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Mid-year population estimates, South Africa
2005

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LIST OF ABBREVIATIONS

ASFR Age-specific fertility rate
ASSA Actuarial Society of South Africa
BMR Bureau of Market Research
HSRC Human Sciences Research Council
IMF International Monetary Fund
IMR Infant mortality rate
SDDS Special Data Dissemination Standard
TFR Total fertility rate
WHO World Health Organization
- Not applicable/ Not provided

Provinces:
EC Eastern Cape
FS Free State
GP Gauteng
KZN KwaZulu-Natal
LP Limpopo
MP Mpumalanga
NC Northern Cape
NW North West
WC Western Cape

SUMMARY

- This release uses cohort-component methodology to estimate the 2005 mid-year population of South Africa. The assumptions underlying the estimates have been provided in the document.

- The estimates explicitly account for HIV/AIDS. The estimates are rounded off to the nearest hundred.

- The mid-2005 population is estimated at approximately 46,9 million. Africans are in the majority (approximately 37,2 million) and constitute about 79% of the total South African population. The white population is estimated at 4,4 million, the coloured population 4,1 million and the Indian/Asian population 1,1 million. (It will be observed that the population estimates for 2005 are lower than previously published. This is primarily a result of additional information about mortality now available to Statistics South Africa.)

- Fifty-one per cent (approximately 23,8 million) of the population is female.

- The provincial estimates show that KwaZulu-Natal has the largest share of the population (20,6%), followed by Gauteng (19,2%) and Eastern Cape (15,0%). Northern Cape has the smallest share of the population (1,9%).

- There has been much concern about the effect of HIV on the future size of the South African population. The overall estimated HIV-prevalence rate is approximately 10%. The HIV-positive population is estimated at approximately 4,5 million. The overall impact of HIV on the level of fertility is unlikely to be large in comparison with other factors influencing fertility in South Africa.

- Internal migration patterns show a shift to three main areas. KwaZulu-Natal, Western Cape and Gauteng have positive net migration, with the largest number of persons expected to migrate into Gauteng (about 520 000) for the period 2001–2006. Eastern Cape and Limpopo are expected to have the largest negative net migration, with Eastern Cape expected to experience negative net migration of approximately 320 000 for the period 2001–2006.

Mid-year estimates for South Africa by population group and sex, 2005

Population group	Male		Female		Total	
	Number	% of total pop	Number	% of total pop	Number	% of total pop
African	18 320 400	79,4	18 885 300	79,3	37 205 700	79,4
Coloured	2 036 700	8,8	2 112 100	8,9	4 148 800	8,8
Indian/Asian	565 100	2,4	588 800	2,5	1 153 900	2,5
White	2 148 100	9,3	2 231 700	9,4	4 379 800	9,3
Total	**23 070 300**	**100,0**	**23 817 900**	**100,0**	**46 888 200**	**100,0**

Pali J. Lehohla
Statistician-General
Statistics South Africa
31 May 2005

1. INTRODUCTION

Statistics South Africa (Stats SA) subscribes to the specification of the IMF's Special Data Dissemination Standard (SDDS) and publishes the population estimates for the country as a whole and for the nine provinces annually. The estimates in this release cover all the residents of South Africa at the 2005 mid-year. The estimates explicitly take HIV/AIDS into account. This release forms part of a bigger project on population projections to be published later this year, which will provide a range of estimates.

The release provides a detailed description of the methods and assumptions underlying the South African mid-year population estimates for 2005. Estimates at the national level are presented by population group, age and sex. Provincial estimates are provided by age and sex. The estimates given here may be changed as new data and information become available.

2. OVERVIEW OF ESTIMATION METHODOLOGY

Methodology for national population estimates

In a projection, the size and composition of the future population of an entity, such as a country, is estimated. Although there are crude estimation methods, such as inflating the total or sub-populations at one date by an assumed overall mean annualised growth rate, most serious estimation efforts use a cohort-component approach. In such an approach, agreed fertility, mortality and migration schedules are used as input.

The choice of estimation methodology implies a set of necessary projection inputs and achievable outputs. One should select a methodology that will provide the desired level of detail in the output. One should also select a methodology whose data requirements can be met. This criterion might conflict with the goal of incorporating relevant relationships. More sophisticated projection methodologies will typically be more demanding of data. The gains in using a more realistic model of population dynamics might sometimes be outweighed by the loss introduced by error in the additional data required.

The inputs for a cohort-component method of estimation are derived from detailed substantive analyses of the trends in fertility, mortality and migration. This requires an intensive analysis of the available data and its quality. Often life tables are generated through this process. For example, this approach adjusts for reported fertility and transforms the parities to age-specific fertility rates (ASFRs), which in turn are used as input for estimating the average annual number of births. The estimation of mortality and additional deaths due to HIV/AIDS requires multiple iterations as controls for the adjustment of sero-prevalence data are needed to make the data applicable to the whole population.

In the cohort-component method, a base population is estimated that is consistent with known demographic characteristics of the country. Levels of mortality, fertility and migration are estimated for the base year and projected to future years. This method follows a cohort of people of the same age throughout their lifetime according to their exposure to mortality, fertility and migration. Starting with a base population by sex and age, the population at each specific age is exposed to the probability of dying as determined by the projected mortality levels and patterns by sex and age. Once the number of deaths are estimated, they are subtracted from the surviving population and those remaining alive become older. Fertility rates are projected and applied to the female population in childbearing ages to estimate the annual number of births. The method incorporates migration into the estimation procedure. Migrants are added or subtracted from the population at each specific age. The procedure is repeated for each year of the projection period, resulting in the projected population by age and sex, as well as crude death and birth rates, rates of natural increase, and rates of population growth. This estimate takes the impact of HIV into account.

For the 2005 estimates, the cohort-component method is used by applying the Spectrum Policy Modelling System. The integration is based on DemProj, which supports many of the calculations in the other components – FamPlan, Benefit-Cost, AIM and RAPID (Stover, 2003: 2). Demproj is used to make the demographic projection, while AIM is used to incorporate the impact of HIV on fertility and mortality.

Methodology for sub-national estimates

The cohort-component procedure is also used for sub-national projections, provided that information on mortality, fertility and migration is available for each of the provinces. The most important difference between sub-national and national projections is that for sub-national projections both internal and international migration should be taken into account. International migration is treated in the same way as for a national projection. Internal migration, on the other hand, requires information on the regions of origin of the in-migrants and regions of destination of the out-migrants. If the projection is made for urban and rural areas, the procedure is straightforward and several computer programmes are available to carry it out. For a larger number of regions, it is more difficult to project them all simultaneously (Willekens & Rogers, 1978).

Regional population projections, when summed to obtain the population for the whole country, may produce some inconsistent trends of mortality and fertility at the national level. To avoid this, it has been suggested to first make a population projection for the whole country to serve as a control total for the sum of the regions. Arguments have been presented both in favour of and against this procedure. Arguments in favour of a control total contend that information for the whole country is frequently of better quality than information for each of the regions because vital events may be recorded by place of registration rather than by place of occurrence. Such misplacement of vital events may result in a distorted estimate of the components of growth of each region and hence their sum may not reflect the proper total for the country. The argument against a control total is that, if vital

registration is reliable, whatever happens in a country will be the result of what happens in each of the regions.

For the few countries that produce regional population projections, there is usually a projection for the whole country serving as a control and the regional projections are adjusted to this national total. It is advantageous to compare the sum of the regional projections with the total derived independently for the whole country. A small difference produces confidence in the regional projections in relation to what is expected for the whole country, while a large difference indicates that there were inconsistencies between the assumptions made for the regional projections and those made for the national projections. The latter situation calls for a revision of the assumptions. Once revised, projections result in small differences.

