representing the fraction of the cohort with more than one conviction which will be convicted again. Eventually, continual application of the Probability of Reconviction means that the whole cohort has flowed into the various stocks that represent the fraction of the cohort which will not be convicted (again).

¹⁸ ONS population projections: www.statistics.gov.uk/StatBase/Product.asp?vlnk=10710 (Mid-1982 to Mid-1990 for England & Wales - 27/03/03, Mid-1991 to Mid-2000 Local Authority Population Studies: 07/10/04, Mid-2001 (Revised) Local Authority Population Studies: 09/09/04) and www.statistics.gov.uk/StatBase/Product.asp?vlnk=8519 (2008-based National Population Projections - Current Datasets)

Figure C2: Conviction projections stock-flow model



The cohorts are aged as time progresses in the model. At each modelled time point, the fraction of each cohort which has been convicted is counted. This fraction is multiplied by the population estimates for the age of that cohort at that time to give the total number of convictions for the cohort.

The model produces monthly convictions projections from the start of 2000 to the end of 2016. Projections for total convictions by gender gave a reasonable fit to historical data, but projections broken down by age group were not found to model the historical numbers of convictions well. To account for this, projections for juveniles, adults and young adults¹⁹ were adjusted using the fractional difference between projected and historical values for the whole of 2009 (with males and females treated separately). 2009 data was also used to find additive seasonality which was applied to the entire projected period. The resulting projections were between 3% and 11% of historical data for the last half of 2008 (average absolute difference) with the largest deviations appearing for the smallest and most volatile populations.

Total convictions projections show a slow decline from 2010. This is principally due to the projections for juveniles and young adults and can be attributed to changes in the underlying population, where the number of people aged from 10 to less than 21 is predicted to fall from 2010 to 2015²⁰. Other historical deviations from the projections may be attributable to changes in the system, e.g. a change in focus on crime type or a change in the type of disposals used for detected crimes. For the future projections we assume there will be no further changes in system behaviour.

¹⁹Juveniles are aged from 10 to less than 18; Young adults are aged from 18 to less than 21; Adults are 21 or over.

²⁰ONS population projections: as before (footnote 18)

Producing prison population projections

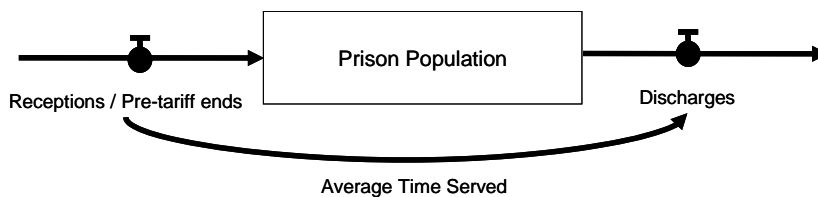
Prison population projections are produced using the Prison population stock-flow model. The principal sub-populations in prison - determinate sentence, life sentence, imprisonment for public protection (IPP), remand and recall - are modelled using stock-flow structures based on the generic structure shown in Figure C3. To enable detailed calibration of the model, the stock-flow channels are further broken down by gender, reception age group and sentence length sub-band.

Monthly inflows to prison for these sub-populations are based on the convictions projections described above. Historical receptions are set equal to the fraction of total convictions which resulted in each type of reception. Projected receptions are set to the average of this fraction for the last twelve months of historical data (February 2009 to January 2010 inclusive).

For recall prisoners this assumes that recalls can be averaged over time. The model explicitly shows a certain fraction of recall receptions per conviction and sets recall receptions in the same month as their related conviction receptions. We assume that this is effective in implicitly modelling the real world situation in which individual prisoners can be recalled a number of times and recall receptions are always some time after their related conviction receptions.

