

# Australian Crime Trends and Population Ageing: A Quantified Perspective

Lisa Rosevear<sup>†</sup>

Given that 15-24 year olds have a higher incidence of criminal involvement than other age groups, structural ageing can be expected to have a profound impact on crime trends. The purpose of this paper is to present preliminary findings from a research project that seeks to quantify the proportion of historical and projected change across the Australian criminal justice system attributable to changes in the population age structure. Major findings are that an age structure/crime pattern does exist, and operates in accordance with offender age profiles and the timing of the onset of demographic change.

The proportion of persons in a population's age structure aged 15-24 years can be expected to influence the respective population's crime rate.<sup>1</sup> Where the proportion of young persons in a population is large, the group's impact on the respective crime rate will be large; if small, the impact will be smaller. Structural ageing – i.e. the increasing proportion of the population that is old - can be expected to influence crime trends as the 15-24 year age group undergoes a reduction in its population share.<sup>2</sup> The Australian population is ageing structurally, and the age/crime pattern is similarly evident. It is probable that structural ageing is already influencing Australian crime trends and will continue to do so. Despite such anticipation, 'one frequently overlooked influence on long-term crime trends is the age structure of the population' (Weatherburn 2001, p. 2). To date, the impact of structural ageing on Australian crime trends has received minimal attention, particularly in terms of systematic, quantitative research. This paper will consider the age structure/crime pattern in Australia on two levels:

- firstly, the effect of structural ageing across offence categories and how these results can be interpreted in light of the age profile associated with various offences; and

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<sup>†</sup> University of Tasmania

<sup>1</sup> See Cline (1980) and Australian Institute of Criminology (2005) for summaries regarding the higher incidence of persons aged 15-24 years in criminal activity.

<sup>2</sup> Here 'crime' is taken to mean street crime rather than crimes of the powerful, such as corporate crime or environmental crime.

- secondly, the importance of considering the effect of structural ageing across population groups (not just national or grand-scale populations), using prison population data as a reference point.

The onset of structural ageing in Australia arose primarily from the difference in size between the reproductive (or parental) cohort, in this case the baby boomers (born between 1946 and 1965), and the echo cohort, the offspring of the baby boomers. From around 2011, the passage of the baby boom cohort through the age structure will result in an increasing proportion of persons in the 65+ age group. More importantly, and particularly in relation to crime, post-baby boom fertility rates have declined. This has resulted in fewer individuals entering the base of the population age structure (lower level of replacement population), causing the proportion at those ages to contract (decline) and accordingly, the proportion at the older ages to increase. As fertility continues to fall, the process sees successively smaller cohorts working their way through the age structure. These cohorts are smaller in proportion (although not necessarily in size) than their predecessors. Hence, as the echo cohort, and any other subsequent waves, passes upwards through the age structure, they generate oscillating impacts on the crime rate.

Based on the unlikely event of contemporary social and economic conditions generating pre-baby boom fertility trends in coming years, and the inability of migration to counteract current fertility trends due to the eventual ageing of, and low fertility levels for, migrants, structural ageing is expected to continue (Jackson 2007). It is projected that between 2007 and 2026, the 65+ year age group will have grown by an incredible 90 per cent but that the total growth for all other age groups will be a mere 11 per cent.

## **International Studies**

The age structure/crime pattern has been explored on an international level, primarily in the United States in relation to arrests or convictions, and utilising a variety of quantitative research designs.

Based on Uniform Crime Report and National Crime Survey data, Steffensmeier and Harer (1987) concluded that 40 per cent of the decline in the reported total Crime

Index rate for 1980-84 is attributable to structural ageing, with property crime being affected at a higher level than personal crime. This variation is associated with personal crime offenders being older than property crime offenders, in combination with the baby boom cohort progressing into their late twenties and early thirties during 1980-84. This means that, during the examined period, there were a higher number of persons in the population reflecting the age profile of personal crime offenders than property crime offenders. In a subsequent study for 1980-88, Steffensmeier and Harer (1991) found that this trend was continuing, albeit that offence rates appeared to have stabilised.

