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A methodology for population estimation at National, Provincial and District Level: The approach used by Statistics South Africa (2024)

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Contents

List of tables

List of Figures

Acronyms and abbreviations

AIDS	Acquired Immunodeficiency Syndrome
AIM	AIDS Impact Model
ANC	Antenatal Care
ANCHSS	Antenatal HIV Sentinel Survey
ART	Antiretroviral Therapy
CBR	Crude Birth Rate
CDR	Crude Death Rate
COVID-19	Coronavirus Disease 2019
CSIR	Council for Scientific and Industrial Research
DATCOV	Daily Hospital Surveillance for COVID-19
DBE	Department of Basic Education
DemProj	Demographic Projections
DHA	Department of Home Affairs
HIV	Human Immunodeficiency Virus
IEC	Independent Electoral Commission
IMF	International Monetary Fund
IMR	Infant Mortality Rate
IOM	International Organisation for Migration
IPF	Iterative Proportional Fitting
LGE	Local Government Elections
MACOD	Mortality and causes of death
MDB	Municipal Demarcation Board
NDoH	National Department of Health
NICD	National Institute for Communicable Diseases of South Africa
NPR	National Population Register
NSO	National Statistical Organisation
OECD	The Organisation for Economic Co-operation and Development
PAS	Population Analysis System
PMTCT	Prevention of Mother-to-Child transmission
PLWHIV	People living with HIV
RAPID	Rapid Mortality Surveillance
RNI	Rate of Natural Increase
SDDS	Special Data Dissemination Standards
Stats SA	Statistics South Africa
TFR	Total Fertility Rate
U5MR	Under-five Mortality Rate
UNDESA	United Nations Department of Economic and Social Affairs

Definition of concepts

Age-specific fertility rate (ASFR) – The fertility rate obtained for specific age groups during a given year or reference period per 1,000 women.

Annual growth rate (GR) – The rate at which the population is increasing or decreasing in a given year due to natural increase and net migration, expressed as a percentage of the base population.

Cohort component projection – A projection made by subjecting all cohorts, on an annual or five-year basis, to mortality and migration assumptions, and applying fertility assumptions to women of reproductive age.

Crude birth rate (CBR) – The number of births in a year per 1,000 mid-year population of a specific year.

Crude death rate (CDR) – The number of deaths in a year per 1 000 mid-year population of a specific year.

Epidemic – A disease that affects a large number of people within a community, population or region.

Excess deaths – The number of deaths observed during the pandemic above a baseline of recent trends

Life expectancy at birth (e(0)) – The average number of additional years a person could expect to live if the age-specific death rates for a given year prevailed for the rest of his/her life.

Life table – A tabular display of life expectancy and the probability of dying at each age (or age group) for a given population, according to the age-specific death rates prevailing at that time.

Pandemic – An epidemic that has spread over multiple countries or continents.

Population Estimates- a calculation of the size or distribution of a population or another characteristic of the population for the present or past

Population projection – Computations depicting the future course of a population's size, its structure, and its interaction with dynamics such as fertility, mortality, and migration. The projection is constructed based on assumptions about the future course of those population dynamics.

Rate of natural increase (RNI) – The rate at which the population is increasing or decreasing in a given year due to the surplus or deficit of births over deaths, expressed as a percentage of the base population.

Sex ratio – The number of males per 100 females in a population.

Total fertility rate (TFR) – The average number of children born alive to a woman during her lifetime if she were to bear children at each age in accordance with the prevailing age-specific fertility rates.

Under five-mortality rate (U5MR) – The number of deaths to children under the age of five per 1 000 live births

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1. Overview

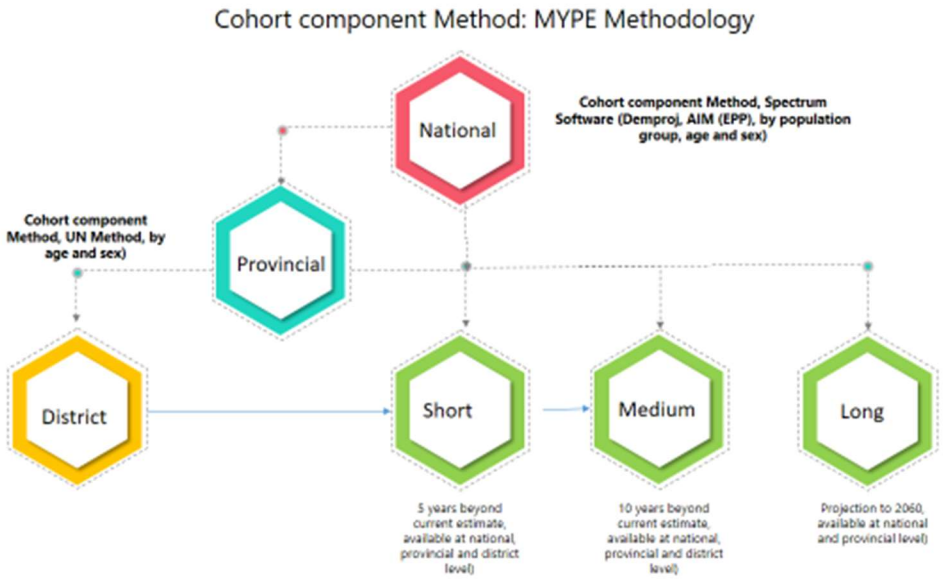
In order to meet the need for population estimates, Statistics South Africa (Stats SA) publishes national, provincial and district population estimates annually. This report provides users of the mid-year population estimates (MYPE) with a description of the methodology employed by Statistics South Africa. The actual estimates may be downloaded from the Stats SA website:
https://www.statssa.gov.za/?page_id=1866&PPN=P0302&SCH=73305

We distinguish between three levels of geography in our projections. These are:

(a) Projection of the national population by using the SPECTRUM system.
(b) Provincial projection by applying a UN sub-national method of cohort-component projections (United Nations, 1992).
(c) District projection by applying a UN sub-national method of cohort-component projections (United Nations, 1992).

These estimates are unique for each year due to the updated assumptions, data inputs as well as the software used. It is therefore important to note that population and other demographic data in each release form a new set of a time series. Users should therefore compare the time series data in each statistical release and not data between statistical releases.

Figure 1: Mid-year population process of projections



Stats SA subscribes to the specifications of the Special Data Dissemination Standards (SDDS) of the International Monetary Fund (IMF). These standards dictate that the MYPE release should be disseminated within one month of the mid-year. The mid-year estimates are an estimate of the population as at 30th June in a given year. The estimates of stock such as population size, number of people living with HIV etc. pertain to the middle of the year i.e. 30th June, whilst the estimates of flow e.g. births, deaths, Total Fertility Rates (TFRs), Infant Mortality Rates (IMRs) etc. are for a 12-month period e.g. 1st July 2023 to 30th June 2024. A *stock*

variable is measured at a given time and represents a quantity at each moment in time – e.g. the number of people within the population at a certain point whilst an estimate of flow is typically measured over a certain interval of time. The mid-year population estimates are published annually. It would be misleading to compare values and rankings with those of previously published reports, due to revisions and updates of the underlying data, as well as programmatic updates in software that influence forecasting. Users are therefore advised to use the complete series, published along with this report on the Stats SA website.