For developing countries where information on interregional migration flows may not be available or reliable, regional projections can still be produced by using net migration flows. If, in addition, mortality and fertility can be estimated for each region based on vital registration data or indirectly from census data, then it is feasible to make regional population projections. In this case, a comparison of the sum of the regions with the country total is a requirement and the adjustment of the regional or sub-national projections to the country total is also highly recommended.

3. KEY ASSUMPTIONS OF POPULATION ESTIMATES IN SOUTH AFRICA

Importance of selecting an appropriate base population

A cohort-component projection requires a population distributed by sex and age to serve as the base population for the starting date of the projection. Reliable estimates of the levels of mortality, fertility and migration are required for the same year. Usually, the base population is taken from the latest available census. However, the reported data on the population age and sex structure may be affected by underenumeration in certain ages as well as by age misreporting. During the first years of the projection period, errors in the age and sex composition of the base population may have a large impact on the projected population. Thus, if the projection starts with errors in the base year, such errors will be carried throughout the projection period and will also have an impact on the projected number of births. For example, if children aged 0–4 years were underestimated in the base population, the surviving cohorts of these children will be smaller than they should be. Furthermore, smaller cohorts will be projected as reaching reproductive age, which in turn will lead to an underestimation of the number of births from these cohorts. An evaluation of the completeness of enumeration and the extent of age misreporting should be made and any adjustments should be based on those evaluations.

Fertility assumptions

There has been much concern about the effect of HIV on fertiliy in South Africa. According to empirical studies in Africa, HIV-positive women appear to have lower fertility by 25%–40% than HIV-negative women (United Nations, 2002a). The United Nations (2002a) further argues that a 25% national adult HIV-prevalence rate translates into a 10% reduction in the total fertility rate (TFR). Given that fertility in South Africa declined from the mid-1980s to the mid-1990s by an average of 15% per year (United Nations 2002b), the overall impact of HIV on the level of fertility is unlikely to be large in comparison with other factors influencing fertility in South Africa.

Table 1 shows the fertility assumptions used in this projection. From analyses of the 2001 census a TFR for Africans of 3,0–3,1 was calculated (Moultrie & Dorrington, 2004; Phillips et al., 2004). For the coloured population, the TFR was about 2,5 (Phillips et al., 2004). Estimates for Indians/Asians indicated a TFR of 2,0 (Moultrie & Dorrington, 2004) while the TFR for the white population was 1,8–1,9 (Moultrie & Dorrington, 2004; Phillips et al., 2004; Udjo, 2003b, 2004).

Table 1: Estimated total fertility rates, 2001–2005

	African	Coloured	Indian/Asian	White	South Africa
2001	3,0	2,4	2,0	1,7	2,82
2002	3,0	2,3	1,9	1,7	2,81
2003	3,0	2,3	1,9	1,7	2,81
2004	3,0	2,3	1,9	1,7	2,81
2005	3,0	2,3	1,9	1,7	2,78

Mortality assumptions

The AIDS impact model (AIM) is used to project the impact of the HIV/AIDS epidemic and requires that a demographic projection be prepared first. Assumptions need to be made with regard to:

- the impact of HIV on infant and child mortality
- the adult HIV-prevalence rate
- the time lapse between becoming HIV-positive and death
- the age and sex distribution of those infected with HIV

The mother-to-child transmission rate (the proportion of babies born to HIV-positive mothers who will also become HIV-positive) has been estimated as between 25% and 48% in developing countries (Bryson, 1996). This projection assumes a mother-to-child transmission rate of 32%. The time lapse from becoming HIV-positive until death due to AIDS in this projection uses the fast patterns for both males and females.

Table 2 shows the assumptions about life expectancy, infant and under 5 mortality for South Africa from 2001 to 2005. The adult HIV-prevalence rate (the proportion of adults who are infected with HIV) is shown in Table 3. As expected, the prevalence rate is highest among women aged 15–49. The overall prevalence rate is approximately 10%.

Table 2: Estimated life expectancy at birth, infant mortality and under 5 mortality, 2001–2005

	Life expectancy at birth			Infant mortality rate			Under 5 mortality		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
2001	48,4	53,8	51,0	57,4	50,1	53,8	77,3	67,0	72,2
2002	47,1	51,9	49,5	57,4	50,0	53,7	77,4	66,9	72,3
2003	46,2	50,3	48,2	57,2	49,7	53,5	77,2	66,7	72,0
2004	45,5	48,9	47,2	57,3	49,7	53,6	77,3	66,7	72,1
2005	45,0	48,8	47,1	57,3	49,7	53,6	77,4	66,7	72,1

Table 3: Estimated adult HIV-prevalence rates, 2001–2005

	2001	2002	2003	2004	2005
Women 15–49 years	15,8	16,3	16,7	17,4	18,1
Women 20–64 years	14,4	14,8	15,1	15,6	16,1
Men 20–64 years	14,4	14,8	15,1	15,7	16,3
Adults 20–64 years	14,4	14,8	15,1	15,6	16,2
Adults 15–49 years	14,7	15,1	15,4	16,1	16,7
Total population	**8,4**	**8,7**	**9,0**	**9,4**	**9,8**

Migration assumptions

It is often difficult to make plausible migration assumptions, due to inadequate data. This estimate incorporates migration assumptions using published and adjusted migration data from Stats SA and other sources. It is estimated that the large out-migration of whites will decline substantially over time and that the positive in-migration of Africans will continue (see Table 4).

Table 4: Estimated net migration assumptions, 1991–2010

Period	White	African
1991–1995	-284 000	81 000
1996–2000	-325 000	145 000
2001–2005	-139 000	192 000
2006–2010	-48 000	205 000

Comparison of Stats SA assumptions with other sources

Table 5 compares the assumptions and estimates from selected population models where available. Differences between the Stats SA and other estimates are primarily due to differences in assumptions about the rapidity with which the HIV epidemic will spread.

The Stats SA HIV/AIDS-prevalence rate for adults aged 15–49 is estimated at about 17%. Life expectancy at birth is estimated at 47 years. The HSRC estimate of life expectancy at birth is 45 years.

According to Stats SA, the estimated infant mortality rate is 54 deaths per 1 000 live births. The estimate of the IMR by the Bureau of Market Research (BMR) appears implausible.

The estimate of total fertility, generally accepted by most demographers as having the largest impact on future population size, was 2,8 in the Stats SA model compared to 2,5 in the ASSA models. The fertility assumptions used in the ASSA models appear implausible and are inconsistent with estimates by Moultrie and Dorrington (2004) based on empirical data.

Table 5: Comparison of Stats SA population estimates with other estimation models

	Model	2000	2005
Estimated total population in millions	ASSA 2002*	44,0	46,0
	ASSA 2002**	44,0	46,2
	BMR 2004	-	47.0
	HSRC	43,1	45,1
	Stats SA	44,5	46,9
Life expectancy at birth	ASSA 2002*	55	46
	ASSA 2002**	56	49
	BMR 2004	-	46
	HSRC	50	45
	Stats SA	53	47
Infant mortality rate	ASSA 2002*	65,6	68,0
	ASSA 2002**	63,5	52,3
	BMR 2004	-	72,1
	HSRC	65,5	56,2
	Stats SA	54,3	53,6
Total annual number of deaths in millions in the year starting 1 July	ASSA 2002*	0,6	0,8
	ASSA 2002**	0,5	0,8
	BMR 2004	-	0,9
	HSRC	0,6	0,8
	Stats SA	0,5	0,7
HIV-prevalence rate for adults aged 15–49 years	ASSA 2002*	15,4	20,3
	ASSA 2002**	14,7	18,8
	HSRC	17,0	16,3
	Stats SA	14,2	16,7
Total fertility rate	ASSA 2002*	2,7	2,5
	ASSA 2002**	2,7	2,5
	Stats SA	2,9	2,8
Birth rate	ASSA 2002*	24,8	22,4
	ASSA 2002**	24,8	22,3
	HSRC	25,9	23,5
	Stats SA	24,6	23,8
Annual number of births in millions in the year starting 1 July	ASSA 2002*	1,09	1,03
	ASSA 2002**	1,09	1,03
	BMR 2004	-	1,18
	HSRC	1,12	1,06
	Stats SA	1,09	1,09