Carrington (2001) anticipates a decline of 15 per cent in the Canadian crime rate by 2026 (*ceteris paribus*), with a further 4 per cent by 2041. By 2006 the 'ageing out' of the baby boomers from the high crime activity age groups is posited as accounting for 40 per cent of this transition. Likewise, 40 per cent of the projected decline for 2026, and 33 per cent of the decline by 2041, is attributed to the projected reduction of persons aged 15-24 years (the echo cohort) in the population. However, an increase in offences of 7 per cent for this echo cohort is projected by 2011 due to the increase in absolute size of this very high crime group until 2011, before the decline occurs. Therefore, the ageing-out of the baby boom generation, as opposed to the ageing out of the echo cohort, is expected to have the most influence on future Canadian crime trends.

What is problematic about the majority of international studies is the utilisation of non-demographic methodologies. Consequently, the concepts of age and age structure have been somewhat inadequately conceptualised and operationalised. The underlying criminal and population data are also often found to be inadequate or unavailable (for related discussion, see Marvell and Moody 1991). These deficits have posed significant challenges for past investigators and also raise questions as to the reliability of many past findings related to the age structure/crime pattern. Additionally, many complexities of the age structure/crime pattern have not been addressed, such as regional variation within national populations. Indeed, the lack of conclusive evidence for an age structure/crime pattern has led Marvell and Moody (1991, p. 237) to conclude that the pattern 'has been drawn into question because crime has not declined even though high-crime age groups have shrunk...[and hence, the] failure of predictions invites re-examination of the bases upon which they were made'.

## Research Design and Method

The purpose of this paper is to present a range of findings from a research project considering the impact of structural ageing on Australian crime trends over a 75 year period (1982-2004 and projecting to 2051). The project encompasses apprehension, court and imprisonment data, exploring the dynamic between age structure and crime on a regional level, by gender and offence, utilising population level analysis, specifically standardisation, to control for and locate the level of change in crime levels that can be attributed to structural population ageing. In other words, it seeks to show what the number of persons associated with the separate stages of the criminal justice system over the period of investigation would be if current age-specific imprisonment rates (and underlying factors such as current sentencing practices and associated political, economic and social factors) hold *and* the general population ages as predicted.

These findings will form a foundation for challenging the claim that evidence for an age structure/crime pattern is inconclusive, and that the latter is not homogenous as portrayed in much existing research. Although changes in surveillance, apprehension, sentencing, legislation, recording and the like, along with broader political and socio-economic factors, are involved in the 'measurement' of trends in crime at both a state and national level and underlie age-specific crime rates, the impact of such changes cannot be quantified by the research design used in this investigation. Nor can any specific conclusions be drawn. Nevertheless, it is still possible to investigate whether the changing age structures that are characteristic of population ageing are having an impact.

To locate the influence of structural ageing on crime trends, population and crime-related data are analysed through the process of standardisation. The purpose of standardisation is to remove the age structural (compositional) effects that compromise the measurement of crime rates over time. Any summary variable (like the total crime rate) is comprised of at least two factors: changes in the underlying variable (in this case, the actual crime rate); and changes in the composition (and size) of the population for which the summary measure is being examined. In its most basic form, standardisation applies a standard distribution to one or another compositional variable, so that it statistically removes the effect of changes in that variable. In illustration, the age structure at the first observation (for example, 1987) is held constant and applied to the observed age-specific rates of the underlying variable of interest, such as apprehensions or imprisonment, for the period being examined (for example,

1987-2004). The summed results for each year indicate what the total crime-associated rate (and/or numbers) would be *if* the population age structure had not changed over the period. A similar approach is used to project the likely impact of a changing age structure on crime into the future, with the age specific crime-related rates for the most recent year (in this instance, 2004) being applied to the projected population at each age. The difference between the observed and age-standardised figures are taken to indicate the extent to which changes in the population age structure have either reduced or contributed to an increase in the crime-related rate.

Further details of the application of standardisation in this investigation are provided in Appendix A.