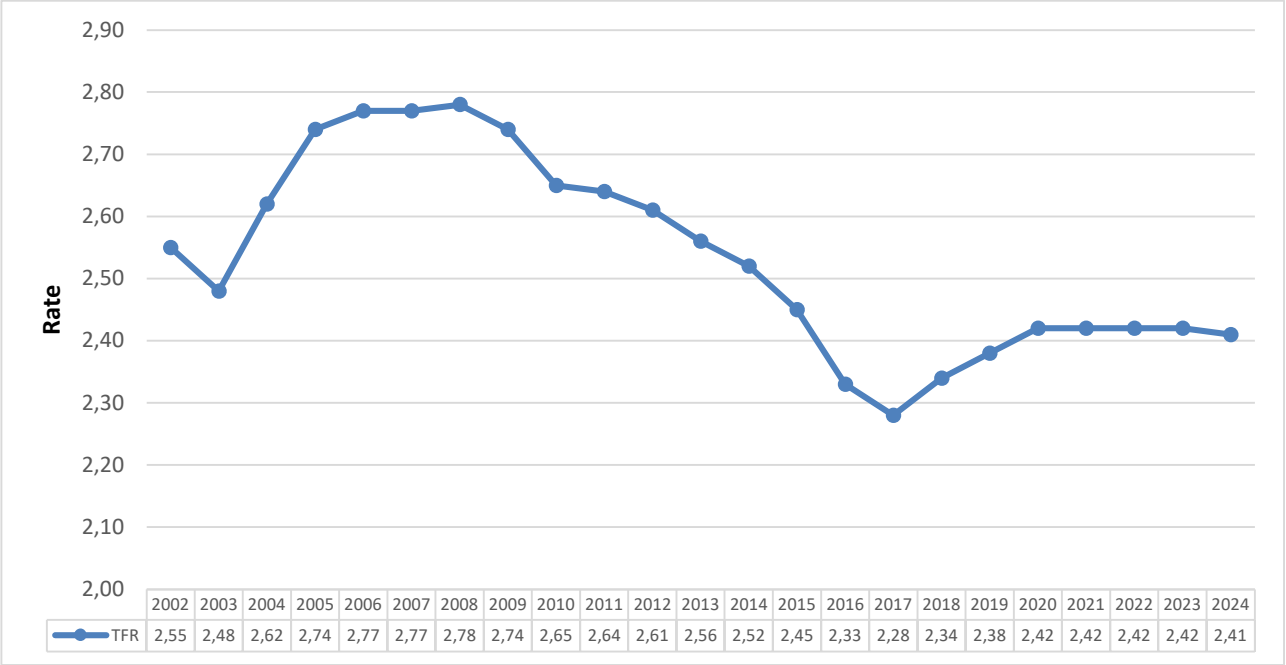
2. National estimates/ projections

Estimates/ Projections are developed via a cohort-component method, utilizing a software known as the Spectrum Policy Modelling system. Spectrum is a Windows-based system of integrated policy models and is updated continuously. The four components required for population estimation are as follows:

Base Population: A cohort-component projection requires a base population distributed by age and sex. For the projection at national level, we use the 1985 population (adjusted) as the base population. Given the history of South Africa and population counts pre democracy, the 1985 population is regarded as the most reflective of the country at the time. The cohort base population is projected into the future according to the projected components of population change i.e. fertility, mortality and migration.

Fertility: The time series of TFR estimates for all population groups in South Africa are derived following a detailed review of TFR estimates (1985–current), published and unpublished, from various authors, methods and data sources. Current assumptions of national fertility are based on trends seen in published live births data currently available at national level in the vital registration system (VRS) and the District Health Information System (DHIS) (Stats SA, 2015; Stats SA, 2023(a); NDoH, 2021). Currently, the latest births data from VRS are from the Recorded live births report for the most recent year of 2022. Whilst census data does offer TFR estimates, this is for just one point in time every 10 years. Census 2022 fertility data was not available at the time of the MYPE release. For this reason, MYPE was unable to evaluate the trend in fertility to the Census 2022 point Administrative data, adjusted for completeness provides better estimates of TFR over time. In recent years there have been an array of possible and plausible outcomes for fertility in South Africa due to the impact of COVID-19 as well as the lag in available administrative birth data. For this reason, the MYPE has assumed a fertility pattern aligned to empirical trends seen in available administrative data post 2020. The finalised TFR assumptions can be found in Figure 2 (page 9). The estimates of fertility show a fluctuation over the period 2002–2024, giving rise to a population structure indicative of that of the Census 2011 population structure. Since 2009, overall fertility has declined from an average of 2,74 children per woman to 2,41 children in 2024. A dip in fertility seen in 2016/2017 is reflective of empirical birth registration data in the DHIS and the recorded live births data (Stats SA, 2023(a); NDOH, 2021). Other inputs required in DemProj include the age-specific fertility rates (ASFR) trend and sex ratios at birth

Figure 2: Assumptions of Total Fertility Rate



Mortality: Stats SA applies the country-specific UN Model Life table for South Africa in Spectrum. Spectrum allows for input LE without the impact of HIV/AIDS and the AIM component is applied to it. The age pattern of mortality is based on various sources, data and methods, these include deaths data from the RAPID mortality surveillance (RMS), Mortality and causes of death report (2020 data is the latest one available), Demographic and Health Survey (DHS) among others. Survival rates from the selected life tables are used to project the population forward. The Mid-year estimates are also tasked with providing HIV/AIDS estimates for the population at a national level as this has an impact on mortality levels and patterns over time. This is done using the AIM component of the Spectrum model.

Table 1: Assumptions of expectation of life at birth, 2002–2024

	Life expectancy at birth	
Year	Male	Female
2002	60,8	67,3
2003	60,7	68,4
2004	60,7	68,5
2005	60,7	68,6
2006	60,8	68,7
2007	60,8	68,7
2008	60,9	68,7
2009	60,9	68,7
2010	60,9	69,8
2011	62,5	69,8
2012	63,3	69,9
2013	63,5	69,9
2014	63,6	70,0
2015	63,7	70,1
2016	63,7	70,3
2017	63,9	70,5
2018	64,3	70,3
2019	64,5	70,4
2020	64,7	71,0
2021	64,8	71,0
2022	64,8	71,2
2023	64,7	71,2
2024	65,1	71,2

In the AIM projection, several programmatic and epidemiological data inputs specific to South Africa are required. These include programme coverage of adults and children on antiretroviral treatment (ART) and Prevention of mother-to-child-transmission (PMTCT) treatment (NDoH, 2023). In addition to eligibility for treatment as per national guidelines, the epidemiological inputs include antenatal care data (ANC). The assumptions regarding the HIV epidemic in South Africa are based primarily on the prevalence data collected from pregnant women attending ANC services. The Antenatal HIV Sentinel Survey (ANCHSS) has been conducted annually in South Africa since 1990, and biennially since 2015, with the most recent estimates being from 2022 (Woldesenbet, S.A, et al., 2021; NDoH, 2021, NDOH, 2023). The main aim of the survey is to monitor HIV epidemic trends among 15–49 year old pregnant women attending ANC clinics. However, ANC surveillance data produce biased prevalence estimates for the general population because only a select group of people (i.e. only pregnant women attending antenatal public health services) are included in the sample (see Table 2). The South African National HIV Prevalence, Incidence, Behaviour and Communication Survey (SABSSM) data that produces national estimates for the country is used in the model to correct for this bias (Shisana et al., 2014; Simbayi et al., 2019). Although the report for the 2022 survey has not yet been published, HSRC has released a summary sheet with some results. Spectrum has yet to incorporate the 2022 results. ART data is available from NDoH and as such, programmatic coverage of adults and children on antiretroviral treatment to date has been incorporated into the model (NDOH, 2023). Other inputs in the AIM model include the following: Median time from HIV infection to death, and ratio of new infections. Indicators of HIV prevalence, incidence and HIV population numbers over time show the impact of HIV on the population.