** ASSA 2002. Results from running ASSA 2002_lite_040701 with “no” to interventions (see http//www.assa.org.za)
*** ASSA 2002. Results from running ASSA2002_lite_040701 with “yes” to all interventions (see http//www.assa.org.za)
BMR: Bureau of Market Research, 2004
HSRC: Rehle & Shisana, 2003

4. COUNTRY ESTIMATES, 2005

Table 6 shows the mid-year estimates for 2005 by population group and sex. This table shows that the mid-year population is estimated at approximately 46,9 million. Africans are in the majority (approximately 37,2 million) and constitute 79,4% of the total South African population. The white population is estimated to be 4,4 million, the coloured population 4,1 million and the Indian/Asian population 1,1 million. Fifty-one per cent (approximately 23,8 million) of the population is female. The median age of the South Africa population is approximately 23 years.

It will be observed that the population estimates for 2005 are lower than previously published. This is primarily a result of additional information about mortality now available to Statistics South Africa.

Table 6: Mid-year estimates for South Africa by population group and sex, 2005

Population group	Male		Female		Total	
	Number	% of total pop	Number	% of total pop	Number	% of total pop
African	18 320 400	79,4	18 885 300	79,3	37 205 700	79,4
Coloured	2 036 700	8,8	2 112 100	8,9	4 148 800	8,8
Indian/Asian	565 100	2,4	588 800	2,5	1 153 900	2,5
White	2 148 100	9,3	2 231 700	9,4	4 379 800	9,3
Total	**23 070 300**	**100,0**	**23 817 900**	**100,0**	**46 888 200**	**100,0**

Table 7 shows that the implied rate of growth for the South African population has been declining steadily between 2001 and 2005. While the growth rate for the white population has been negative during this period, it has increased from about -1,2 to -0,4. For the other population groups, the growth rates have declined. Africans have experienced the largest decline over this period (approximately 0,08% per year). The overall growth rate for 2004–2005 is estimated at 0,92% with the rate for females slightly lower than that of males.

Table 7: Estimated annual population growth rates, 2001–2005

		2001–2002	2002–2003	2003–2004	2004–2005
African	Male	1,39	1,29	1,21	1,11
	Female	1,38	1,26	1,15	1,03
	Total	1,38	1,28	1,18	1,07
Coloured	Male	1,25	1,17	1,09	1,01
	Female	1,26	1,18	1,10	1,02
	Total	1,25	1,18	1,09	1,01
Asian	Male	0,84	0,80	0,77	0,77
	Female	0,91	0,87	0,83	0,82
	Total	0,88	0,83	0,80	0,80
White	Male	-1,32	-1,09	-0,84	-0,49
	Female	-1,15	-0,92	-0,67	-0,33
	Total	-1,23	-1,01	-0,75	-0,41
Total	Male	1,10	1,04	0,99	0,94
	Female	1,10	1,03	0,96	0,90
	Total	1,10	1,03	0,98	0,92

Table 8 shows the mid-year population by age, sex and population group explicitly taking HIV/AIDS into account. There are approximately 15,2 million children (33%) aged 0–14 years and approximately 2,6 million people older than 60 years (6%) in the population. Figures 1a to 1e show the population pyramids for the country as a whole and the four population groups.

Table 8: Mid-year population estimates by population group, age and sex, 2005

Age	African			Coloured			Indian/Asian			White			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	2 184 200	2 162 500	4 346 700	203 800	200 000	403 800	44 300	43 300	87 600	114 400	111 400	225 800	2 546 700	2 517 200	5 063 900
5-9	2 136 100	2 124 800	4 260 900	204 100	200 900	405 000	48 500	47 700	96 200	136 200	132 800	269 000	2 524 900	2 506 200	5 031 100
10-14	2 137 200	2 134 900	4 272 100	202 300	200 300	402 600	52 300	51 900	104 200	162 200	158 200	320 400	2 554 000	2 545 300	5 099 300
15-19	2 039 600	2 040 000	4 079 600	190 900	190 500	381 400	53 700	53 900	107 600	166 700	162 800	329 500	2 450 900	2 447 200	4 898 100
20-24	1 938 500	1 892 000	3 830 500	187 400	187 600	375 000	54 000	53 900	107 900	154 700	153 100	307 800	2 334 600	2 286 600	4 621 200
25-29	1 780 200	1 696 600	3 476 800	192 400	192 700	385 100	49 700	50 100	99 800	126 000	123 400	249 400	2 148 300	2 062 800	4 211 100
30-34	1 538 500	1 522 700	3 061 200	187 700	190 900	378 600	43 900	44 700	88 600	118 100	115 500	233 600	1 888 200	1 873 800	3 762 000
35-39	1 009 100	1 056 300	2 065 400	155 200	162 400	317 600	41 000	42 100	83 100	158 600	155 500	314 100	1 363 900	1 416 300	2 780 200
40-44	844 500	937 400	1 781 900	134 600	143 800	278 400	37 900	39 700	77 600	172 400	172 900	345 300	1 189 400	1 293 800	2 483 200
45-49	712 800	822 200	1 535 000	109 000	118 600	227 600	34 200	36 300	70 500	173 700	180 400	354 100	1 029 700	1 157 500	2 187 200
50-54	552 700	651 200	1 203 900	82 000	91 500	173 500	30 000	32 800	62 800	155 700	161 200	316 900	820 400	936 700	1 757 100
55-59	422 000	516 400	938 400	59 400	69 800	129 200	24 400	27 800	52 200	145 700	156 700	302 400	651 500	770 700	1 422 200
60-64	378 600	453 400	832 000	47 900	55 200	103 100	19 900	22 700	42 600	129 100	137 400	266 500	575 500	668 700	1 244 200
65-69	282 100	358 200	640 300	35 900	44 900	80 800	14 200	17 300	31 500	95 800	107 500	203 300	428 000	527 900	955 900
70-74	186 800	249 800	436 600	23 200	31 300	54 500	8 800	11 600	20 400	63 300	79 700	143 000	282 100	372 400	654 500
70-79	104 800	147 600	252 400	12 300	17 700	30 000	4 900	7 300	12 200	39 900	57 800	97 700	161 900	230 400	392 300
80+	72 700	119 300	192 000	8 600	14 000	22 600	3 400	5 700	9 100	35 600	65 400	101 000	120 300	204 400	324 700
Total	**18 320 400**	**18 885 300**	**37 205 700**	**2 036 700**	**2 112 100**	**4 148 800**	**565 100**	**588 800**	**1 153 900**	**2 148 100**	**2 231 700**	**4 379 800**	**23 070 300**	**23 817 900**	**46 888 200**

All numbers have been rounded off to the nearest hundred.

