Mid-year estimates
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THE POPULATION OF SOUTH AFRICA IS PROVISIONALLY ESTIMATED TO BE 43,05 MILLION BY MID 1999 GIVEN THE 1996 CENSUS FIGURES AS THE BASE POPULATION AND THE ASSUMPTIONS MADE IN THE ESTIMATION OF FERTILITY AND MORTALITY.

The population of South Africa is estimated to have grown from 40,58 million in October 1996 to 43,05 million in mid 1999 and the economically active population is estimated to have grown from 14,9 million to 15,8 million over the same period. These are preliminary estimates and would differ from the estimates that would result when certain factors such as internal migration and additional deaths due to HIV/AIDS are taken into account.

Summary

The report presents preliminary mid-year estimates of the population generally, and the economically active population in particular, for the RSA for 1999, and for 15 separate groupings, namely, urban and non-urban areas, 5 population groups including "other and unspecified" and 9 provinces. The growth rates

that underlie these estimates are summarised in Table B. These growth rates are ‘inferred’ growth rates which may differ from actual growth rates. After projection and subsequent interpolation, the ranking order of the different population subgroups did not change. The procedure for obtaining these estimates is outlined in the explanatory notes.

At present, these population estimates should be regarded as preliminary. The methodology used in obtaining the estimates does not take factors such as additional mortality due to HIV/AIDS and internal migration into account. Stats SA is presently revising its projection methodology to take these factors into account, and will publish new adjusted estimates later in the year. There is a large demand for interim estimates, which prompts us to issue this publication.

Explanatory notes

A. Population estimates

Overview

Traditionally, population projections have been performed mostly by the cohort-component method which in essence uses a deterministic macro-simulation approach. Recent research efforts in the field of projections have seen the development of stochastic macro-simulation wherein the concept of uncertainty is introduced into the projection model as well as the use of micro-simulation. In essence, depending on the resources available, population projections could be developed at varying degrees of sophistication and complexity. At Stats SA, plans are currently underway to revise the projection methodology to include additional deaths due to HIV/AIDS and internal migration. It is hoped that the results of that exercise will be used in preparing the detailed population projection report due to be published later in 1999.

In this statistical release, only the base population estimates are given (without taking account of additional AIDS deaths, internal migration (including non-urban to urban migration) or uncertainty.

In preparing this report, we made use of only the 1996 Census data. The data were used in three respects:

1. In providing the base population for doing the projections.

2. In providing fertility estimates used for estimating the population aged, 0-4 in 2001.

3. In providing mortality estimates used for deriving five-year survivorship probabilities.

The analysis was done separately for males and females at the national level and for 15 other separate groupings, namely, urban and non-urban areas, 5 population groups including "other and unspecified" and

9 provinces.

Base population

The base population used was the 1996 Census data which had been adjusted for undercount by the post-enumeration survey. The reported ages of the population were used as they were, without any adjustments made to them. A small proportion of the population had unspecified ages. This proportion was distributed among the population of known ages through the standard procedure explained below. Projections were done on the population with known ages, and an adjustment factor for pro-rating the population of unknown ages,*k*, was calculated and was applied to the projected population. The adjustment factor, *k*, is calculated as follows:

$k = P_T / (P_T - P_u)$

where P_T is the total population over all ages (including those with unknown ages)

P_u is the population of unknown ages.

The adjustment factors obtained are given in Table A.

Table A. Adjustment factors for unknown ages in 1996

		Adjustment factor for unknown ages,*k*
	Gender	1996
RSA	Males	1.013249
	Females	1.011280
Urban	Males	1.013399
	Females	1.010921
Non-urban	Males	1.013069
	Females	1.011682
Africans/Blacks	Males	1.012713

	Females	1.011033
Coloureds	Males	1.008511
	Females	1.007423
Indians/Asians	Males	1.009092
	Females	1.008806
Whites	Males	1.016343
	Females	1.013680
Other and	Males	1.081407
Unspecified	Females	1.049809
Western Cape	Males	1.012425
	Females	1.008996
Eastern Cape	Males	1.009130
	Females	1.007416
Northern Cape	Males	1.012227
	Females	1.009987
Free State	Males	1.011974
	Females	1.010441
KwaZulu-Natal	Males	1.015138
	Females	1.013524
North West	Males	1.009349
	Females	1.007395
Gauteng	Males	1.014680
	Females	1.012884
Mpumalanga	Males	1.019284
	Females	1.016576
Northern Province	Males	1.013774

	Females	1.012319

Note: The categories used in the first column are non-overlapping since the provincial totals add up to the RSA total. The five population groups and the urban/non-urban locations also add up to the RSA total.