Table 2: National HIV prevalence from ANC data per province: 1990-2022

	Western Cape	Northern Cape	Eastern Cape	Free State	KwaZulu-Natal	Mpumalanga	Limpopo	North West	Gauteng
1990	0,1	0,2	0,4	0,6	1,6	0,4	0,3	1,1	0,7
1991	0,1	0,2	0,6	1,5	2,9	1,2	0,5	6,5	1,1
1992	0,3	0,7	1,0	2,9	4,5	2,2	1,1	0,9	2,5
1993	0,6	1,1	1,9	4,1	9,5	2,4	1,8	2,2	4,1
1994	1,2	1,8	4,5	9,2	14,4	12,2	3,0	6,7	6,4
1995	1,7	5,3	6,0	11,0	18,4	16,2	4,9	8,3	12,0
1996	3,1	6,5	8,1	17,5	19,9	15,8	8,0	25,1	15,5
1997	6,3	8,6	12,6	20,0	26,9	22,6	8,2	18,1	17,1
1998	5,2	9,9	15,9	22,8	32,5	30,0	11,5	21,3	22,5
1999	7,1	10,1	18,0	27,9	32,5	23,8	11,4	23,0	23,9
2000	8,7	11,2	20,2	27,9	36,2	29,7	13,2	22,9	29,4
2001	8,6	15,9	21,7	30,1	33,5	29,2	14,5	25,2	29,8
2002	12,4	15,1	23,6	28,8	36,5	28,6	15,6	26,2	31,6
2003	13,1	16,7	27,1	30,1	37,5	32,6	17,5	29,9	29,6
2004	15,4	17,6	28,0	29,5	40,7	30,8	19,3	26,7	33,1
2005	15,7	18,5	29,5	30,3	39,1	34,8	21,5	31,8	32,4
2006	15,1	15,6	28,6	31,1	39,1	32,1	20,6	29,0	30,8
2007	15,3	16,5	28,8	31,5	38,7	34,6	20,4	30,6	30,5
2008	16,1	16,2	27,6	32,9	38,7	35,5	20,7	31,0	29,9
2009	16,9	17,2	28,1	30,1	39,5	34,7	21,4	30,0	29,8
2010	18,5	18,4	29,9	30,6	39,5	35,1	21,9	29,6	30,4
2011	18,2	17,0	29,3	32,5	37,4	36,7	22,1	30,2	28,7
2012	16,9	17,8	29,1	32,0	37,4	35,6	22,3	29,7	29,9
2013	18,7	17,5	31,4	29,8	40,1	37,5	20,3	28,2	28,6
2014	18,7	16,1	31,3	34,4	42,4	35,8	20,9	28,7	27,6
2015	18,9	19,0	30,2	29,8	44,4	34,9	21,7	29,2	30,2
2017	15,9	17,9	33,7	32,7	41,1	37,3	23,4	27,7	32,2
2019	17,9	20,2	36,5	32,8	40,9	34,1	19,7	26,9	28,1
2022	16,3	15,2	32,9	30,3	37,1	30,9	19,4	25,7	26,4

Source: National Department of Health, (2023).

Table 3 below shows results from the SABSSM survey conducted by the HSRC. Prevalence results from this survey are used to adjust results from ANC data to give a more representative prevalence of the entire population. As mentioned before, Spectrum has yet to incorporate the 2022 results into the model, however, the published estimates are used to evaluate levels developed in the model.

Table 3: HIV Prevalence among 15-49 over time, SABSSM survey

Survey Period	N	%	95% CI
2002	4 795	15,6	13,9-17,5
2005	9 245	16,2	14,8-17,7
2008	8 106	16,9	15,5-18,4
2012	14 720	18,8	17,5-20,3
2017	12 302	20,6	19,2-22,0
2022	25 051	17,0	16,0-18,0

Source: HSRC 2019 SABSSM survey; SAMSIMM VI 2023

On 5th March 2020, South Africa recorded the first case of COVID-19 in its borders. By the 11th of March, the WHO declared COVID-19 a global pandemic. South Africa's first COVID-19 death occurred on 27 March 2020. Using all cause deaths reported in the death registration system of South Africa (adjusting for late registration and completeness), the MRC developed estimates of excess deaths experienced during the COVID-19 pandemic (Dorrington et al, 2021). Excess deaths refer to the number of deaths observed during the pandemic above a baseline of recent trends (Dorrington et al, 2021; NDoH, 2020). The age-mortality profile of the disease indicated that older people and those with co-morbidities specifically diabetes and hypertension, faced a higher risk of mortality (Biswas, et al, 2020, Booth et al, 2021; Sanyaolu et al, 2020; Pillay et al, 2020; Goldstein and Lee, 2020). However, people with broader categories of respiratory diseases, circulatory diseases and cancer also faced higher risk of mortality (Sanyaolu et al, 2020; Stokes et al., 2020, Biswas et al, 2020; Booth et al, 2021; Pillay et al, 2020). About 85% of excess deaths were attributed to the COVID-19 pandemic (Moultrie et al, 2021). Given the various constraints in measuring the number of COVID-19 direct and indirect deaths, all-cause mortality was used to quantify the burden of the pandemic (Karlinsky and Kobak, 2020, Aburto et al, 2021, Dorrington et al, 2021). Excess deaths due to COVID-19 have been incorporated into the model. Within DemProj, a COVID-19 editor allows for the inclusion of COVID-19 related deaths by age and sex to be incorporated into the model for projections. Census 2022 mortality data was not available at the time of the MYPE release.

Migration: Table 4 shows international migration by population group for selected periods. The impact of the COVID-19 pandemic on international migration for the period 1st July 2019 to 30th June 2020 was endured for only a quarter of the year. However, for the period 1st July 2020 to 30th June 2021, assumptions for international migration incorporated the impact of COVID-19 for a 12-month period. For the year 2021, the assumption is that international migration remained at a low level, given the situation of effective travel bans, lockdown reactions to surges in infection levels and mutation of the virus, low vaccination rollout numbers globally, worsening economic and employment opportunities, among other factors (Appendix 1). For the year 2022, given the relaxation of travel bans and the rise of sub-variants rather than completely new mutations as well as the increase in vaccination rollout, it seemed unnecessary for the revival of travel bans, with many countries opening their borders with various conditions. The routine data collected by DHA's immigration officers at ports of entry into the country confirm a slow/gradual increase in foreign travellers/movement into South Africa in from 2022 onwards. For the month of March 2022, foreign travellers arriving into SA increased by 110% from March 2021 (Stats SA, 2022(a)). However, the 110% should be interpreted with caution, as it is an increase

from a very low base resulting from COVID-19 Level 1 lockdown regulations. In April 2022, travellers arriving in the country increased by 128,9% when comparing 2022 to 2021 (Stats SA, 2022(b)). It should be noted that the reported number of travellers in 2021 are far lower than the number of reported travellers prior to the COVID-19 pandemic and restrictions thereof (Appendix 2). However, the April 2023 data shows a significant improvement in foreign travellers arriving in South Africa with a 72% increase (accounting for about a million foreign travellers compared to the half a million the April before) (Stats SA, 2023(b)). In February 2024, travellers arriving in the country increased by 15,8% when comparing 2024 to 2023 (Stats SA, 2024(a)). The number of travellers arriving in February 2024 is still a quarter of a million less than the 2020 number, buttressing the fact that pre-COVID levels have not been reached. The May 2024 report on tourism shows that the number of foreign arrivals in the country was about 320 000 lower than the number reported in May 2019 before the COVID pandemic (Stats SA, 2024(b)).

Table 4: International net-migration assumptions for the period by population group, 2001–2026

	African	Indian/Asian	White	Net international migration
2001–2006	619 509	35 562	-99 574	555 497
2006–2011	878 851	53 047	-106 787	825 111
2011–2016	1 100 815	65 431	-111 346	1 054 900
2016–2021	956 984	60 700	-90 957	926 727
2021 2026	792 857	49 989	-84 308	758 538

Note: The estimate refers to the flow figure from 1st July of the first year in the period to 30th June of the last year of the period

If the net flow of migrants is outward, then net migration is reflected as a negative number whilst if the net flow is inward, then it is reflected as a positive number (Table 4). Net international migration estimates are derived using not only Census 2011 migration data, but also migration numbers and proportions from various other authors, methods and data sources such as the OECD, United Nations Department of Economic and Social Affairs (UNDESA) which form part of the UN network. Census data from National statistics offices (NSOs) of various countries as well as migration data is also sourced**.** Compared to other components of change, the net migration rate can be volatile, as encountered during the outbreak of COVID-19 (since March 2020) until the end of worldwide lockdowns where international travelling was allowed. This was an unexpected shock to the migration system.

Projecting international migration post-June 2020 was a contentious activity. This is particularly the case at a time when the pandemic and its subsequent treatment unfolded. Unlike the past, whereby trends were stable, the context of a pandemic results in a rather highly variable trajectory. Whilst there were numerous revisions to policy regarding entry to and exit from SA since March 2020 and during the height of the pandemic period, migrants were allowed to move freely as they wished with the end of lockdown regulations. The MYPE 2024 series has assumed a resumption in migratory patterns, whilst not entirely to the level of pre-COVID-19, but on an upward trajectory. As migration data comes to the fore over time, migration assumptions will be revised accordingly. Looking at the number of tourists in the country, in December 2023, Stats SA reported that although the number has been on an increase since COVID-19 restrictions were stopped, the number has not reached pre-COVID-19 levels (Stats SA, 2023(c)). This was still the case in May 2024.