The apprehension and criminal court data utilised in relation to this paper were accessed from the Office of Crime Research and Statistics *Crime and Justice* reports (relating to police apprehensions by age, gender and offence for 1987-2004). Prison data were accessed through the Australian Institute of Criminology's (1983-1993) *Australian Prisoners* and the Australian Bureau of Statistics' (1995-2005) *Prisoners in Australia* (prisoners by age, sex and state/territory 1982- 2004). The population data were also accessed from the Australian Bureau of Statistics, under *Population by Age and Sex, Australian States and Territories* (2005a) (population by age, gender and state/territory, 1982-2004) and *Population Projections, Australia, 2004-2102* (2005b) (population by age, gender and state/territory, 2004-2051).<sup>3</sup>

## Structural Ageing and Offence Trends

Three offence categories will be considered here - offences against property, sexual offences and fraud offences - over the 1987-1997 and 1998-2004 periods.<sup>4</sup> The age-specific rates for these three offence categories, calculated specifically for the analysis, are presented in Figure 1. Based on these rates, against property crime presents the youngest offender profile, in that it clearly peaks at 14-17 years and steadily declines

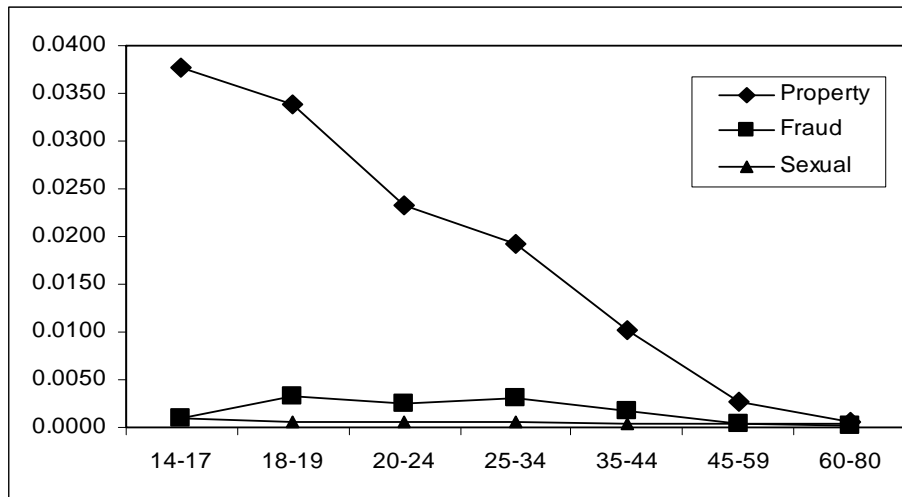
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<sup>3</sup> The medium series (B) population projections (ABS 2005b) are used here. These assume annual net international migration of 110,000 beginning immediately, fertility falling to 1.7 births per woman by 2018, and life expectancy at birth increasing to 84.9 years for males and 88 for females by 2051.

<sup>4</sup> The data were analysed over two periods to overcome differences in counting rules applied by the Office of Crime Statistics and Research.

thereafter. Fraud has the oldest offender profile of the three categories, this being the only offence group for which 14-17 years is not the peak period and offence rates do not decline to any marked degree until 45-59 years. Age-specific rates for sexual offences are relatively even across age groups.

**Figure 1 Age-Specific Apprehension Rates, South Australia 2004.**



Source: Calculated by author from OCSAR (1988-2005).

The crude and age-standardised results for the three offence categories, including the age effect as a percentage, are presented in Tables 1 and 2. For against property offences, the difference between the 1997 crude and age-standardised apprehension numbers is 2,129 apprehensions (see Table 1). In other words, in the absence of structural ageing (i.e. if the age structure of the 1987 population had remained constant between 1987-97), the number of apprehensions in 1997 would have been 14.07 per cent higher than was observed. This is the highest level in the age effect indicated for the three offence categories considered here. Given that against property offences has the youngest age profile of the three offence categories, it makes sense that this would be the offence category most affected by structural ageing, in that there are fewer persons in the population relevant to the age groupings that are most associated with such offences. What is of interest is that fraud offences, with the oldest age profile of the three offence categories and expressing an age effect of 6.80 per cent (around half the level as for against property offences), has been effected by structural ageing at a much higher level than sexual offences. This offence category has a relatively even age profile, and the difference between the crude and age-standardised numbers for 1997 represents

an age effect of a negligible 1.78 per cent. These results suggest that although, not surprisingly, against property offence apprehensions are affected at the highest level by structural ageing, those offence categories with more extreme offender age profiles (be this younger or older) are affected more dramatically than offences with more evenly distributed age-specific offender rates.