Estimation of population aged 0-4

From the census data, reported fertility (births in the past twelve months) per woman and parity (average number of children ever born per woman) were obtained. However, if there was misunderstanding of the reference period reported, true fertility could have been underestimated. There is therefore the need to adjust the reported fertility estimates. The method opted for is that of Arriaga (1983). In which the reported parities are transformed into age-specific fertility rates, and are subsequently cumulated. These cumulated rates are compared with another set of cumulated rates, obtained from reported fertility, to derive adjustment factors.

Adjustment factors used could have been based on age groups 20-24, 25-29 or 20-29. However they were based on women in the age group of 20-29 years, as they usually give estimates that lie between those obtained from either the 20-24 age group or the 25-29 age group. The program used for doing this is FERTPF in the United Nations Software Package for Mortality Measurement (MORTPAK). Note that there are other methods for indirectly estimating fertility which would not necessarily give the same results. With direct techniques, it is possible to arrive at a fixed value, but with indirect methods, the values and variances vary slightly within an acceptable range.

The adjusted age-specific fertility rates are used to obtain an estimate of the average annual number of births. This is multiplied by five to obtain average number of births for five years. This number is separated into males and females using an assumed sex ratio at birth. For each pair of male and female life tables, the respective number of five-year births is multiplied by the five-year survivorship ratio from birth to obtain an estimate of the population aged 0-4.

Life table and survivorship ratios

A life table is the demographer’s way of representing the effects of mortality. In the absence of complete statistics on reported deaths, methods have been devised to obtain life tables either from correcting the reported deaths for incompleteness or from using a completely different approach based on information on the survivorship of a respondent’s kin (sons, daughters, sisters, mother, father or spouse). The method independent of the reported deaths in a given country, but dependent on reported deaths in other countries (through the use of model life tables). The methods convert the proportions of dead kin among all reported kin (by five-year age groups of respondent) into a series of life table probabilities of surviving to a given age in childhood or from one adult age to another, and their corresponding time locations. Given the time trend of these probabilities, one can use interpolation or extrapolation to obtain a point probability

estimate at a given date (within an acceptable range). The life table for a given date can then be constructed using probability estimates derived from either childhood mortality or adult mortality or both. The choice has to be guided by performance of the models and by prior knowledge about expected mortality conditions which are likely to prevail.

From the census data, information on number of women, children dead, children surviving, classified by five-year age groups of mother was used to calculate probabilities of surviving in childhood using the Trussell version of the Brass method. The census data collected on childhood mortality does not give breakdowns by gender. Hence this procedure could only be done for both male and female combined. The program used for doing this is QFIVE developed by the United Nations. Further, data on respondents whose mothers were still alive ('not orphaned') together with information on mean age at child-bearing and children ever born was used to calculate female adult mortality through the 'maternal orphanhood' method of Hill and Trussell, and through the maternal orphanhood method of Brass. Finally, data on respondents whose fathers were still alive, together with information on mean age at paternity, were used to calculate male adult mortality through the 'paternal orphanhood' method of Brass. For specific estimates derived from these methods, the time trends were plotted. Linear regression equations were fitted, and estimates of intercepts and slopes of the fitted straight lines were obtained. These estimates were then used to obtain point estimates of life table probabilities of surviving to given ages for dates referring to mid 1996.