3. Provincial projections

3.1 Overview

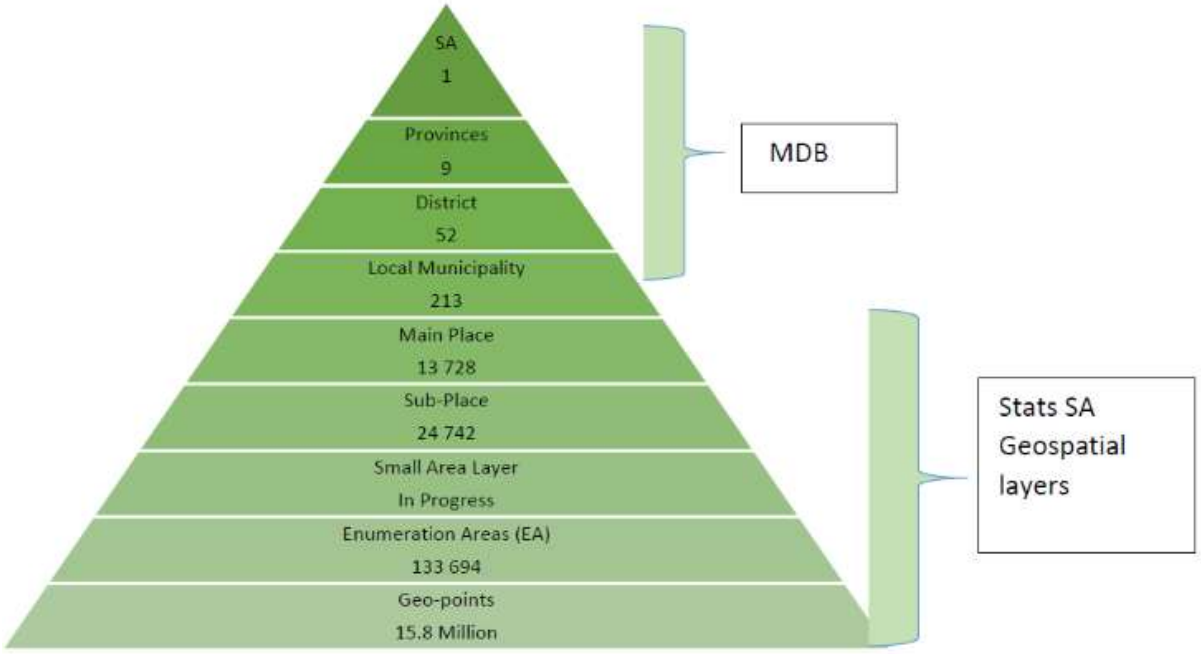
When projections for all the regions of a country are desired and the appropriate data are available, a multi-regional approach should be considered, as this is the only way to guarantee that the total migration flows between regions will sum to zero, or to the assumed level of international migration (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 *et al*., 1978), the task of preparing data can become overwhelming if there are too many regions. If there are only a few streams, however, the multi-regional method is the best method to use. In South Africa, 2448 (9x8x17x2) migration streams are derived if the multi-regional model is applied in calculating migration streams by age groups (17 in total) and sex for each province.

3.2 Boundary changes

In South Africa, the Municipal Demarcation Board (MDB) determines the boundaries of local and district municipalities. The board further delimits municipal wards for purposes of local government elections. MDB is an independent authority responsible for the determination of municipal boundaries in the country. Census data boundaries are continuously updated depending on the latest boundary determination by MDB. As a result, the MYPE also has to follow those boundary directives and this also applies to the input data used (i.e. VRS data input). Changes to boundaries and names instituted in 2016 were incorporated into the MYPE in 2016. This resulted in minor changes in population estimates only at the Provincial and district level. The MDB concluded the ward delimitation process in December 2020 and handed the ward boundaries to the Independent Electoral Commission (IEC) to prepare for the 2021 Local Government Elections (LGE). There was no change in population by age and sex at a national level when the 2011 census was placed on the new 2021 demarcated boundaries. There was a negligible difference in population numbers when placed on the 2021 provincial demarcated boundaries. At a district level, there was a sizeable difference in population numbers when placed on the 2021 provincial demarcated boundaries and this was incorporated into the MYPE estimation. The Census 2022 frame is based on the 2021 municipal boundary demarcation.

Figure 3: The Geospatial Frame Layers



Source: Stats SA (2022) How the count was done.

3.3 The age-structure of the provinces

The base from which a population projection is done is very important as it has a big effect on the outcome of a projection. It also forms the base from which the provincial fertility and mortality rates are adjusted. MYPE series provides estimates as far back as 2002 at the provincial level. For the preparation of the 2001 age-structures of the provinces, two sources of data were used, namely (a) the provincial 2001 Census populations by age and sex (on 2021 boundaries); (b) the projected South African population by age and sex July 2001.

It is crucial that the 2011 provincial estimates in the 2024 series closely match the age and sex totals from the 2011 Census for each province. Similarly, the 2022 population estimates are developed to align as close as possible to the 2022 census age and sex structure given the fertility, mortality and migration input data as well as the confirmed Census 2011 structure. To align data, adjustments to the 2001 provincial numbers are necessary.

Using the two sources of data mentioned above, the 2001 base age structures of each of the nine provinces by sex are determined by applying an iteration process. An iterative proportional fitting (IPF) is a mathematical scaling technique that can be used to ensure that a two-dimensional table of data is adjusted so that the distribution of rows and columns agrees with those reported in a different alternative source (Norman, 1999). Five iterations were enough to obtain stable populations.

3.4 Calculation of migration rates

For sub-national areas, migration is often the major determinant of population growth and can also be seen as the most difficult component of growth to forecast accurately as migration is subject to greater volatility than either fertility or mortality rates.

It should be noted that migration data are difficult to collect, and a census by far provides more accurate measures of migration stock and flow (in the absence of reliable administrative data). The Community survey of 2016 regrettably had a low level of inter-provincial migration. Similarly, Census 2022 results have revealed lower than expected migration data, and this was compounded by the high undercount from the Post enumeration survey (PES). Given this, provincial population projections continue to use migration rates from Census 2011 adjusted for changing trends noted in the Census 2022 and administrative data on the age and sex distribution of the population. These migration rates are applied to the different projection periods with modifications where inconsistencies are found. Whilst initiatives by the Department of Home Affairs are underway to improve the availability of information of movement across borders, census data will continue to remain the primary source of migration data in the country.

There are two procedures most frequently used for measuring internal migration i.e. inter-provincial migration:

(a) Procedures based on questions on censuses or surveys intended to detect migration.
(b) Procedures based on other population characteristics such as age-structure and place of birth.

Census questions ascertaining movement are used to follow the approach in (a) above, in the Stats SA methodology. Census questions detecting migration were used to determine the usual residence and previous residence of every person during the census period.

To convert the response to these migration questions to migration rates per thousand of the population in specific age groups, the following steps were followed:

(a) Determine the usual province of residence of each person at the time of the census or survey.
(b) Determine the previous province of residence.
(c) If the usual province of residence and the previous province of residence were the same, then the person is classified as a non-migrant.
(d) If the usual province and previous province are different, then the direction of the migration stream is determined.
(f) Cross tabulate age (five-year age groups) with the usual province for every previous province (see Table 5).

Once the steps are taken to establish the migration numbers, we convert the migration information obtained to migration rates per thousand of the population. This is done by using two sets of information, namely the cross-tabulations of previous and usual provinces for the total population and by age groups.

Since 2013 the Mid-year population estimates series have been based on the migration rates of Census 2011 (between 2006 and 2011), adjusted based on population change in age and sex structure over time. From census data it is be possible to determine out-migration rates for each province. Census 2011 migration rates have been used adjusted for changing trends noted in Census 2022. Applying these rates to the age structures of the provinces over time it is possible to establish migration streams between the provinces for the various periods i.e. 2001-2006, 2006-2011, 2011-2016, 2016-2021 and 2021-2026 Whilst rates are lower, the pattern of the streams by which people permanently moved across provinces and even districts remained consistent. It should also be noted that COVID-19 restricted movements for a short period of time. Those restrictions were temporary and cannot be used unadjusted as assumptions for future migration.

The age distribution of the out-migrants from each province to every other province by sex is derived from Census 2011. The results of these analyses are given in Table 5 to illustrate the out-migration of the female Eastern Cape population to the other eight provinces. To complete the analyses eight similar tables (not shown here) have been constructed. Table 5 does not show the volume of migration, but only indicates the age distribution of the migrants. It is clear from this table that the highest percentage of migrants is found amongst those in the age group 15–24. For example, in Gauteng, about 46% of the out-migrants were from the age group 15–24 years. It is therefore clear that the information in both tables must be used to calculate out-migration rates per thousand of the population. An example of such a calculation is given in Table 6.