However, this trend alters somewhat when looking at the 1998-2004 period (see Table 2). In this instance, it is the fraud offence category that indicates the highest level of influence attributable to structural ageing. The difference between the observed and age-standardised number of fraud apprehensions for 2004 is 78, representing an age effect of 4.98 per cent. This is higher than against property apprehensions (age effect 3.77 per cent) and sexual offence apprehensions (age effect 1.18 per cent). Compared to the 1987-1997 period, sexual offences continue to be the offence category that is the least effected by structural ageing, but it is now the offence with the oldest offender profile (fraud offences) that indicates the highest level of the age effect, as opposed to the offence with the youngest offence group (against property offences).

**Table 1 South Australian Apprehensions 1987-1997: Observed and Age-Standardised Numbers, and Effect of Change in Population Age Structure (as a percentage)**

Offence category	1987	1997 (crude)	1997 (standardised)	Age effect %
Against Property	13,474	15,133	17,262	14.07
Sexual	364	567	577	1.78
Fraud	1,323	7,089	7,571	6.80

Source: Calculated by author from OCSAR (1988-2005), ABS (2005a)

**Table 2 South Australian Apprehensions 1998-2004: Observed and Age-Standardised Numbers, and Effect of Change in Population Age Structure (as a percentage)**

Offence category	1998	2004 (crude)	2004 (standardised)	Age effect %
Against Property	16,154	14,004	14,532	3.77
Sexual	516	631	638	1.18
Fraud	3,367	1,575	1,653	4.98

Source: Calculated by author from OCSAR (1988-2005), ABS (2005a)

The difference in the effect of structural ageing in relation to specific offence categories can be linked to the timing of the progression of the baby boom and subsequent cohorts through the age structure. As mentioned previously, the baby boom cohort was born 1946-1965. This would mean that during the initial 1987-1997 period, some members of the baby boom cohort would still have been aged under 24 years in 1987. Bearing in mind that the 1987 population age structure formed the foundation for the analysis of this period (to which the 1997 observed apprehension numbers were standardised), the baby boom cohort would not have completely aged out of the criminal career period at this stage. However, by the 1998-2004 period, for which the 1998 population age structure formed the foundation for age-standardisation of 2004 apprehensions, not only would the baby boom cohort have passed through the criminal career period themselves, but due to declining fertility rates, the subsequent echo cohorts were not producing the same number of persons in the young age groups as had previously been the situation. At the same time, the proportion of persons aged 25 years and over would have increased somewhat. In other words, the population age structure against which apprehensions were standardised in the second period of analysis (1998-2004) was structurally older than that of the initial period of investigation (1987-1997). Based on this demographic movement, it would seem logical that against property offences would have initially indicated the higher degree of effect, but that subsequently fraud offences would have indicated the highest level of effect.

Comparing the results for the 1987-1997 and 1998-2004 periods, three trends emerge: first, when the age structure of the population is younger, the younger offence categories exhibit the most change as the proportion of young persons commences to decline; second, when the age structure of the population is older, the older offence categories exhibit the most change as the proportion of older persons has increased; and third, offence categories that have a relatively even age-specific offender profile (in comparison to other offence categories) do not indicate any real change that could be attributed to structural ageing.

Considering the influence of structural ageing for equivalent offences at the adult criminal court level for the period 1987-2004, the same trend as was evident for apprehensions during 1987-1997 emerges. Again, the against property offence of serious criminal trespass indicates the highest level of the age effect (20.48 per cent) of the three

offences considered here (see Table 3).<sup>5</sup> This is followed by the fraud offence category (13.28 per cent) and sexual offence category (8.28 per cent). The trend indicated for apprehensions during 1987-1997 is most likely reinforced in criminal court appearances because the 1987 age structure formed the foundation for the entire criminal court analysis (in this example, the 2004 data were age-standardised against the 1987 age structure, rather than the 1998 age structure as for apprehensions). This would mean that the 2004 data in the criminal court appearance analysis are being standardised against a younger age structure than was the case for apprehensions. The second potential reason is that an older age range was applied for criminal court appearances (18-80 years, compared to 14-80 years for apprehensions).