Figure 1a: Population pyramid of the South African population, 2005

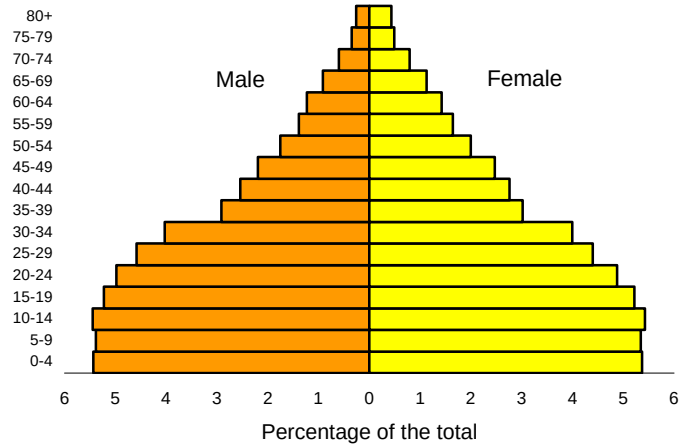


Figure 1b: Population pyramid of the African population, 2005

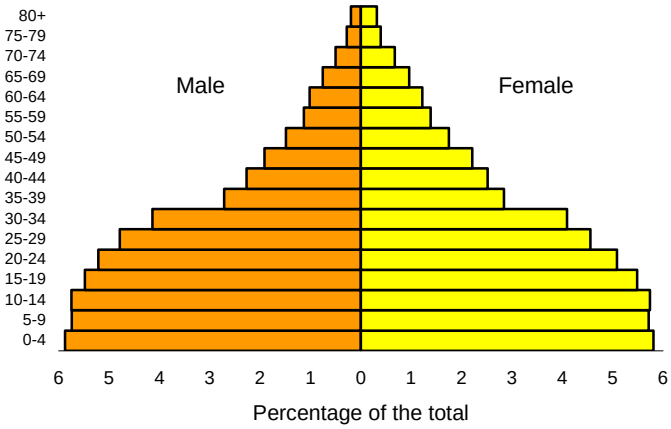


Figure 1c: Population pyramid of the coloured population, 2005

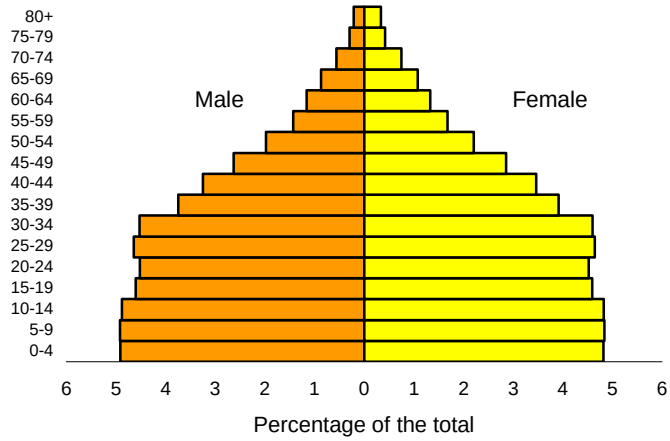


Figure 1d: Population pyramid of the Indian/Asian population, 2005

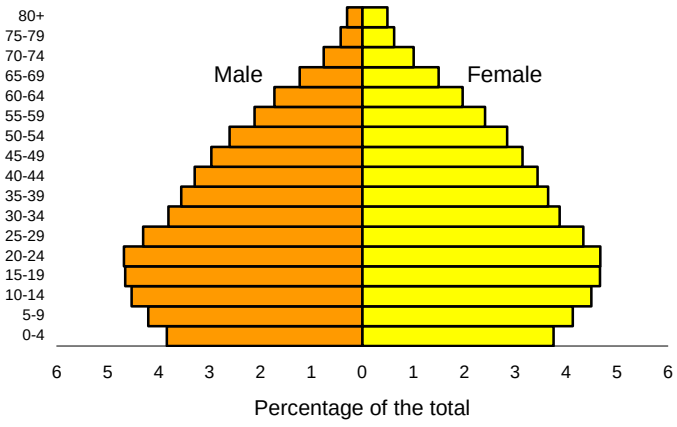
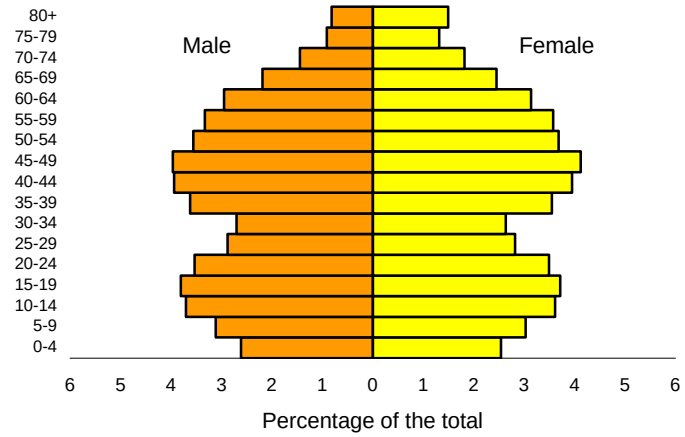


Figure 1e: Population pyramid of the white population, 2005



5. METHODS AND ASSUMPTIONS FOR PROVINCIAL ESTIMATES

Overview of provincial estimation methodology used in South Africa

When projections for all the regions of a country are desired and the appropriate data are available, a multi-regional approach should be considered, as this is the only way to guarantee that the total migration flows between regions will sum to zero, or to the assumed level of international migration (United Nations, 1992). Developed by Willekens and Rogers (1978), these methods have not been widely used in developing countries, largely due to the lack of adequate migration data and the difficulty of applying these methods.

Multi-regional methods require the estimation of separate age-specific migration rates between every region of the country and every other region, and such detailed data are rarely available. Although it is possible to estimate some of the missing data (see Willekens, Por & Raquillet, 1979), the task of preparing data can become overwhelming if there are many regions. If there are only a few streams, however, the multi-regional method is the best method to use. In South Africa, 576 (9x8x4x2) migration streams are derived if the multi-regional model is applied in calculating migration streams by population group, age and sex for each of the nine provinces.

Calculating provincial population estimates for South Africa

The main steps in deriving provincial mid-year population estimates for South Africa are as follows.

1. Calculate the number of out-migrants

Whereas a projection for a single region involves multiplying the population at the first time-point in each five-year age group by a survival rate to obtain the survivors to the next five-year age group at the second time point, a multi-regional projection involves a compound survival rate which specifies the probability of surviving and being in a particular region at the second time-point. A compound survival rate is the product of the survival rate and the out-migration rate(s) to each of the other provinces. The number of out-migrants from province A to each of the other provinces (B to I) is then defined as:

$$OUT^{AB}_{t+5,x+5} = P^{A}_{t,x} * S^{A}_{t,x} * MR^{AB}_{t,x}$$
$$OUT^{AC}_{t+5,x+5} = P^{A}_{t,x} * S^{A}_{t,x} * MR^{AC}_{t,x}$$
$$\vdots$$
$$OUT^{AI}_{t+5,x+5} = P^{A}_{t,x} * S^{A}_{t,x} * MR^{AI}_{t,x}$$

Where:

$S^{A}_{t,x}$ is the survival ratio of province A, age group x, first projection period; $MR^{AB}_{t,x}$ is the migration rate of province A to province B, age group x, first projection period; $MR^{AC}_{t,x}$ is the migration rate of

province A to province C, age group x, first projection period; and $MR_{t,x}^{AI}$ is the migration rate of province A to province I, age group x, first projection period. The migration rate is defined as the number of migrants per thousand of the population in a specific age group.

2. Calculate the number of survivors by province

For survival in the same province, the compound rate is the survival rate times one minus the sum of the out-migration to the other provinces. That is, the survivors (those that have not died or migrated) for people in age group x+5 and period t+5 of province A is obtained by the following formula:

$$SUR_{t+5,x+5}^{A} = P_{t,x}^{A} * S_{t,x}^{A} * (1 - MR_{t,x}^{AB} - MR_{t,x}^{AC} - MR_{t,x}^{AD} - .....MR_{t,x}^{AI})$$

Where:

$P_{t,x}^{A}$ is the population of province A, age group x, first time period; and the other symbols are defined as before. The number of survivors in each of the other provinces is calculated in the same way.