Table 5: Female migrants from Eastern Cape to other provinces (percentage distribution)

	Province in 2021							
Age group	**FS****	**GT**	**KZN**	**LIM**	**MP**	**NC**	**NW**	**WC**
Births (2016-2021)	0,060519991	0,0557	0,0626	0,0747	0,0820	0,0706	0,0810	0,0567
0-4	0,078544898	0,0524	0,0635	0,0836	0,0676	0,0879	0,0650	0,0638
5-9	0,075486126	0,0483	0,0628	0,0494	0,0646	0,0855	0,0406	0,0652
10-14	0,120166048	0,1073	0,1291	0,0922	0,1145	0,1257	0,0814	0,1325
15-19	0,187786760	0,2446	0,2402	0,1598	0,1768	0,1299	0,1979	0,2448
20-24	0,151846187	0,2126	0,1682	0,1638	0,1745	0,1327	0,2059	0,1823
25-29	0,107712475	0,0982	0,0881	0,1355	0,1168	0,0850	0,1320	0,0867
30-34	0,071444177	0,0638	0,0612	0,0857	0,0768	0,0729	0,0882	0,0543
35-39	0,049705047	0,0436	0,0428	0,0593	0,0462	0,0579	0,0531	0,0381
40-44	0,029495303	0,0266	0,0261	0,0379	0,0233	0,0519	0,0252	0,0241
45-49	0,019008084	0,0151	0,0176	0,0198	0,0157	0,0276	0,0102	0,0154
50-54	0,011361154	0,0095	0,0112	0,0097	0,0094	0,0257	0,0066	0,0110
55-59	0,011033428	0,0075	0,0095	0,0097	0,0105	0,0140	0,0047	0,0091
60-64	0,008302381	0,0051	0,0057	0,0044	0,0073	0,0084	0,0025	0,0060
65-69	0,006663754	0,0033	0,0055	0,0052	0,0050	0,0098	0,0022	0,0043
70-74	0,005571335	0,0031	0,0025	0,0044	0,0046	0,0065	0,0018	0,0025
75-79	0,003604981	0,0019	0,0020	0,0026	0,0029	0,0042	0,0008	0,0018
80+	0,001747870	0,0013	0,0013	0,0024	0,0017	0,0037	0,0010	0,0013
Total	1	1	1	1	1	1	1	1

* The numbers and figures found in the table above are merely used to illustrate the calculation applied

**The FS column has more decimal places in order to illustrate the calculations in Table 6.

Table 6: Calculation of "scaled" migration rates (out-migration of Eastern Cape females to the Free State in the period 2016 to 2021)

Age in 2016	EC Female Population in 2016	Out-migration rates from the EC to the FS (Table 5)	Estimated migrants	Scaled migration rates
Births (2016-2021)		0,060519991		0,001936
0–4	387 164	0,078544898	30 410	0,002513
5–9	446 561	0,075486126	33 709	0,002415
10–14	450 993	0,120166048	54 194	0,003844
15–19	403 541	0,187786760	75 780	0,006007
20–24	305 412	0,151846187	46 376	0,004858
25–29	253 482	0,107712475	27 303	0,003446
30–34	199 671	0,071444177	14 265	0,002285
35–39	182 789	0,049705047	9 086	0,001590
40–44	182 212	0,029495303	5 374	0,000944
45–49	153 021	0,019008084	2 909	0,000608
50–54	127 907	0,011361154	1 453	0,000363
55–59	108 174	0,011033428	1 194	0,000353
60–64	119 473	0,008302381	992	0,000266
65–69	91 015	0,006663754	607	0,000213
70–74	61 401	0,005571335	342	0,000178
75–79	35 740	0,003604981	129	0,000115
80+	31 958	0,001747870	56	0,000056
Total	**3 540 514**	**1**	**304 177**	
Calculated total out-migration rate			304 177 / 3 540 514 = 0,0859132	
Desired total out-migration rate			0,002748335	
Scale factor			0,002748335 / 0,0859132 = 0,03198967	

* The numbers and figures found in the table above are merely used to illustrate the calculation applied

The scaled migration rates in the last column of Table 6, were calculated by applying the scale factor to the census 2011 migration rates (third column). These out-migration rates for the Eastern Cape females to the Free State will be used in the cohort-component projections. For each of the nine provinces, sixteen tables in the format of Table 6 are created.

3.5 Provincial fertility rates

The following steps were used to obtain a set of age-specific fertility rates (ASFR) for each province to be used in the provincial cohort-component projections:

(a) Analyses of the recorded live births datasets (for the period 2002 to 2022) were done to adjust for late registration and completeness. The number of births in the age groups 15 to 49 was obtained for each province.

(b) The total number of births generated from the provinces was then compared with the total number of births in the RSA projection (from Spectrum file). Proportional adjustments were made if necessary and TFRs were calculated by applying the births to the specific provincial 15-49 age structure.
(c) Using these adjusted TFRs and age-specific fertility rates as well as survival ratios, the number of births and the 0–4 projected population were obtained. The projected 0–4 years and 5–9 years populations were checked for consistency. Provision was made to adjust the TFR manually if inconsistencies were found.
(d) The process above was repeated if inconsistencies were found in (c), when comparing estimates to other sources, and proportional adjustments were made if necessary. Census and CS fertility rates are used to evaluate the assumed trend in fertility over time in MYPE. Census 2022 fertility rates at provincial level were not available for use at the time of the release.

3.6 Provincial survival ratios

The following steps were used to obtain a set of survival ratios for each province to be used in the provincial cohort-component projections:

(a) Analyses of the Mortality and Causes of Death datasets from 2002 to 2020 were done to adjust for late registration and completeness.
(b) The numbers of male and female deaths calculated for each province were then compared with the total number of male and female deaths in the RSA projection respectively (from Spectrum file). Proportional adjustments were made if necessary.
(c) Age-specific mortality rates (m(x)) were then calculated.
(d) Using the m(x) rates Life Tables for both males and females and for each province were calculated.
(e) Life expectancies at birth as well as survival ratios by age can be read from the obtained life tables (see the shaded areas in Table 7 below). The survival rates are now available to be used in the projection.
(f) Census mortality rates are used to evaluate the assumed trend in mortality over time in MYPE. Census 2022 mortality at provincial level were not available for use at the time of the release.

An example of the calculations for the female population follows the steps as described above and is given in Tables 7 (a) and 7 (b). The first step is to compare the total number of deaths for all the provinces with the number of RSA. In this example the total number of RSA deaths was 294 666 and the deaths by province total 333 314. The adjusted deaths (for each age group in a province) are calculated by applying an adjustment factor of 0,884049274 (294 666 divided by 333 314). The adjusted deaths are given in column 7 in the table below. The second step is to calculate the m(x)-values for each age group based on the adjusted number of births. Life tables for each province and sex can now be constructed. This is done by applying the LTMXQXAD spreadsheet in the Population Analysis System (PAS). LTMXQXAD Constructs a life table from age-specific death rates or from the probabilities of dying between two specific ages. The survival ratios read from the constructed life tables and which will be used in the projection, are given in the last column of Tables 7 (a) and 7 (b) (shaded).