**Table 3 South Australian Criminal Court Appearances 1987-2004: Observed and Age-Standardised Numbers, and Effect of Change in Population Age Structure (as a percentage).**

Offence category	1987	2004 (crude)	2004 (standardised)	Age effect %
Serious Criminal Trespass	924	1,388	1,672	20.48
Sexual	365	485	525	8.28
Fraud	1,149	616	698	13.28

Source: Calculated by author from OCSAR (1988-2005), ABS (2005a)

## Structural Ageing and Prison Populations

Although prison data are not deemed to be as indicative of crime trends as other forms of criminal data, in the absence of national data sets in relation to recorded crime, Australia's prison populations were considered as a means of locating variation in the effect of structural ageing across Australia's states and territories. This is important because these populations are not ageing at the same rate (Jackson and Felmingham 2002). Currently, the Northern Territory is Australia's youngest region (4.8 per cent of the population aged 65 years and over) and South Australia is its oldest (15.4 per cent). In between are the Australian Capital Territory (9.8 per cent), Western Australia (11.8 per cent), Queensland (12.1 per cent), Victoria (13.5 per cent) New South Wales (13.7 per cent) and Tasmania (14.5 per cent). Hence, the results for South Australia and the

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<sup>5</sup> The specific offence of serious criminal trespass is used in the adult criminal court analysis, rather than the against property category used for apprehensions, due to variation in the offence categories between the stages of the criminal justice system included in *Crime and Justice* (OCSAR).

Northern Territory are of particular interest by comparison with the national result because these are Australia's oldest and youngest regions respectively. The Australian population age distribution for 2004 is provided in Table 4.

**Table 4 Australian Population Age Distribution 2004: By State/Territory.**

Age category (in yrs)	National	NSW	VIC	QLD	SA	WA	TAS	NT
14-17	6.69	6.59	6.48	6.95	6.40	7.13	7.02	7.81
18-19	3.43	3.33	3.36	3.54	3.35	3.63	3.48	3.83
20-24	8.58	8.35	8.64	8.83	8.08	8.76	7.73	10.41
25-29	8.27	8.34	8.39	8.28	7.41	8.27	6.79	10.99
30-34	9.26	9.34	9.43	9.28	8.36	9.18	7.96	12.06
35-39	8.90	8.79	9.08	8.88	8.51	9.09	8.21	10.93
40-44	9.39	9.37	9.27	9.44	9.25	9.63	9.41	10.63
45-49	8.73	8.65	8.62	8.73	8.77	9.07	9.11	9.07
50-54	8.05	7.93	7.89	8.12	8.27	8.32	8.59	8.23
55-59	7.33	7.26	7.15	7.52	7.67	7.29	7.93	6.18
60-64	5.51	5.54	5.42	5.62	5.73	5.36	6.22	4.08
65+	15.88	16.51	16.27	14.82	18.19	14.28	17.55	5.78

Source: Calculated by author from ABS (2005a).

Total prison numbers for South Australia increased by 664 persons between 1982 and 2004 (Table 5). By 2004, structural ageing was containing potential growth by 13.84 per cent, or 204 prisoners. Over the same time period, the youthful Northern Territory's population increased by 402 persons. Age-standardisation indicates that the 2004 prison population growth was being constrained by 20.89 per cent arising from structural ageing, or a potential 146 prisoners. In comparison, age-standardisation illustrates that structural ageing had, by 2004, reduced potential growth in national prison rates and/or numbers by 11.17 per cent (or 2,692 persons).

**Table 5 Australian Prison Populations 1982-2004: Observed and Age-Standardised Numbers and Effect of Change in Population Age Structure (as a percentage).**

Location	1982	2004 (crude)	2004 (standardised)	Age effect %
National	9,809	24,113	26,805	11.17
South Australia	808	1,472	1,676	13.84
Northern Territory	299	701	847	20.89

Source: Calculated by author from AIC (1983-1993), ABS (1994-2005), ABS (2005a)

From these results, structural ageing has had a greater impact on both the South Australian and Northern Territory prison populations than nationally although the difference was more substantial for the Northern Territory. This is similar to the trends that emerged from the analysis of apprehension and criminal court data, in that the population with a more average onset of structural ageing is effected at a lower level than the populations with more extreme ageing processes. As would also be expected, the younger population of the Northern Territory is being impacted by structural ageing at a higher level than the 'old' population of South Australia.