Monthly outflows (including outflows due to prisoner mortality) for determinate sentence, remand and recall prisoners are based on average custodial sentence length. Data on average custodial sentence length is calibrated in the model so that the modelled stock of prisoners is close (within 0.5% at the total level) to the actual historical numbers²¹. Projected outflows are based on average of this calibrated sentence length for the last twelve months of historical data.

Figure C3: Generic stock-flow structure in the Prison population stock-flow model



²¹ Historical numbers are taken from a more detailed breakdown of published Offender Management and Caseload Statistics: www.justice.gov.uk/publications/prisonandprobation.htm

IPP and life sentence prisoners have an extra section in the stock-flow structure which models their pre-tariff detention. Outflows from this section into the generic stock-flow structure depend on tariff length which is left largely unchanged from the management information source data (though life sentence tariffs were tuned for data before 2005, when more detailed data started to be collected on life sentences as a consequence of changes in the 2003 Criminal Justice Act²²).

Subsequent outflow for IPP and life sentence prisoners depend on the frequency and outcome of Parole Board hearings. These values are tuned so that over history the entire modelled stock of pre- and post-tariff prisoners is close to the actual historical numbers²³. Projected outflows are based on the calibrated frequency and outcome of Parole Board hearings averaged over the last twelve months of historical data.

The non-criminal population is modelled differently. In this case, the projected size of the non-criminal population is set equal to the average size of the non-criminal population over the last 3 months of published data. This ensures that the non-criminal projections reflect the latest and most accurate count of the non-criminal population.

The main stock-flow structure shown in Figure C3 calculates the flow of prisoners into and out of prison based on their age group on reception (juvenile, young adult, adult). Dynamic aging matrices are used to convert projections by reception age group into projections by current age group. Separate matrices are provided for males and females and remand and sentenced prisoners.

The population in prison at the end of each modelled month is aggregated into the categories defined by gender, current age group and, for determinate sentence prisoners, sentence length band, to produce unadjusted prison projections.

Accounting for the impact of legislation and for seasonal effects

Prison stock-flow model outputs are subject to post-model adjustments to show the impact the withdrawal of End of Custody Licence (ECL) and the legacy of retrospective changes to release arrangements. Post-model adjustments are also used to account for seasonal variation in the population. Post-model adjustments have been applied equally to all the scenarios modelled.

²² www.opsi.gov.uk/acts/acts2003/ukpga_20030044_en_1

²³ Historical pre and post tariff populations have been modelled from total populations using a separate model

ECL was introduced for determinate sentence prisoners at the start of June 2007 and ended in mid March 2010. The effect of ECL was to reduce the prison population by 1,200 prisoners²⁴. The prison stock-flow model outputs do not account for ECL because they are based on management information which included ECL prisoners (for administration purposes). To model ECL, determinate sentence projections were reduced by 1,200 (with reductions for the various sub-populations scaled according to the fraction of the total for that category over the central 31 months of the ECL period) between June 2007 and February 2010 and by 741 in March 2010.

Release arrangements for determinate sentence prisoners were changed in 2005 (as a result of changes made in the 2003 Criminal Justice Act) so that determinate sentence prisoners who committed offences from 2005 were released at the half way point of their sentence, instead of at the two-thirds point. No post-model adjustments are required to model this change because there is sufficient historical data to ensure any impacts are captured in the model calibration. However, in 2008 the Criminal Justice and Immigration Act applied this change retrospectively to most determinate prisoners who had committed offences before 2005. The calibration of the model assumes these prisoners would serve their sentence as they would have done before the retrospective rule change, so the “bounty” gained in each category as a result of the change needs to be subtracted from the determinate sentence projections. Total “bounty” gained was found to be 229 prison places at peak levels. It was also found to reduce over time as the number of prisoners to which the retrospective change applies goes down.