Table 7 (a): Calculation of female survival ratios for provincial projections

	Age category	Population in 2016	Deaths	Adjusted		Survival ratios	
				Deaths	m(x)	Categories	Values
EC	0	69 939	5884	5 202	0,0744	Birth	0,9177
	1-4	317 225	3140	2 776	0,0088	0- 4	0,9745
	.	.	.	.	.	.	.
	80-84	21 446	3316	2 932	0,1367	75-79	0,5717
	85+	10 512	2484	2 196	0,2089	80+	0,3913
	EC Total		**52111**	**46 069**	**LE=56,3**		
FS	0	31 344	2960	2 617	0,0835	Birth	0,9068
	1-4	122 286	1486	1 314	0,0107	0- 4	0,9688
	.	.	.	.	.	.	.
	80-84	7 209	1165	1 030	0,1429	75-79	0,5549
	85+	4 782	1161	1 026	0,2146	80+	0,3794
	FS Total		**23263**	**20 565**	**LE=53,6**		
GT	0	85 909	6578	5 815	0,0677	Birth	0,9256
	1-4	318 539	2670	2 360	0,0074	0- 4	0,9783
	.	.	.	.	.	.	.
	80-84	15 073	2248	1 987	0,1319	75-79	0,5851
	85+	9 722	2248	1 987	0,2044	80+	0,4008
	GT Total		**51045**	**45 127**	**LE=58,4**		
KZN	0	110 491	12655	11 188	0,1013	Birth	0,8851
	1-4	464 769	7959	7 036	0,0151	0- 4	0,9563
	.	.	.	.	.	.	.
	80-84	20 673	3592	3 176	0,1536	75-79	0,5260
	85+	11 800	2998	2 650	0,2246	80+	0,3591
	KZN Total		**93169**	**82366**	**LE=48,4**		
LIM	0	61 848	5311	4 695	0,0759	Birth	0,9159
	1-4	273 599	2808	2 482	0,0091	0- 4	0,9735
	.	.	.	.	.	.	.
	80-84	17 848	2782	2 459	0,1378	75-79	0,5688
	85+	11 932	2833	2 505	0,2099	80+	0,3892
	LIM Total		**40481**	**35 787**	**LE=55,9**		

*The numbers and figures found in the table above are merely used to illustrate the calculation applied

Table 7 (b): Calculation of female survival ratios for provincial projections (continued)

	Age category	Population in 2016	Deaths	Adjusted		Survival ratios	
				Deaths	m(x)	Categories	Values
MP	0	43 463	4310	3 810	0,0877	Birth	0,9017
	1-4	171 468	2274	2 010	0,0117	0- 4	0,9660
	.	.	.	.	.	.	.
	80-84	7 503	1235	1 092	0,1455	75-79	0,5476
	85+	4 384	1077	952	0,2172	80+	0,3742
	MP Total		**26865**	**23 750**	**LE=52,3**		
NC	0	12 576	842	744	0,0592	Birth	0,9355
	1-4	48 485	321	284	0,0059	0- 4	0,9828
	.	.	.	.	.	.	.
	80-84	2 427	344	304	0,1253	75-79	0,6038
	85+	1 820	408	361	0,1982	80+	0,4140
	NC Total		**6201**	**5 482**	**LE=61,2**		
NW	0	36 840	3215	2 842	0,0772	Birth	0,9144
	1-4	140 356	1483	1 311	0,0093	0- 4	0,9728
	.	.	.	.	.	.	.
	80-84	7 284	1142	1 010	0,1386	75-79	0,5664
	85+	5 319	1268	1 121	0,2107	80+	0,3875
	NW Total		**22997**	**20331**	**LE=55,5**		
WC	0	43 634	2018	1 784	0,0409	Birth	0,9564
	1-4	168 864	587	519	0,0031	0- 4	0,9909
	.	.	.	.	.	.	.
	80-84	8 708	1067	943	0,1083	75-79	0,6526
	85+	6 439	1328	1 174	0,1823	80+	0,4489
	WC Total		**17183**	**15190**	**LE=67,6**		
		Total prov deaths	333315				
RSA	**0**	**38 653**					
	1-4	**17 511**					
	.	.					
	80-84	**16 244**					
	85+	**15 487**					
							RSA Total deaths = 294 666
							Adjustment factor = 294 666 / 333 315 = 0.88404

*The numbers and figures found in the table above are merely used to illustrate the calculation applied

3.7 Provincial population estimates

The format that explains the cohort-component method used to project the provincial populations is shown in Table 8 below. The projection is for the Eastern Cape female population. Please note that the same population was used in the discussion of mortality (Table 7 (a) and 7(b)) and migration (Table 5).

Table 8: Projection of the Eastern Cape female population

Age	Population 2016	Survival ratio (Table 7)	Age specific fertility	Migration rates (per thousands of population) to:							
				FS (Table 5)	GT*	KZN	LIM	MP	NC	NW	WC
Births (2016-2021)	426 668	0,9177		0,00194	0,00952	0,00567	0,00106	0,00154	0,00055	0,00393	0,01649
0–4	387 164	0,9745		0,00251	0,00895	0,00575	0,00118	0,00127	0,00069	0,00316	0,01854
5–9	446 561	0,9908		0,00241	0,00826	0,00570	0,00070	0,00121	0,00067	0,00197	0,01895
10–14	450 993	0,9878		0,00384	0,01833	0,01170	0,00131	0,00215	0,00099	0,00396	0,03849
15–19	403 541	0,9802	0,0609	0,00601	0,04179	0,02177	0,00226	0,00332	0,00102	0,00962	0,07114
20–24	305 412	0,9742	0,1380	0,00486	0,03634	0,01525	0,00232	0,00328	0,00104	0,01000	0,05298
25–29	253 482	0,9696	0,1644	0,00345	0,01678	0,00799	0,00192	0,00219	0,00067	0,00641	0,02520
30–34	199 671	0,9645	0,1431	0,00229	0,01090	0,00555	0,00121	0,00144	0,00057	0,00428	0,01579
35–39	182 789	0,9579	0,0994	0,00159	0,00745	0,00388	0,00084	0,00087	0,00045	0,00258	0,01107
40–44	182 212	0,9476	0,0436	0,00094	0,00455	0,00237	0,00054	0,00044	0,00041	0,00123	0,00701
45–49	153 021	0,9305	0,0162	0,00061	0,00258	0,00160	0,00028	0,00029	0,00022	0,00049	0,00449
50–54	127 907	0,9049		0,00036	0,00162	0,00101	0,00014	0,00018	0,00020	0,00032	0,00318
55–59	108 174	0,8693		0,00035	0,00128	0,00087	0,00014	0,00020	0,00011	0,00023	0,00264
60–64	119 473	0,8217		0,00027	0,00087	0,00052	0,00006	0,00014	0,00007	0,00012	0,00175
65–69	91 015	0,7580		0,00021	0,00057	0,00050	0,00007	0,00009	0,00008	0,00011	0,00125
70–74	61 401	0,6754		0,00018	0,00054	0,00023	0,00006	0,00009	0,00005	0,00009	0,00073
75–79	35 740	0,5717		0,00012	0,00033	0,00018	0,00004	0,00005	0,00003	0,00004	0,00052
80+	31 958	0,3913		0,00006	0,00022	0,00011	0,00003	0,00003	0,00003	0,00005	0,00036

* The calculations of the migration rates to the other provinces as well as the age specific fertility rates are not given in this document
**The numbers and figures found in the table above are merely used to illustrate the calculation applied

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

3.7.1 Calculate the number of out-migrants (5 years and older)

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:

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

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

$MR^{AI}_{t,x}$ 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.

3.7.2 Calculate the number of survivors by province (5 years and older)

For survival in the same province, the compound rate is the survival rate multiplied by 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 are obtained by using the following formula:

$$SUR^{A}_{t+5,x+5} = P^{A}_{t,x} * S^{A}_{t,x} * (1 - MR^{AB}_{t,x} - MR^{AC}_{t,x} - MR^{AD}_{t,x} - .....MR^{AI}_{t,x})$$

Where: $P^{A}_{t,x}$ 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.

Applying the formulas in sections 3.7.1 and 3.7.2 and using the data in Table 8 will result in the number of out-migrants as set out in Table 9. The calculations in Tables 8 and 9 will have to be repeated for all the other female population in the other provinces (not shown). The same format, except for the fertility assumptions, is used for the male populations.

