INTRODUCTION

The Australian Bureau of Statistics (ABS) publishes three types of population measures:

- census counts;
- estimated resident population; and
- population projections.

This article discusses each of these measures and explains the methodology used to compile them. A brief discussion about service population estimates is also included.

ABS Geographic Classification

The ABS uses the Australian Standard Geographical Classification (ASGC) as its standard geography for disseminating ABS statistical data, including population measures. The ASGC is a hierarchically structured classification with a number of geographic levels to satisfy different statistical purposes. The base unit is the Collection District (CD) which contains 220 dwellings on average in urban areas. Through the aggregation of CDs, the Statistical Local Area (SLA) is defined, followed by the Statistical Subdivision, the Statistical Division (SD) and so on up to the national level. Population measures are available at a range of levels, including CD, SLA, SD and State/Territory. This article discusses measures at the SLA, State/Territory and national levels.

MEASURES DURING CENSUS YEARS

The Census of Population and Housing is the largest statistical collection undertaken by the ABS and one of the most important. It provides the social and demographic statistics upon which Australian public policy, planning and decision making is based. The objective of the Census is to accurately measure the number of people in Australia at a point in time, and obtain details about their key characteristics and the dwellings in which they live. The census count provides a reliable basis for the estimation of the population of each of the States and Territories, and at smaller geographic levels.

Census Counts

The Census, conducted every five years, provides two basic counts of population:

- *Place of enumeration*. This count includes every person who spent census night in Australia, based on where they stayed that night, including people on board vessels in or between Australian ports, or on long–distance trains, buses or aircraft; and
- *Place of usual residence*. This is a count of all people within the scope of the Census on the basis of where they usually live, rather than where they were on census night. Each person is required to state his or her address of usual residence, as well as where they actually were on census night. In selecting the census day the ABS aims to select a date which minimises the proportion of the population who are not at their usual place of residence.

Estimated Resident Population

The Census provides the basis for the production of Australia's official population estimate, the estimated resident population (ERP). ERP is compiled quarterly for Australia and the States and Territories, and annually for SLAs.

For census years, the ERP for Australia and States/Territories is determined as follows:

- Beginning with census counts on a place of enumeration basis, counts on a place of usual residence basis are obtained by counting each person in their stated SLA of usual residence, rather than where they were counted on census night. Persons who do not state their address of usual residence on the census form are allocated to the SLA of enumeration. Overseas visitors are excluded from these counts. These counts are referred to as place of usual residence counts;

Estimated Resident Population *continued*

- In determining ERP, an allowance is made for the net undercount on a place of usual residence basis. Whilst every effort is made to ensure full coverage of people and dwellings in the census, inevitably small numbers of people are missed whilst others are counted more than once. In Australia more people are missed on the census than are counted more than once. The net effect of overcount and undercount is called net undercount. To measure net undercount the ABS conducts a Post Enumeration Survey (PES) shortly after the census. The PES is a sample survey used to estimate the number of people (and their characteristics) who for one reason or another did not complete or were not included on a census form, or were included on more than one census form. From this survey, the net under–enumeration is determined and net undercount rates calculated. These rates take into account differences in net undercount according to a person's age, sex and geographic location. In the 1996 Census, the net undercount for Western Australia was 1.6 per cent (28,100 people);
- Australian residents temporarily overseas on census night are added back into the population. Estimates of Australians temporarily overseas on census night are obtained from information provided to the Commonwealth Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) by persons returning to Australia in the 12 months following the Census; and
- The estimate after the above three steps is the ERP as at the census date. The estimate is further adjusted in order to obtain the ERP figures as at June 30 by subtracting the estimated increase in the population due to natural increase (births minus deaths) and net overseas migration (and for States/Territories, net interstate migration) between June 30 and the census date.

Differences in the census based measures

The following table presents 1996 place of enumeration counts, place of usual residence counts and ERP for selected Western Australian SLAs. This table illustrates the differences that can occur between the three measures. In addition to differences between the measures due to the concepts they are measuring, regional factors can have an effect on each of the different types of population measures.