In order to decide on which points to combine in deriving a life table, diagnostics were performed on these estimates. The diagnostics showed that estimates for survivorship during childhood performed far better than estimates of probabilities of surviving during adulthood (with male adult mortality performing even better than female adult mortality). Life tables constructed using the combination of estimates of childhood and adult mortality did not prove plausible (with life expectancies at birth exceeding 80 years in several instances). However, when life tables were constructed with only one childhood mortality estimate as input (probability of surviving to age 5, *l(5)*), the results proved plausible, in accordance with expected mortality differentials. As a result, the life tables obtained were based on *l(5)*. In order to obtain separate life tables for males and females as required, the sex differential embodied in the selected model life table was assumed. Specifically, *l(5)* was taken as a male value for the male life table and as a female value for the female life table. The program used for estimating female adult mortality using Hill-Trussel method is ORPHAN in MORTPAK while the program used for obtaining the life table from the *l(5)* estimate is MATCH also in MORTPAK. As South Africa has a heterogenous population, the Coale Demeny West model was used as the reference model life table.

The desired five-year survivorship ratios were obtained directly from the outputs of the MATCH program

Note that there are other methods for constructing life tables and the results of all the different methods would not necessarily be the same.

Forward projection

The census data by age and gender was grouped into five year age groups (with the exception of 0-1, 1-4 and the open interval 75+) and applied to the appropriate survivorship ratios to obtain a population forwardly projected to 2001. It is the total of the projected population that is compared with the 1996 population to obtain the growth rates as further explained below.

Growth rates and interpolation

Using the census totals for 1996 and the projected totals for 2001, exponential growth of the population was assumed and the 'inferred' growth rate, *r* was obtained as follows:

$P_{t2} = P_{t1*} \exp (r *(t2- t1))$

where t1 is the initial time and t2 is the final time.

Hence, $r = 0.2* \log_e (P_{2001}/ P_{1996})$

Regarding the population estimates for the period, 1991-1996, one could either use growth rates derived for that period (using backward projection of the 1996 census to 1991 and inferring the growth rate from the totals) or assume that the growth rates for the period, 1996-2001 would be applicable for the earlier period as well. Both methods were attempted but the latter procedure gave more plausible results and hence has been adopted.

For any given date, tx , either prior to 1996 or after 1996, the mid-year population estimate is obtained as follows:

$P_{tx} = P_{1996.775*} \exp (r *(tx- 1996.775))$

where 1996.775 is the decimalised equivalent of the Census night, 10 October 1996.

Note that the 'inferred' growth rates should not be confused with actual growth rates obtained from data from two censuses. In the same way, growth rates obtained by assuming the population is 'stable' (intrinsic growth rate), differ from actual growth rates. The growth rates calculated are shown in Table B.

Note that these inferred growth rates would change once the projection model is revised to incorporate some of the aspects discussed in the overview section.

Table B. Exponential growth rates inferred from the population projected through the cohort-component method, 1991 - 1998

		Exponential growth Rates, *r*
	Gender	1991-1998
RSA	Males	0.023545
	Females	0.019957
Urban	Males	0.022469
	Females	0.020077
Non-urban	Males	0.026649
	Females	0.021314
Africans/Blacks	Males	0.026520
	Females	0.022473
Coloureds	Males	0.020682
	Females	0.018207
Indians/Asians	Males	0.017039
	Females	0.015679
Whites	Males	0.010300
	Females	0.007426
Others and	Males	0.016872
unspecified	Females	0.013745
Western Cape	Males	0.020230
	Females	0.017868
Eastern Cape	Males	0.023132
	Females	0.017087
Northern Cape	Males	0.015498
	Females	0.013769

Free State	Males	0.021158
	Females	0.018874
KwaZulu-Natal	Males	0.023806
	Females	0.018876
North West	Males	0.022793
	Females	0.020645
Gauteng	Males	0.021956
	Females	0.021826
Mpumalanga	Males	0.026812
	Females	0.023906
Northern Province	Males	0.033112
	Females	0.025307

Note: The categories used in the first column are non-overlapping since the provincial totals add up to the RSA total. The five population groups and the urban/non-urban locations also add up to the RSA total.

Reconciling the totals with the sum of the components

In preparing mid-year estimates for the total population and for some of its components, there is often discrepancy between the sum of the initial estimates of the components and the total population. There is need then to adjust for the differences to arrive at final estimates. The procedure for controlling is known variously as, iterative proportional fitting, raking and rim-weighting.

In this report, controlling was done for males and females separately. The program used for doing this is CTBL32 in Population Analysis Software (PAS) by the US Bureau of Census. The total for each population sub-group was obtained by summing the estimates for males and females.