Table 9: Projection of the Eastern Cape female population

	Survivors in EC	Number of out migrants to:								In-migrants To EC*	Projected Population 2021
		FS	GT	KZN	LIM	MP	NC	NW	WC		
0–4	375 618	758	3 729	2 221	414	603	217	1 540	6 457	6 351	382 773
5–9	361 426	947	3 377	2 169	445	479	260	1 192	6 995	6 358	368 322
10–14	424 812	1 066	3 655	2 522	310	535	296	872	8 384	5 772	431 281
15–19	409 509	1 711	8 166	5 212	584	958	441	1 764	17 147	6 874	417 486
20–24	333 477	2 377	16 530	8 611	894	1 313	403	3 805	28 139	7 487	342 678
25–29	260 022	1 446	10 812	4 537	690	976	309	2 975	15 763	7 997	269 395
30–34	229 897	848	4 122	1 964	472	538	165	1 575	6 194	6 650	237 527
35–39	184 488	441	2 099	1 069	233	277	110	824	3 041	4 493	189 633
40–44	170 063	278	1 304	679	147	152	79	452	1 938	2 912	173 440
45–49	169 644	162	786	409	93	76	71	212	1 210	1 907	171 907
50–54	140 882	87	367	228	40	41	31	70	639	1 312	142 473
55–59	114 932	42	188	117	16	21	23	37	368	884	116 102
60–64	93 488	33	120	82	13	19	10	22	248	636	94 322
65–69	97 798	27	85	51	6	14	7	12	172	327	98 274
70–74	68 791	14	39	34	5	6	6	8	86	134	68 991
75–79	41 389	7	22	10	2	4	2	4	30	57	41 473
80+	32 900	3	10	5	1	1	1	2	16	27	32 961
Total	**3 509 136**	**10 247**	**55 411**	**29 920**	**4 365**	**6 013**	**2 431**	**15 366**	**96 827**	**60 178**	**3 579 038**

* To obtain the in-migrants to the EC, similar calculations were done for all the other provinces.
** The numbers and figures found in the table above are merely used to illustrate the calculation applied

3.7.3 Calculate the number of in-migrants (5 years and older)

The number of in-migrants to province A (see second last column in Table 9) is obtained by adding the out-migrants from the other provinces (B to I) to province A, that is:

$$IN^{A}_{t+5,x+5} = OUT^{BA}_{t+5,x+5} + OUT^{CA}_{t+5,x+5} + OUT^{DA}_{t+5,x+5} + ... + OUT^{IA}_{t+5,x+5}$$

3.7.4 Projected population (5 years and older)

The projected provincial population of A in each age group aged 5 years and older (see last column in Table 9) is simply the sum of the survivors in province A and the number of in-migrants to province A, and the net-international migrants to province A, namely:

$$P^{A}_{t+5,x+5} = SUR^{A}_{t+5,x+5} \boxed{+ IN\ (\text{net international migrant})^{A}_{(t+5,\ X=5)}}$$

Table 10: Projection of the Eastern Cape female population

Age	Total in-migrants to EC	EC Population in 2021	From outside SA
0–4	6 351	382 773	804
5–9	6 358	368 322	538
10–14	5 772	431 281	697
15–19	6 874	417 486	1103
20–24	7 487	342 678	1714
25–29	7 997	269 395	1376
30–34	6 650	237 527	980
35–39	4 493	189 633	652
40–44	2 912	173 440	465
45–49	1 907	171 907	356
50–54	1 312	142 473	279
55–59	884	116 102	286
60–64	636	94 322	198
65–69	327	98 274	149
70–74	134	68 991	66
75–79	57	41 473	27
80+	27	32 961	34
Total	**60 178**	**3 579 038**	**9724**

* The numbers and figures found in the table above are merely used to illustrate the calculation applied

3.7.5 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 the present and the date 5 year previous. 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. The projected 0–4 population (see first entry in the last column of Table 9) is calculated by applying the formula in sections 3.7.1 to 3.7.4.

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.

The provincial estimates by age and sex are constrained to the National estimates by age and sex. Similarly, the district estimates by age and sex are constrained to the relevant provincial estimate by age and sex (ONS, 2020).

4. District estimates

Stats SA develops district estimates and projections that are updated annually. It is therefore important to note that population and other demographic data in each release including the district estimates form a new set of time series. District estimates are made available for the year 2002 to current.

When developing the district population estimates and projections, Stats SA uses a cohort-component method. To develop the estimates and projection, the base-year 2001 (census based on 2021 boundaries), fertility, mortality and both internal as well as international migration are required. The base from which a population projection is done is very important as it has a great effect on the outcome of a projection. Census information regarding the population structure over time was used as an input in determining the base. The projections are unique for each year due to the assumptions made and the latest updates on data inputs i.e. fertility, mortality and migration patterns.

4.1 District municipality estimation

For district projections, the fertility, mortality and migration are done for 5-year periods i.e. 2001-2006, 2006-2011, 2011-2016, and 2016-2021 etc. A cohort component method is used to develop the projection for each 5-year period. There are several principles that must be considered when implementing the cohort component method. To preserve the integrity of the age cohorts as they progress through time, it is helpful to follow basic principles: i.e. the number of years in the projection should be equal to the number of years in the age groups. Also, projections by sex are essential in that projection for females determine the projection of births.

4.2 Age-sex structures of the base population

The base age/sex structures of 2001 of the district municipalities were determined through an iteration process and using the following datasets:

- The projected 2001 provincial populations by sex and five-year age groups (2021 boundaries);
- The district municipalities and metro populations for Census 2001 by age and sex (2021 boundaries).

4.3 Migration trends between district/metropolitan municipalities

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). A multi-regional approach is used to develop migration flows between regions, which sum to zero, or to the assumed level of international migration (United Nations, 1992). Developed by Willekens and Rogers (1978), 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. For example, in South Africa, 90 168 migration streams are derived if the multi-regional model is applied at a district level where there are 52 district and metropolitan municipalities.

Migration data are difficult to collect, and a census by far provides more accurate measures of migration stock and flow even at the district level (in the absence of reliable administrative data). International net-migration already determined at the national level to be positive is distributed to the various provinces. Subsequently, positive net-migrants are distributed to the various districts within each province such that they sum to province.

Census 2011 inter- district migration rates have been used in projections. Census 2022 results have revealed lower than expected migration data, and this was compounded by the high undercount from the Post enumeration survey (PES). Given this, district population projections continue to use migration rates from Census 2011 adjusted for changing trends noted in the census 2022 and administrative data on age and sex distribution of population. These migration rates are applied to the different projection periods with modifications where inconsistencies are found. Using the various components of change mentioned above, the MYPE at district level are developed using the cohort component method.

4.4 Fertility estimation of district/metropolitan municipalities

The following steps were used to obtain a set of age-specific fertility rates for each district municipality and each metro to be used in these cohort-component projections:

(a) Analyses of the recorded live births datasets (2002 to 2022) were done to adjust for late registration and completeness. The number of births for women in the age groups 15 to 49 were obtained. This was done for each district municipality and metro.
(b) The total number of births generated from the district municipalities was then compared with the total number of births in that specific province. Proportional adjustments were made if necessary and TFRs calculated by applying the births to the specific district municipality or metro population 15-49 female age structure.
(c) Using these adjusted TFRs and age-specific fertility rates as well as survival ratios, the number of births and the 0–4 projected population were obtained. The projected 0–4 year and 5–9 year populations were checked for consistency. Provision was made to adjust the TFR if inconsistencies were found.
(d) The process above was repeated if inconsistencies were found in (c). Census and CS fertility rates are used to evaluate the assumed trend in fertility over time in MYPE. Census 2022 fertility rates at district level were not available at the time of the release of the MYPE.

4.5 Mortality estimation of district/metropolitan municipalities

The following steps were used to obtain a set of survival ratios for each district municipality and metro and was used in the cohort-component projections:

(a) Data up to 2020 (2002-2020) are available at this level to do analyses of the Mortality and Causes of Death datasets and to adjust for late registration and completeness.
(b) The numbers of male and female deaths calculated for each district municipality were then compared with the total number of male and female deaths in that specific province. Proportional adjustments were made if necessary.
(c) Age-specific mortality rates (m(x)) were then calculated.

(d) Using the m(x) rates separate Life Tables for males and females and for each district council were calculated.
(e) Life expectancies at birth as well as survival ratios by age can be read from the obtained life tables.
(f) The process above was repeated if inconsistencies were found in (d). Census Morality rates are used to evaluate the assumed trend in mortality over time in MYPE. Census 2022 mortality at district level were not available at the time of the release of the MYPE.

5. Credibility of data/ Data confrontation at district level

The age-sex pattern of mortality is informed by both the Mortality and causes of death data (MACOD) from the Vital registration system (VRS) and district health information system (DHIS). The number of registered deaths processed by Stats SA and those recorded on the National Population Register (NPR) is maintained by the DHA for the period 1997−2020.

In general, estimated deaths reported in MYPE are always expected to be higher than those in the vital registration system. The MYPE reports on all deaths occurring and not just those registered. Deaths data from the DHA are collected regardless of residency status i.e. citizens, permanent and non-permanent residents. Births to foreign parents are excluded from the RLB with effect from 2015. The NPR maintained by DHA only includes deaths of South African citizens and permanent residents whose particulars were already on the NPR. Birth, death and immunization data from the District Health Information System (DHIS) is sourced for comparison purposes. The data from all sources are used to triangulate the best-fit estimate in the MYPE at the National, Provincial and district level. Other sources of data used to determine the plausibility of the MYPE district age and sex structure include the Independent Electoral Commission Data (IEC) and Department of Basic Education data (DBE), available at the district level.