Projecting to 2051, the Northern Territory will continue to be the youngest region of Australia (11.6 per cent), while it is expected that Tasmania will take over from South Australia as the oldest region within the next few years (31.3 per cent). Therefore, it is more useful to compare these two regions to the national population when considering prison population levels on a projective level.

**Table 6 Australian Prison Population Projections, 2004-2051: Observed and Age-Standardised Numbers and Effect of Change in Population Age Structure (as a percentage).**

	Crude Projected Change	Reduction in Crude Projection due to Structural Ageing	Age Effect
	No.	No.	%
National	14,304	2,692	11.20
Tasmania	-37	74	18.95
Northern Territory	570	181	14.23

Source: Calculated by author from ABS (1994-2005), ABS (2005b)

Structural ageing can be expected to constrain prison population growth in Tasmania by between 18.95 and 25.92 per cent (depending on the degree to which there is a reduction in the size of the Tasmanian population) (see Table 6). Growth in the Northern Territory prison population, however, is expected to be restricted by structural ageing by 14.23 per cent. Hence, the opposite trend to that of the retrospective analysis is evident here, in that it can be expected that the older populations will be more affected by structural ageing in the future. This trend is consistent with that found for apprehensions; initially, the younger populations are more affected by structural ageing but, in time, this switches and the older population becomes affected at a higher

level. Again, the national age effect, being 11.2 per cent, is less than the age effect for the two extreme populations.

## Conclusion

Similar trends emerge from the apprehensions, criminal court and prison analyses; namely, that the age profile in question - either at an offence level (as per apprehensions and criminal courts) or a strictly population level (as per prison populations) - appears to have a direct impact on the level and timing of the crime-related factor in question. Younger populations were initially affected at the highest level by structural ageing. This trend is evident at the offence level, with the greatest age effect indicated for the younger offence category of against property apprehensions between 1987-1997. It is also evident at the population level where the age effect in relation to prison populations is greatest for the youngest general population of the Northern Territory between 1982-2004. However, older populations went on to become affected by structural ageing at the highest level, as evident in the age effect for fraud offences - with an older age profile compared to property offences - between 1998-2004 and the Tasmanian prison population - reflecting the oldest general population of Australia - between 2004-2051.

In reference to previous criticisms or observations of the age structure/crime relationship, based on the results presented here in relation to the status of this relationship for Australia, two remarks can be put forward. Firstly, the age structure/crime relationship is not homogenous as portrayed in much of the international research. This was determined through the differing level of the age effect across offence categories and prison populations. Such variance can be related to both age offender profiles and demographic trends. Secondly, there is distinct evidence for the existence of an age structure/crime pattern. This relates to both the emergence of similar trends across the analyses for offences and prison populations, as well as to the negligible levels in the age effect located, with all results being significant due to the analysis being conducted on population level data as opposed to a sample.

In terms of policy implications, the analysis serves to indicate to criminal justice-related facilitators the potential changes in the composition of crime and apprehension patterns, assuming all else remaining equal. Standardisation of recorded crime data (by

type of crime) indicates that structural ageing has the potential to reduce numbers for some types of crime (fraud and property) while others (sexual offences) may be expected to increase but at a lower rate than would occur in the absence of structural ageing. The prison population analyses may be particularly useful for correctional facility planning, in relation to potentially smaller prison numbers and increases in the median age of prisoners.

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## Appendix A – Standardisation

### Retrospective Analysis

For each individual analysis, two streams of data are entered in to an assigned spreadsheet. These two streams of data are general population data and crime-related data (for example, against property offences). Both streams of data are entered on an annual basis, expressed as a number. It is essential that both the general population and crime-related data are organised by identical age groups, for the same years, and correspond to the same population group (for example, both streams of data relate to the male South Australian population). Initially, these two streams of data form the basis for two calculations: population age distribution and age-specific rates for the crime-related data.