3. Calculate the number of in-migrants

The number of in-migrants to province A is obtained by adding the out-migrants from the other provinces (B to I) to province A, that is:

$$IN_{t+1,x}^{A} = OUT_{t+1,x}^{BA} + OUT_{t+1,x}^{CA} + OUT_{t+1,x}^{DA} + ... + OUT_{t+1,x}^{IA}$$

4. Sum the survivors and in-migrants to obtain the population aged 5 years and older

The projected provincial population of A in each age group aged 5 years and over is simply the sum of the survivors in province A and the number of in-migrants to province A, namely:

$$P_{t+1,x}^{A} = SUR_{t+1,x}^{A} + IN_{t+1,x}^{A}$$

5. Calculate the number of births and survivors aged 0–4 years

Annual births are estimated by applying the age-specific birth rates assumed for each province to the number of women in each of the reproductive age groups. This step is done separately for 1996 and 2001; the results are averaged and then multiplied by five to obtain the total number of births in the specific province for the first five-year projection interval. The total number of births is multiplied by the assumed sex ratio at birth to obtain the number of male births. This projection process can be repeated for further time intervals and the assumed levels of mortality, fertility and migration can be altered for each projection period, if desired.

Assumptions of the provincial mid-year population estimates

Base population by province, population group and sex

The provincial base populations were determined by using a series of iterations in order to ensure that for each sex and age group the sum of the provincial population is equal to the estimated total population. The 2001 provincial base populations were constructed using three sources:

- the adjusted 2001 census population by age and sex for each of the nine provinces;
- the 2001 mid-year country estimate population by age and sex; and
- an estimate of the total population in each province.

Fertility assumptions

The provincial age-specific fertility rates and TFRs were obtained from the fertility analyses of the 2001 population census (Moultrie & Dorrington, 2004). To determine if the suggested rates generate the same number of births as were obtained from the total population, the age-specific fertility rates were applied to the provincial female populations in the age groups 15–49 years. The number of births obtained in this way was less than the total births obtained from the country projections. The age-specific fertility rates were therefore adjusted. Figure 2 shows the provincial TFRs and the age-specific fertility rates are shown in Figure 3.

Figure 2: Provincial total fertility rates, 2001–2006

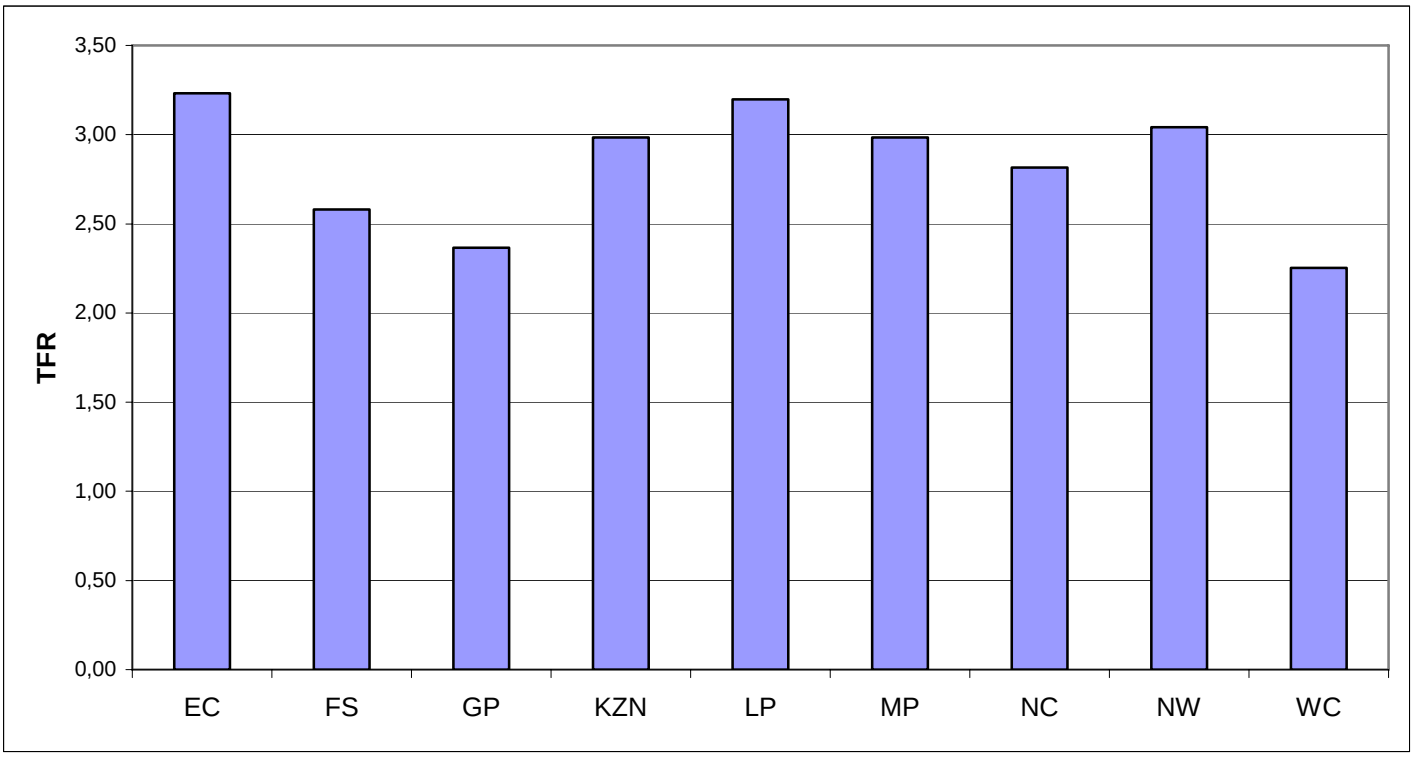
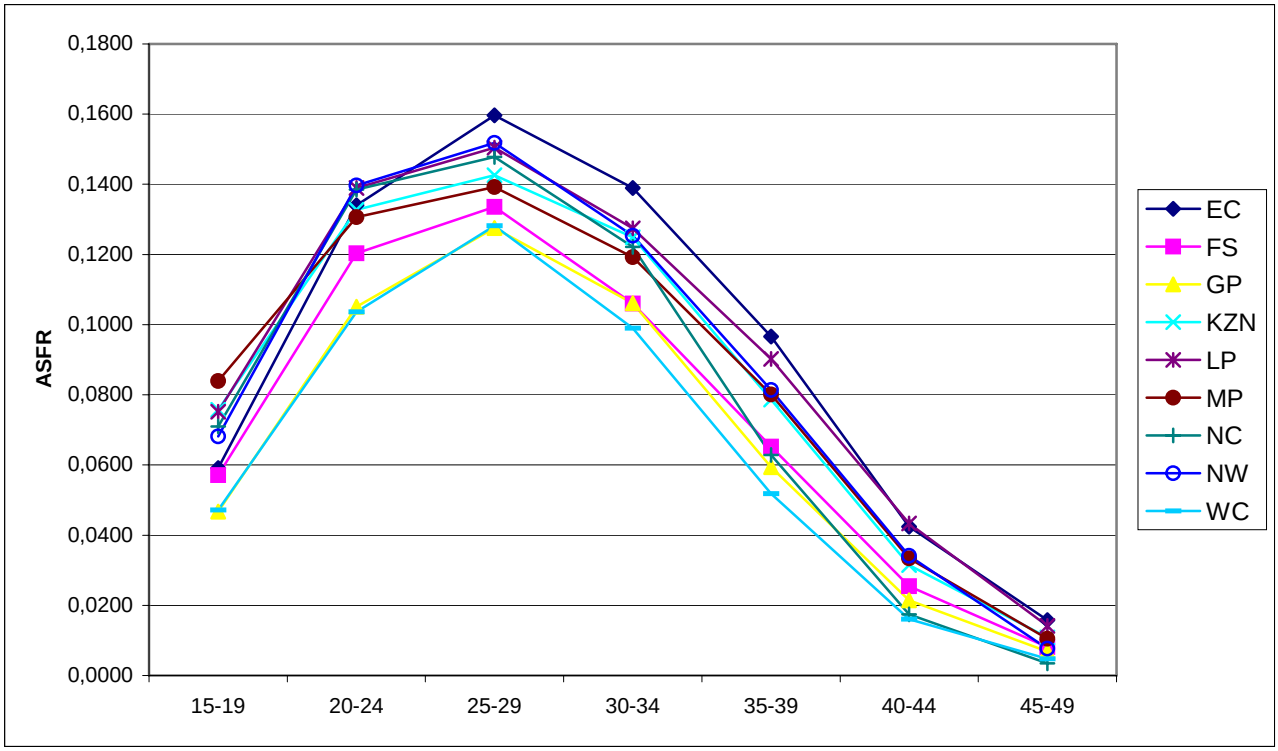