For example, the table shows large differences between the place of enumeration counts and the ERP figures for Perth (C) — Inner, Perth (C) — Remainder and Fremantle (C) — Inner. These differences are due to the higher numbers of people staying in hotels, motels and hospitals on census night in these SLAs.

PLACE OF ENUMERATION, PLACE OF USUAL RESIDENCE, ERP 1996 — SELECTED SLAs

	PLACE OF ENUMERATION		*PLACE OF USUAL RESIDENCE*		*ESTIMATED RESIDENT POPULATION*	
Statistical Local Area	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Perth (C) — Inner	1 686	1 127	237	147	269	151
Perth (C) — Remainder	4 158	3 124	2 738	2 089	2 947	2 233
Fremantle (C) — Inner	517	352	346	269	387	311
Laverton (S)	1 081	488	748	429	780	434
Leonora (S)	2 434	1 077	1 682	1 001	1 745	1 029
Menzies (S)	379	142	227	118	235	119
Sandstone (S)	224	71	113	48	119	50
Wiluna (S)	1 513	366	838	267	882	280
Yalgoo (S)	431	146	259	117	271	121
Carnarvon (S)	4 478	4 138	3 218	3 018	3 328	3 057
Exmouth (S)	2 102	1 806	1 078	957	1 114	969
Shark Bay (S)	1 003	940	440	395	454	399
Broome (S)	7 018	6 699	4 909	4 596	5 084	4 682
Nedlands (C)	9 986	10 890	9 466	10 415	10 137	10 919
Kalgoorlie/Boulder (C)	16 120	13 563	15 466	13 235	16 120	13 467
Victoria Park (T)	12 710	13 695	12 249	13 344	12 912	13 807

Note: Place of enumeration and place of usual residence counts are as at census night, 6 August 1996, and the estimated resident population is at 30 June 1996.

The estimates for the SLAs of Laverton, Leonora, Menzies, Sandstone, Wiluna and Yalgoo show much higher place of enumeration counts for males than the ERP figures. This is mainly attributed to fly–in fly–out workers in the mining industry. The difference between the place of enumeration counts and ERP figures for the Shires of Carnarvon, Exmouth, Shark Bay and Broome are due to tourists and tourism–related workers. In contrast the last three SLAs presented in the table show very little difference between the Census counts and the ERP figures.

ESTIMATES BETWEEN CENSUS YEARS

For the years between censuses, the ERP is calculated using different methods for the various geographic levels.

Estimating at the national and State level

National and State level ERP figures are compiled and published on a quarterly basis. Using the census–based ERP as the initial base population, post–censal estimates at the national level are compiled using births, deaths and overseas migration data. At the State level an additional item, interstate migration, is included.

This process can be expressed mathematically as follows:

$$P_{t+1} = P_t + b_{t,t+1} - d_{t,t+1} + m_{t,t+1}$$

for each area, where

P_t resident population of the area at time t

$b_{t,t+1}$ births of residents of that area between time t and t+1

$d_{t,t+1}$ deaths of residents of that area between time t and t+1

$m_{t,t+1}$ net migration (arrivals to that area minus departures from that area) between time t and t+1.

The resultant updated population (P_{t+1}) is then used as the base population for further updates, until the population is re–counted at a census. This process is referred to as the component method.

The births and deaths data used in this process are obtained from the Registrar of Births, Deaths and Marriages in each State. Data on overseas migration are obtained from DIMIA. A data source for interstate migration is unavailable, as movement between the Australian States and Territories is totally unregulated. Given this, interstate migration counts have to be estimated. Changes in Medicare enrolments are used for this purpose with adjustments made to take into account under–registration. These adjustments are derived by comparing Medicare based migration rates with migration rates from the latest available census.

Estimating at the sub–State level

The component method is the fundamental demographic equation and is the ideal method of updating populations. However, for ERP at geographical levels lower than State level, the components are not always readily available or accurate. For example, although births and deaths are available at a sub–State level they are generally not available early enough for timely sub–State estimates. Net migration is unavailable, as the methodology applied in calculating State ERPs is considered too inaccurate at sub–State levels. Hence, for ERP figures below State level a different method of calculating the post–censal ERP is used. The method used by the ABS is a method based on regression techniques.