Additive seasonality is seen over history for determinate sentences and remand prisoners. Projections for these prisoner types were smoothed using a centred 13 month average and seasonality was added back in to the projections. Seasonality was added to the smoothed projections over the bulk of the historical period using the simple difference between smoothed and non-smoothed historical data. It was added in to the smoothed projections over the future period (and the last six months of the historical period) using average seasonal adjustments from mid 2006 to mid 2009. No smoothing or seasonal adjustments were made for projections of IPP, life sentence, recall or non-criminal prison populations.

Sentencing scenarios

Three scenarios have been modelled using the prison population stock-flow model. These scenarios reflect potential changes in sentencing behaviour which are manifested as uncorrelated changes in custody rates and average custodial sentence lengths for determinate sentenced prisoners. The scenarios are: “no change”, “increased sentencing” and “decreased sentencing”, these correspond to (though do not use the same assumptions as) the “medium”, “high” and “low” scenarios used in the 2009 projections.

²⁴ Statement made by the Secretary of State for Justice:
www.publications.parliament.uk/pa/cm200910/cmhansrd/cm100222/debtext/100222-0004.htm#1002228, 22 Feb 2010 : Column 28

The scenarios used are summarised in Table C2.

The “no change” scenario assumes that custody rates and average custodial sentence lengths remain static at levels reported in January 2010 for all offenders.

The “increased sentencing” scenario assumes that custody rates are increased by 1% of the current rate each year for all offenders; that average custodial sentence lengths for all males and adult females are increased by 0.5% of the current length each year; and that average custodial sentence lengths for young adult females are increased by 1% of the current length each year.

The “decreased sentencing” scenario assumes that custody rates for all females and adult males are reduced by 1% of the current rate each year, that custody rates for young adult males are reduced by 2% of the current rate each year and that average custodial sentence lengths for all offender groups are reduced by 0.5% of the current length each year.

Table C2: Sentencing scenarios²⁵

Sentencing Trends	Percentage change in...							
	Custody Rate				Average Custodial Sentence Length			
	Adult		Young Adult		Adult		Young Adult	
	Male	Female	Male	Female	Male	Female	Male	Female
Increase	+1	+1	+1	+1	+0.5	+0.5	+0.5	+1
No Change	0	0	0	0	0	0	0	0
Decrease	-1	-1	-2	-1	-0.5	-0.5	-0.5	-0.5

Sentencing for juveniles follows the same patterns as sentencing for young adults in each of these scenarios and no changes are made to custody rates or average custodial sentence lengths for life sentence, IPP, remand, recall and non-criminal prisoners.

No scenarios have been included in these projections which reflect changes to the prison population which might arise from the Structural Reform Plan.

²⁵ These are percentage changes in custody rate and average custodial sentence length, even though custody rate is also expressed as a percentage. They are not percentage point increases.

Appendix D: Stakeholders consulted about scenarios

Internal stakeholders from across the Ministry of Justice.

External representatives from:

National Offender Management Service (NOMS)—Estates;

NOMS—Population Strategy;

NOMS—Public Protection Unit;

NOMS—Scenario Analysis Team;

The Magistrates' Association;

The Probation Service;

The Justices' Clerks Society;

The National Bench Chairmen's Forum;

The Parole Board;

The Sentencing Council.

Contact Points for further information

Current and previous editions of this publication are available for download at

Web link: www.justice.gov.uk/publications/prisonpopulation.htm

Press enquiries should be directed to the Ministry of Justice press office:

Tel: 020 3334 3536

Email: statistics.enquiries@justice.gsi.gov.uk

Other enquiries about these statistics should be directed to:

Ministry of Justice, Justice Statistics – Analytical Services
Zone C, 7th Floor
102 Petty France
London SW1H 9AJ
020 3334 3737

General enquiries about the statistical work of the Ministry of Justice can be emailed to: statistics.enquiries@justice.gsi.gov.uk

General information about the official statistics system of the UK is available from www.statistics.gov.uk

Alternative format versions of this report are available on request from the Ministry of Justice at statistics.enquiries@justice.gsi.gov.uk

© Crown copyright
Produced by the Ministry of Justice