Figure 3: Provincial age-specific fertility rates, 2001–2006



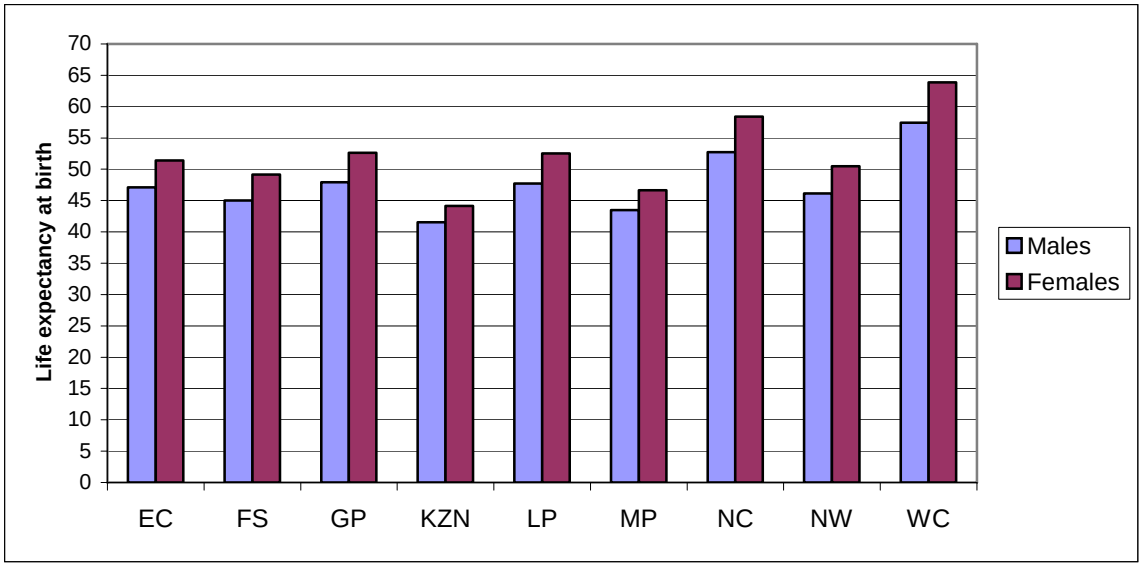
Mortality assumptions

Using the MATCH and LIFTB procedures in MORTPAK, adjustments to an initial set of mortality estimates were made separately for males and females. These were as follows:

- generating life tables from the initial life expectancies at birth for each province;
- applying the age-specific mortality formula (${}_nm_x$) to the provincial census population data to obtain the number of deaths;
- comparing the sum of the provincial deaths with the total deaths. The numbers of provincial deaths were then adjusted separately for males and females; and
- constructing revised sets of ${}_nm_x$-values to calculate revised life tables.

The revised life expectancies at birth were noted and the survival ratios (${}_nS_x$) were then used for the projections. Figure 4 shows the provincial life expectancies at birth for males and females as derived from the ${}_nS_x$ values.

Figure 4: Provincial expectation of life at birth, 2001–2006



Migration assumptions

The migration-related questions asked in the 2001 census enable researchers to determine migration streams between the different provinces. The migration questions differed from those used in the 1996 census and the calculations to determine the migration streams were more complicated. The questions asked in the 2001 census made it possible to determine if a person was a migrant in the five years before the census. The results of the analysis and the migration assumptions used in this projection are given in Table 9. Gauteng, Western Cape and KwaZulu-Natal had a positive net migration rate. There seems to be a high migration movement between Gauteng and North West. The provinces with the highest outflow of people were Eastern Cape and Limpopo.

Table 9: Estimated migration streams for the total population, 2001–2006

Origin	Did not migrate	Destination									Total out-migrants	Net migration
		Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpumalanga	Northern Cape	North West	Western Cape		
Eastern Cape	6 801 200	-	21 200	100 000	89 600	8 400	13 100	5 400	27 700	175 000	440 400	-323 200
Free State	2 820 100	12 000	-	73 600	10 700	5 800	8 700	8 200	25 000	16 000	160 000	-57 700
Gauteng	8 288 800	35 800	29 400	-	63 500	39 000	41 700	6 400	50 200	67 500	333 500	519 900
KwaZulu-Natal	9 390 600	18 800	10 600	124 200	-	6 300	16 300	2 300	5 900	24 800	209 200	4 000
Limpopo	5 470 900	3 700	5 200	249 100	8 700	-	49 900	1 900	26 900	6 400	351 800	-249 300
Mpumalanga	3 062 000	4 400	7 100	107 500	17 600	22 800	-	1 800	13 900	7 100	182 200	-38 700
Northern Cape	840 400	3 900	9 800	15 000	2 500	2 300	1 900	-	9 700	31 900	77 000	-23 900
North West	3 635 500	6 100	12 600	144 700	7 100	14 600	7 900	17 600	-	8 600	219 200	-55 500
Western Cape	4 350 200	32 500	6 400	39 300	13 500	3 300	4 000	9 500	4 400	-	112 900	224 400
Total in-migrants	**-**	**117 200**	**102 300**	**853 400**	**213 200**	**102 500**	**143 500**	**53 100**	**163 700**	**337 300**	**-**	**-**

All numbers have been rounded off to the nearest hundred

6. MID-YEAR PROVINCIAL ESTIMATES, 2005

Table 10 shows the percentage of the total population residing in each of the provinces from 2001 to 2005. The provincial estimates show that KwaZulu-Natal has the largest share of the population (20,6%), followed by Gauteng (19,2%) and Eastern Cape (15,0%) in 2005. Approximately 10% of the population live in the Western Cape. The Northern Cape has the smallest population, with 1,9% of the total population. Free State has the second smallest share of the South African population, with about 6% of the total population residing in this province.

Table 11 shows the detailed provincial mid-2004 population estimates by age and sex. Where necessary the totals by age were reconciled with the national totals, for males and females separately. However, due to the rounding off of data in the tables to the nearest 100, the population totals by sex and age do not always correspond with the totals presented in Section 4.

Figures 5a to 5i show the provincial population pyramids. The pyramid for Gauteng shows the impact of migration to the province by those in the young working ages.