The regression (or correlation) method is based on the establishment of relationships between population growth and the growth in other variables. The ABS uses indicators such as numbers of dwelling approvals, drivers licences, Medicare enrolments, family allowance recipients and electricity connections. The relationships between population growth and these indicators are expressed mathematically in terms of regression coefficients and, with the knowledge of the growth in the indicators for the current time period, population growth is estimated. These models are revised after each census to ensure that the indicators used and the relationships established are providing the best model for SLA population estimation in each State.

The regression based ERP figures are then validated by ABS officers utilising local knowledge and an understanding of the trend behaviours of the indicator data. Sources used in this process currently include: Western Australian Electoral Commission data providing electoral roll counts for each local government area (LGA); school enrolments by LGA; information obtained from local government authorities relating to population changes, building activity and economic conditions; and information sourced from the media and other sources relating to regional issues. The ABS also seeks input from the Western Australian State planning body.

Finally, the SLA ERPs are adjusted to match the State total, compiled through the component method as discussed above. While national and State/Territory population estimates are compiled quarterly, SLA estimates are compiled for June 30 each year only.

SERVICE POPULATION ESTIMATES

Whilst population estimates based on place of usual residence are conceptually sound and are favoured over place of enumeration estimates by many international statistical agencies, the relevance of usual residence based estimates to some users is limited by the level of population mobility hidden within these estimates. Concerned users therefore seek a supplementary series of population estimates to ERP. Service population counts are one such alternative estimate.

Whilst definitions of the term 'service population' vary, the term generally refers to a population that accesses a particular organisation's services. Such persons may be permanent or temporary residents of the area in which the service is sought, or they may be daytime, overnight or short–term visitors to the area. For example, fly–in fly–out workers use services provided by the council in the area in which they work, but they may not necessarily be usual residents of that LGA and hence not counted in the ERP figures. Another example is the influx of commuters that many central business districts experience during the working week. Whilst this population is not considered part of the LGA's resident population, the council still provides services to this group.

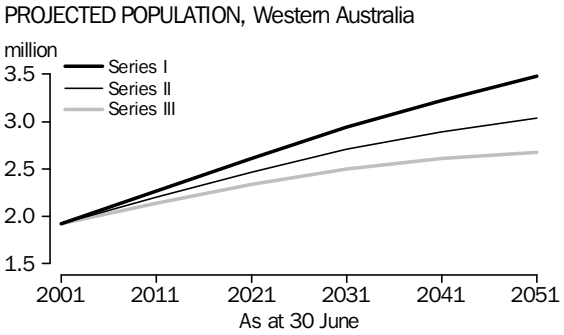
There are however a number of issues related to the development of such estimates and the discussion of these is beyond the scope of this article. For further information relating to service population estimates refer to Demography Working Papers 1996/4 and 1999/3.

POPULATION PROJECTIONS

Population projections are also produced by the ABS. Whereas estimates and census counts refer to points in time in the past, projections usually refer to time points in the future.

ABS population projections are not intended as predictions or forecasts, but are illustrations of growth and change in the population which would occur if the assumptions about future demographic trends prevailed over the projection period. In general, published ABS population projections provide a conservative range of future scenarios using assumptions that reflect the current trends of the components of population change. Historically, the performance of ABS projections has been good, especially at the national level, but they are sensitive to the volatility of the underlying assumptions and the size of the regions involved. These factors, along with the impact of exogenous influences, affect the accuracy of the projections and therefore they must be revised and updated regularly in order to remain useful.

POPULATION PROJECTIONS *continued*



The ABS produces projections using the cohort–component method in which a base population for each sex by single years of age is advanced year by year by applying assumptions regarding future mortality and migration. Assumed age–specific fertility rates are applied to the female population of child–bearing age to provide a new cohort of births. This procedure is repeated for each year in the projection period for each State and Territory and for Australia. The resulting population projections for each year for the States and Territories, by sex and single years of age are adjusted to sum to the Australian totals. The ABS produces a range of projections, usually referred to as series, based on different assumptions regarding fertility, mortality and migration. The graph above shows the different series for projections for Western Australia to 2051.