To calculate the age distribution (the proportion of persons in the annual population at each of the age groups for any given year), the total general population number at each year and age group is divided by the total population number for the equivalent year. The result is the actual (observed) population distribution.

$$p^c x^{t...t+n} = p x^t / T p^{t...t+n}$$

Where p = population

T = Total population

x = age group

t = time

c = crude equation (1)

To calculate the age-specific (crude) crime-related rates for each year and age group included in the analysis, the number of crime-related occurrences is divided by the number of persons in the general population specific to the year and age bracket, including the total number of persons (the total age-specific crude crime-related rate).

$$P^c x^{t...t+n} = P x^t / p x^{t...t+n}$$

Where P = Crime-related occurrences

p = population

x = age group

t = time

c = crude equation (2)

### *Age Standardisation*

The age-specific (crude) crime-related rates (from equation (2)) are age-weighted through the process of direct age-standardisation. The population age distribution (from equation (1)) of the earliest year included in the analysis (for example 1987) is held constant across time (applied to all years between, and inclusive of, all years in the analysis, for example 1987 and 2004) and multiplied by the age-specific imprisonment rates for each age bracket at each year (1987-2004). For each year, the age weighted, standardised rates for the individual age groups are summed to produce a total age standardised rate for each year. All such figures express, as a proportion, the level of the crime-related factor at each year and/or age group had the population age distribution that is held constant (1987) prevailed across the 1987-2004 period.

$$P_{axt\dots t+n} = P_{cx\dots t+n} \sum (pxt^{(1987)} / Tpt^{(1987)})$$

Where P = Crime-related occurrences

p = population

x = age group

t = time

T = Total population

a = age-weighted

c = crude equation (3)

For each year included in the analysis (for example 1987-2004), the total age-standardised crime-related rate is multiplied by the corresponding total number of persons in the general population. These figures express, as a number, what the level of crime-related factor would have been at each year (1987-2004) had the population age

distribution of the earliest year included in the analysis (for example 1987) prevailed, but the population grown and the crime-related rates altered as observed. It can be compared to the actual (observed) number of prisoners across the period of investigation. Likewise, the crude (observed) age-specific crime-related rates can be compared with the age-standardised crime-related rates across the period of investigation.

The final step in the age-standardisation process is to determine the age effect over time as a percentage. Such figures are calculated, on a yearly basis, by deducting the crude number of occurrences for the crime-related factor from the age-standardised number of occurrences for the crime-related factor, and dividing the resultant figure into the actual (observed) number of prisoners, expressed as a proportion.

## **Prospective Analysis**

The method for the prospective analysis is fundamentally the same as for the retrospective analysis. The key difference is that the year 2004 serves as the basis for the analysis (making the standardisation process in-direct, as opposed to the direct process for the retrospective analysis). Therefore, crime-related data is required for the year 2004 only (organised by age, as per the retrospective analysis), and general population projection data (in this analysis covering the years 2004-2051) is utilised. Again, both the population and crime-related data is entered separately in assigned Excel spreadsheet. Because crime-related data is utilised for the year 2004 only, age-specific (crude) crime-related rates can be found only for 2004. Such rates were calculated using the same procedure as outlined for the retrospective analysis (equation (2)).

### *Age-Standardisation*

The age-specific (crude) crime-related rates for 2004 are applied to the projected numbers of persons in the population at each age group and year (2004-2051). For each year, the age-weighted, standardised numbers for the individual age groups are summed to produce a total age standardised number at each year. These age-weighted figures express, as a number, what the level of the crime-related factor is expected to be on the assumption that the 2004 age-specific (crime-related) rates prevail over time, and the population ages and grows as anticipated.

$$Pax^{t...t+n} = Pc_x^{t(2004)} * px^{t...t+n}$$

Where P = Crime-related occurrences

p = population

x = age group

t = time

a = age-weighted equation (4)

The above numbers can then be compared to crude prison projection numbers. These are calculated by applying the total age-specific (crude) crime-related rate for 2004 and to the total projected population number for each year. The difference between the actual and age-weighted prison numbers reflects the effect of population ageing over time.

The final step in the age-standardisation process is to determine the age effect over time as a percentage. Such figures are calculated, on a yearly basis, by deducting the crude number of occurrences for the crime-related factor from the age-standardised number of occurrences for the crime-related factor, and dividing the resultant figure in to the crude projected number of the crime-related factor, expressed as a proportion.