Table 10: Percentage distribution of the projected provincial share of the total population, 2001–2005

Province	2001	2002	2003	2004	2005
Eastern Cape	15,5	15,4	15,3	15,1	15,0
Free State	6,5	6,4	6,4	6,3	6,3
Gauteng	18,5	18,7	18,9	19,0	19,2
KwaZulu-Natal	20,7	20,7	20,7	20,6	20,6
Limpopo	12,3	12,2	12,1	12,1	12,0
Mpumalanga	6,9	6,9	6,9	6,9	6,9
Northern Cape	1,9	1,9	1,9	1,9	1,9
North West	8,2	8,2	8,2	8,2	8,2
Western Cape	9,4	9,5	9,7	9,8	9,9
Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Table 11: Provincial mid-year population estimates by age and sex, 2005

Age	Eastern Cape			Free State			Gauteng			KwaZulu-Natal			Limpopo		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	389 400	386 000	775 400	149 000	147 600	296 600	450 700	442 400	893 100	547 500	542 100	1 089 600	337 400	335 000	672 400
5-9	407 700	400 900	808 600	152 100	150 900	303 000	386 000	383 500	769 500	558 500	554 000	1 112 500	355 400	356 200	711 600
10-14	460 100	454 800	914 900	155 000	153 800	308 800	342 900	342 400	685 300	570 200	567 200	1 137 400	385 000	386 200	771 200
15-19	435 400	430 100	865 500	156 500	154 000	310 500	343 300	347 000	690 300	538 100	536 200	1 074 300	358 900	358 200	717 100
20-24	342 400	342 100	684 500	147 400	143 500	290 900	458 800	422 400	881 200	498 300	496 400	994 700	277 200	287 900	565 100
25-29	252 500	261 800	514 300	129 900	128 400	258 300	558 300	469 700	1 028 000	427 600	425 700	853 300	201 200	231 800	433 000
30-34	200 700	228 800	429 500	115 700	119 300	235 000	529 000	441 100	970 100	359 100	373 800	732 900	154 900	200 500	355 400
35-39	146 100	181 400	327 500	90 000	94 500	184 500	371 200	322 400	693 600	242 800	274 400	517 200	109 600	147 500	257 100
40-44	134 300	177 100	311 400	81 000	85 800	166 800	309 100	284 700	593 800	208 600	252 800	461 400	95 000	135 500	230 500
45-49	126 600	172 600	299 200	71 400	76 500	147 900	259 200	251 300	510 500	178 400	222 300	400 700	81 700	118 200	199 900
50-54	106 300	142 600	248 900	57 900	63 600	121 500	195 800	195 400	391 200	146 900	180 800	327 700	68 900	99 400	168 300
55-59	88 100	119 900	208 000	45 400	52 100	97 500	147 600	152 700	300 300	121 800	156 400	278 200	56 900	81 000	137 900
60-64	85 700	113 800	199 500	39 700	44 100	83 800	120 800	123 600	244 400	105 100	133 700	238 800	52 100	71 000	123 100
65-69	75 700	107 700	183 400	28 100	33 100	61 200	79 000	82 300	161 300	76 100	105 000	181 100	42 600	64 200	106 800
70-74	54 500	75 700	130 200	18 900	24 400	43 300	47 000	53 000	100 000	47 900	73 100	121 000	30 100	52 200	82 300
70-79	31 600	45 500	77 100	9 900	13 300	23 200	25 400	31 500	56 900	27 700	46 600	74 300	19 900	35 500	55 400
80+	22 700	38 700	61 400	7 300	13 000	20 300	19 000	29 500	48 500	19 500	36 500	56 000	16 400	31 500	47 900
Total	**3 359 800**	**3 679 500**	**7 039 300**	**1 455 200**	**1 497 900**	**2 953 100**	**4 643 100**	**4 374 900**	**9 018 000**	**4 674 100**	**4 977 000**	**9 651 100**	**2 643 200**	**2 991 800**	**5 635 000**

All numbers have been rounded off to the nearest hundred

Table 11: Provincial mid-year population estimates by age and sex, 2005 (concluded)

	Mpumalanga			Northern Cape			North West			Western Cape			All provinces		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	185 200	183 800	369 000	47 600	46 900	94 500	211 900	210 600	422 500	228 100	222 800	450 900	2 546 800	2 517 200	5 064 000
5-9	190 800	191 700	382 500	48 500	48 000	96 500	202 300	202 400	404 700	223 600	218 600	442 200	2 524 900	2 506 200	5 031 100
10-14	186 600	188 300	374 900	45 700	45 700	91 400	199 800	199 600	399 400	208 700	207 300	416 000	2 554 000	2 545 300	5 099 300
15-19	178 500	177 700	356 200	42 900	42 700	85 600	191 000	191 300	382 300	206 300	209 900	416 200	2 450 900	2 447 100	4 898 000
20-24	163 400	159 400	322 800	40 500	37 900	78 400	180 400	172 600	353 000	226 000	224 400	450 400	2 334 400	2 286 600	4 621 000
25-29	142 100	139 400	281 500	38 300	35 200	73 500	174 700	158 500	333 200	223 800	212 300	436 100	2 148 400	2 062 800	4 211 200
30-34	122 800	127 200	250 000	35 900	33 900	69 800	159 800	148 800	308 600	210 500	200 400	410 900	1 888 400	1 873 800	3 762 200
35-39	88 800	94 600	183 400	28 400	28 000	56 400	125 600	113 500	239 100	161 300	160 200	321 500	1 363 800	1 416 500	2 780 300
40-44	79 000	83 800	162 800	25 300	25 900	51 200	116 100	102 700	218 800	141 000	145 600	286 600	1 189 400	1 293 900	2 483 300
45-49	67 200	70 500	137 700	23 000	24 400	47 400	102 700	91 400	194 100	119 400	130 300	249 700	1 029 600	1 157 500	2 187 100
50-54	53 900	57 300	111 200	19 400	20 800	40 200	77 100	73 700	150 800	94 200	103 000	197 200	820 400	936 600	1 757 000
55-59	40 400	44 500	84 900	15 700	17 500	33 200	58 800	59 600	118 400	76 700	87 000	163 700	651 400	770 700	1 422 100
60-64	34 300	37 100	71 400	14 700	15 700	30 400	53 600	54 600	108 200	69 700	75 100	144 800	575 700	668 700	1 244 400
65-69	24 500	29 600	54 100	11 000	11 400	22 400	37 700	40 100	77 800	53 100	54 400	107 500	427 800	527 800	955 600
70-74	15 200	20 200	35 400	7 500	8 000	15 500	25 000	28 300	53 300	36 000	37 400	73 400	282 100	372 300	654 400
70-79	9 600	13 200	22 800	3 900	4 500	8 400	14 200	17 300	31 500	19 700	22 900	42 600	161 900	230 300	392 200
80+	7 800	11 500	19 300	3 000	4 500	7 500	10 800	17 400	28 200	13 900	22 000	35 900	120 400	204 600	325 000
Total	**1 590 100**	**1 629 800**	**3 219 900**	**451 300**	**451 000**	**902 300**	**1 941 500**	**1 882 400**	**3 823 900**	**2 312 000**	**2 333 600**	**4 645 600**	**23 070 300**	**23 817 900**	**46 888 200**