Population projections are used by various government bodies and private organisations for many different reasons. The Australian Electoral Commission and various State electoral commissions use projections of the population aged 18 years and over to assist in the redistribution of electoral boundaries. The Commonwealth Department of Health and Ageing uses projections to assist in the planning of health services including hospitals. Other uses include planning for the provision of services such as schools and other community facilities. Commercial enterprises often use projections in order to help determine the best locations for new retail outlets or offices.

Further information regarding population projections can be obtained from the ABS publication *Population Projections, Australia* (Cat. no. 3222.0).

SELECTED CENSUS ERP RELEASES

Australian Demographic Statistics, December Quarter 2001 (ABS Cat. no. 3101.0)
Release date: June 2002
Contains State level preliminary estimates at June 2001

Population by Age and Sex, Western Australia, June 2001 (ABS Cat. no. 3235.5.55.001)
Release date: July 2002
Contains sub–State level preliminary estimates on ASGC 2001 (electronic format)

Population by Age and Sex, Western Australia, June 1991 and June 1996
(ABS Cat. no. 3235.5.55.001)
Release date: July 2002
Contains sub–State level preliminary estimates on ASGC 2001 (electronic format)

Regional Population Growth, Australia, 1991–2001 (ABS Cat. no. 3218.0)
Release date: July 2002
Contains sub–State level preliminary estimates for 3 reference dates on ASGC 2001

Regional Population Growth, Australia, 1991–2001, 2001 Census Edition
(ABS Cat. no. 3218.0.55.001)
Release date: July 2002
Contains sub–State level preliminary estimates for 3 reference dates on ASGC 2001 (electronic format)

SELECTED CENSUS ERP RELEASES *continued*

Population by Age and Sex, Australian States and Territories, June 2002
(ABS Cat. no. 3201.0)
Release date: December 2002
Contains State level final estimates for 5 reference dates on ASGC 2001

Regional Population Growth, Australia, 1991–2001 (ABS Cat. no. 3218.0.55.001)
Release date: February 2003
Contains sub–State level final estimates for 7 reference dates on ASGC 2001 (electronic format)

Regional Population Growth, Australia, 2001–02 (ABS Cat. no. 3218.0)
Release date: February 2003
Contains sub–State level final estimates on ASGC 2002

Regional Population Growth, Australia, 2001–02 (ABS Cat. no. 3218.0.55.001)
Release date: February 2003
Contains sub–State level final estimates on ASGC 2002 (electronic format)

Population Growth and Distribution, Australia, 1996–2001 (ABS Cat. no. 2035.0.55.001)
Release date: February 2003
Contains sub–State level final estimates for 11 reference dates on ASGC 2001 (electronic format)

Population by Age and Sex, Western Australia, June 2001 (ABS Cat. no. 3235.5.55.001)
Release date: February 2003
Contains sub–State level final estimates on ASGC 2001 (electronic format)

Population Growth and Distribution, Australia, 1996–2001 (ABS Cat. no. 2035.0)
Release date: May 2003
Contains sub–State level final estimates for 7 reference dates on ASGC 2001.

REFERENCES

Demographic Estimates and Projections: Concepts, Sources and Methods (ABS Cat. no. 3228.0). Available on the ABS web site at <URL: http://www.abs.gov.au>

Population Projections Australia (ABS Cat. no. 3222.0)

Cook, T., 1996, *When ERPs aren't enough — a discussion of issues associated with service population estimation*, ABS Demography Working Paper 1996/4.

Howe, A., 2000, *Methods and procedures for estimating small area populations in Australia*, ABS Demography Working Paper 2000/3.

Lee, S., 1999, *Service Population Pilot Study. An Investigation to assess the feasibility of producing population estimates for selected LGAs*, ABS Demography Working Paper 1999/3.