B. Estimation of economically active population

Definition

The phrase *economically active* refers to a person aged 15 years or more who is either employed or unemployed but who is looking for work. In other words, someone who is working or who wants to work

and is seeking work is defined as*economically active.*

Crude activity rate is the percentage of the total population that is economically active.

Age-specific activity rate is the percentage of the population in a given age group that is economically active.

Economically active population

When a series of age-specific activity rates are available from two or more censuses, there are techniques for projecting those rates. Those rates could then be used to obtain estimates of the economically active population by applying them to projected populations. In this case, as only a one-census approach is being used, another option has to be used. The method used is as follows:

Crude activity rates were calculated from the 1996 Census data and these rates were equally applied to all the mid-year estimates. The totals were then reconciled with the sub-components as was done with the population estimates above.

C. Note to users who would like to prepare special population estimates

1. If a user needs to estimate the population of a given population group at the provincial level for a non-census date, one option is as follows: He/she might have to make the assumption that the national growth rate for that population group applies at the provincial level and proceed with applying that rate on the provincial total of that population group. Other options are possible.

2. If a user needs to estimate the population at sub-provincial level for a non-census date, one option is as follows: He/she might have to estimate the ratio of that sub-provincial total to the province total and apply that ratio on the provincial estimate at the desired date. Other options are possible.

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1. Mid-year population estimates, 1999
    1. RSA, urban and non-urban

		Mid-1999
RSA	Males	20814425
	Females	22239881
	Total	43054306
Urban	Males	11316037
	Females	11716344
	Total	23032381
Non-urban	Males	9498388
	Females	10523538
	Total	20021926

1. Mid-year population estimates, 1999

1.2 Population groups

		Mid-1999
Africans/Blacks	Males	16019124
	Females	17220755
	Total	33239879
Coloureds	Males	1844300
	Females	1948331
	Total	3792631
Indians/Asians	Males	536057
	Females	556197
	Total	1092254
Whites	Males	2222131
	Females	2316596

	Total	4538727
Others and Unspecified	Males	192812
	Females	198003
	Total	390815

1. Mid-year population estimates, 1999

1.3 Provinces

		Mid-1999
Western Cape	Males	2050174
	Females	2120797
	Total	4170971
Eastern Cape	Males	3104818
	Females	3553852
	Total	6658670
Northern Cape	Males	431533
	Females	443689
	Total	875222
Free State	Males	1309985
	Females	1404669
	Total	2714654
KwaZulu-Natal	Males	4225575
	Females	4699068
	Total	8924643
North West	Males	1759842

	Females	1802438
	Total	3562280
Gauteng	Males	3991820
	Females	3815453
	Total	7807273
Mpumalanga	Males	1468842
	Females	1534485
	Total	3003327
Northern Province	Males	2471837
	Females	2865430
	Total	5337267

2. Estimated economically active population, 1999

2.1 RSA, urban and non-urban

		Mid-1999
RSA	Males	8519263
	Females	7307716
	Total	15826979
Urban	Males	5580996
	Females	4792898
	Total	10373894
Non-urban	Males	2938267
	Females	2514818
	Total	5453085

2. Estimated economically active population, 1999

2.2 Population groups

		Mid-1999
Africans/Blacks	Males	6136522
	Females	5468970
	Total	11605492
Coloureds	Males	850015
	Females	726227
	Total	1576242
Indians/Asians	Males	284228
	Females	164355
	Total	448583
Whites	Males	1182300
	Females	891721
	Total	2074021
Other and Unspecified	Males	66197
	Females	56443
	Total	122640

2. Estimated economically active population, 1999

2.3 Provinces

		Mid-1999
Western Cape	Males	1011081
	Females	830936

	Total	1842017
Eastern Cape	Males	913571
	Females	913183
	Total	1826754
Northern Cape	Males	187781
	Females	145328
	Total	333109
Free State	Males	618597
	Females	505875
	Total	1124472
KwaZulu-Natal	Males	1598952
	Females	1432250
	Total	3031202
North West	Males	741415
	Females	603623
	Total	1345038
Gauteng	Males	2233397
	Females	1772347
	Total	4005744
Mpumalanga	Males	590472
	Females	459748
	Total	1050220
Northern Province	Males	623997
	Females	644425
	Total	1268422

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