All numbers have been rounded off to the nearest hundred

Figure 5a: Population pyramid of Eastern Cape, 2005

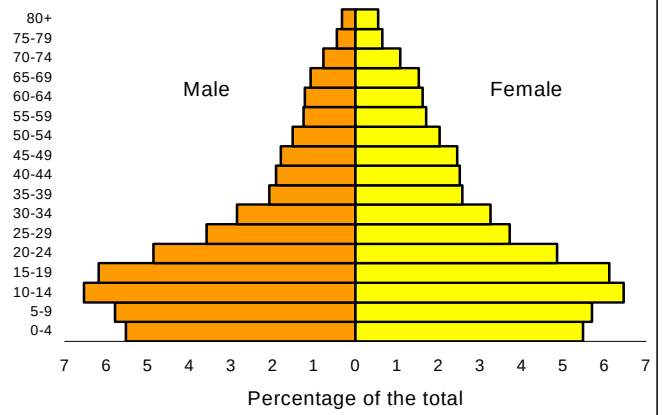


Figure 5b: Population pyramid of Free State, 2005

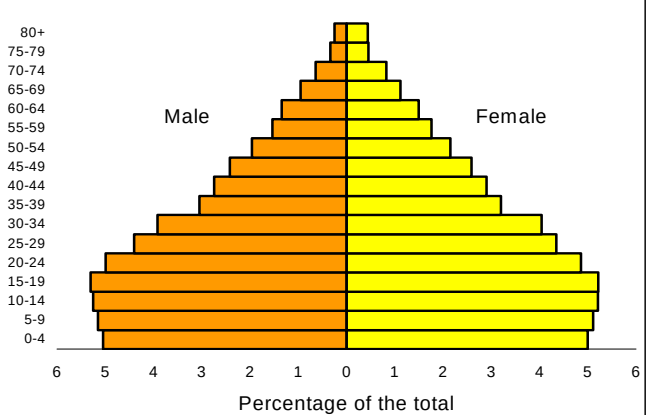


Figure 5c: Population pyramid of Gauteng, 2005

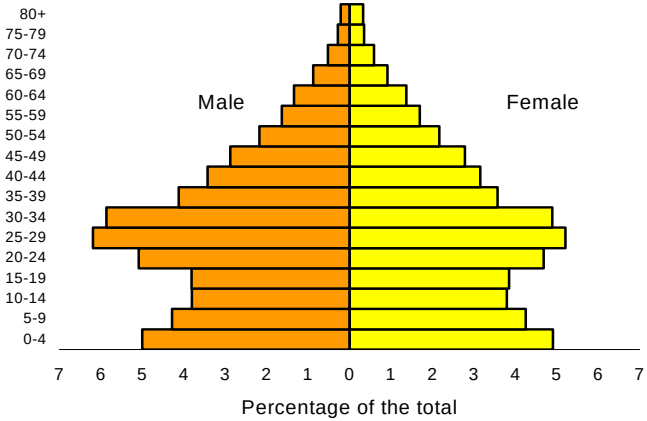


Figure 5d: Population pyramid of KwaZulu-Natal, 2005

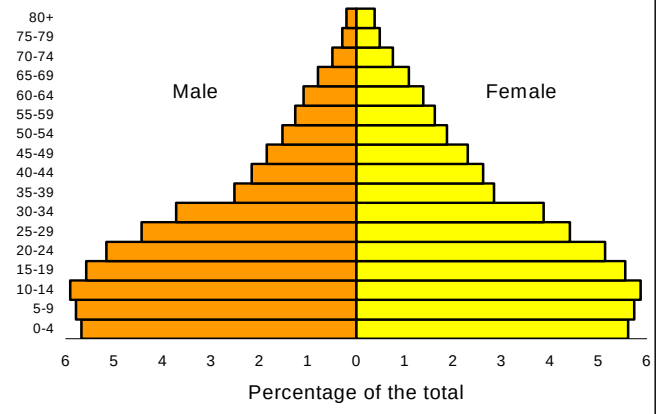


Figure 5e: Population pyramid of Limpopo, 2005

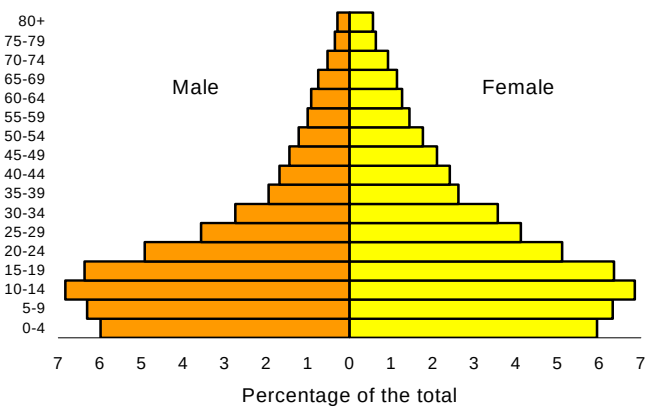


Figure 5f: Population pyramid of Mpumalanga, 2005

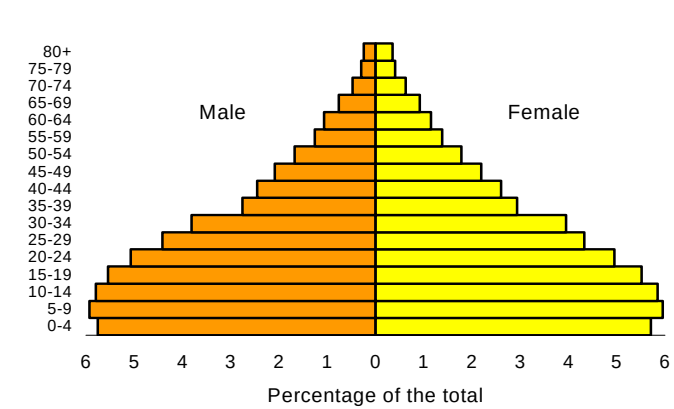


Figure 5g: Population pyramid of Northern Cape, 2005

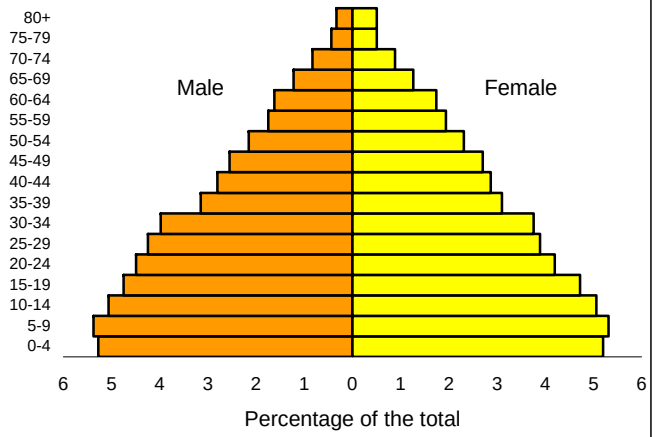


Figure 5h: Population pyramid of North West, 2005

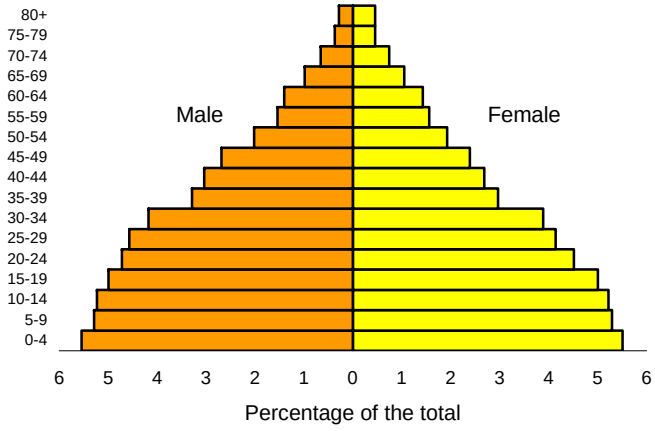
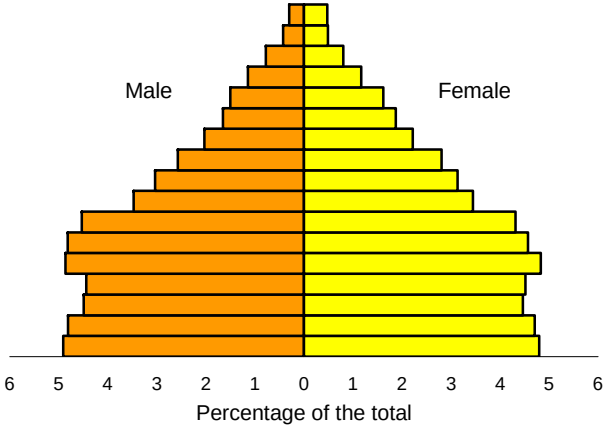


Figure 5i: Population pyramid of Western Cape, 2005



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