Comparisons to the census 2022 and MYPE is often undertaken. The MYPE and census are two very different tools used to provide a count of the population. The census provides a count at a specific point in time. Provided all goes perfectly from fieldwork to response this will be a full count, however this is hardly ever the case for most countries. Countries in the developed world and even SA, often require a statistical weighing adjustment to be done to better estimate the full count. The MYPE is a model based on past censuses, annual births, deaths and migration to determine an estimate of a population. The MYPE relies on administrative and survey data to capture population change over time, which as such is also subject to levels if incompleteness. It is only natural that the vehicles of count and estimation would not necessarily have the exact outcome.

6. Conclusion

Stats SA produces population estimates at national level by population group, 5-year age categories and sex along with provincial population estimates by 5-year age categories and sex. The national and provincial estimates and indicators are published in July annually. Population estimates are also produced at district level by 5-year age categories and sex however, only in electronic format online. District population estimates reports are being developed to accompany the estimates and will be published in 2025. The single age estimates based on the 2024 series are available at national, provincial and district level.

These estimates are unique for each year due to the updated assumptions, data inputs as well as the software used. It is therefore important to note that population and other demographic data in each release form a new set of time series. Users should therefore compare the time series data in each statistical release and not data between statistical releases.

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Appendices

Appendix 1: Lockdown levels and migration

Level 5 26-March-30 April 2020 → Level 4 01-31 May 2020 → Level 3 01 June-17 August 2020 → Level 2 18 August-20 September 2020 → Level 1 21 September-28 December 2020 → Adjusted Level 3 29 December 2020-28 Feb 2021 → Adjusted Level 1 01 March - 30 May 2021

INTERNATIONAL AND NATIONAL BORDER MOVEMENT						
Level 5	Level 4	Level 3	Level 2	Level 1	Adjusted Level 3	Level 1
All borders of the country remain closed except for transportation of good and repatriation of citizen to SA and non-citizens to their countries of citizenship Interprovincial travel is not permitted except to return to work with proof of employment; for movement of learners, with permit; in exceptional circumstances such as funerals (with approval) or essential services	All border of the country remain closed except for transportation of good and repatriation of citizen to SA and non-citizens to their countries of citizenship Interprovincial travel is not permitted except to return to work with proof of employment; for movement of learners, with permit; in exceptional circumstances such as funerals (with approval) or essential services	All border of the country remain closed except for transportation of good and repatriation of citizen to SA and non-citizens to their countries of citizenship Interprovincial travel is not permitted except to return to work with proof of employment; for movement of learners, with permit; in exceptional circumstances such as funerals (with approval) or essential services	All border of the country remain closed except for transportation of good and repatriation of citizen to SA and non-citizens to their countries of citizenship All travel between provinces is allowed for any purpose.	Borders reopened for international travel as of 01 October 2020 subject to restrictions. All travel between provinces is allowed for any purpose	Borders reopened for international travel as of 01 October 2020 subject to restrictions. 20 land borders were closed on 11 January 2021 and re-opened on 15 February 2021 while 30 remain closed. All travel between provinces is allowed for any purpose	Borders reopened for international travel as of 01 October 2020 subject to restrictions. All travel between provinces is allowed for any purpose

AVIATION						
Level 5	Level 4	Level 3	Level 2	Level 1	Adjusted Level 3	Level 1
Air transport permitted only for the shipment of cargo	Ocean and air transport permitted only for the shipment of cargo	Domestic air travel for business only International flights not permitted	Domestic air travel for business only International flights not permitted	Domestic air travel allowed. International travel allowed as of 01 October 2020.	Domestic air travel allowed. International travel allowed as of 01 October 2020.	Domestic air travel allowed. International travel allowed as of 01 October 2020.

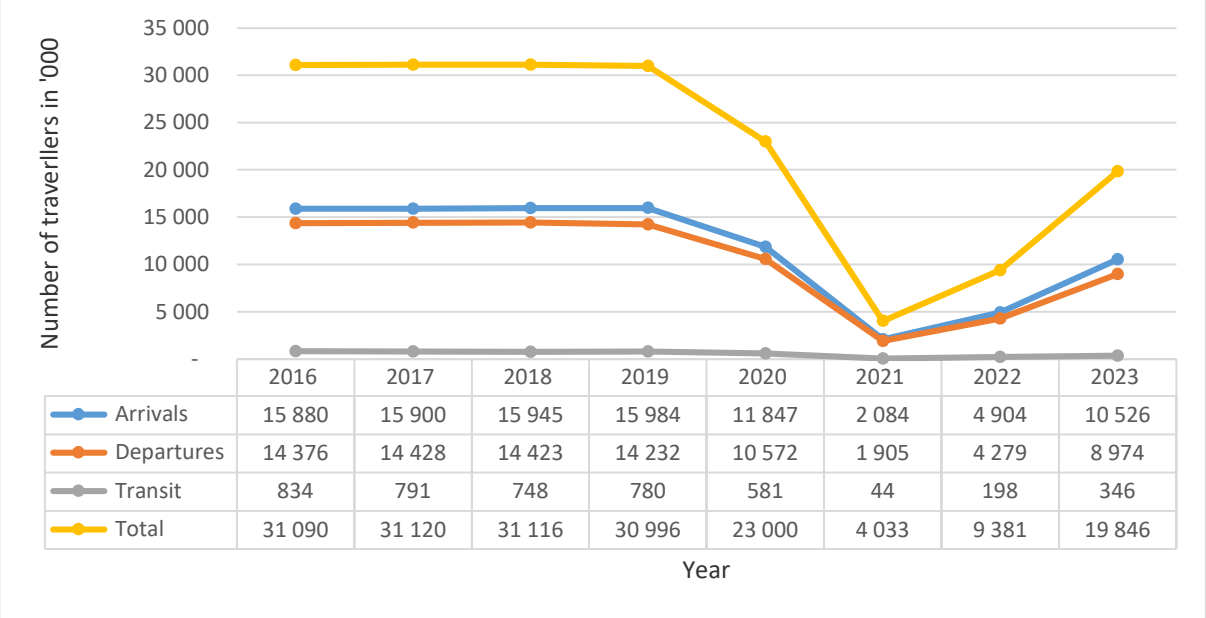
Adjusted Level 2 31 May-15 June 2021 → Adjusted Level 3 16-27 June 2021 → Adjusted Level 4 28 June-25 July 2021 → Adjusted Level 3 26 July - 12 September 2021 → Adjusted Level 2 13 -30 September 2021 → Adjusted Level 1 01 October 2021-4 April 2022 → National state of disaster lifted 05 April 2022 to date

INTERNATIONAL AND NATIONAL BORDER MOVEMENT						
Adjusted Level 2	Adjusted Level 3	Adjusted Level 4	Adjusted Level 3	Adjusted Level 2	Adjusted Level 1	Lockdown ended
20 land borders of the country are fully operational and 33 remain closed. Travelling to and from the country is allowed subject to restrictions. All travel between provinces is allowed for any purpose	20 land borders of the country are fully operational and 33 remain closed. Travelling to and from the country is allowed subject to restrictions. All travel between provinces is allowed for any purpose	20 land borders of the country are fully operational and 33 remain closed. Travelling to and from the country is allowed subject to restrictions. Interprovincial travel is restricted when travelling to and from Gauteng only – except for work, business or commercial travel. Leisure travel is prohibited	20 land borders of the country are fully operational and 33 remain closed. Travelling to and from the country is allowed subject to restrictions. All travel between provinces is allowed for any purpose.	20 land borders of the country are fully operational and 33 remain closed. Travelling to and from the country is allowed subject to restrictions. All travel between provinces is allowed for any purpose	21 land borders of the country are fully operational and 32 remain closed except for the Telle Bridge port of entry. All travel between provinces is allowed for any purpose	Partial re-opening of borders still in place. 21 land borders of the country are fully operational and 32 remain closed. All travel between provinces is allowed for any purpose

AVIATION						
Adjusted Level 2	Adjusted Level 3	Adjusted Level 4	Adjusted Level 3	Adjusted Level 2	Adjusted Level 1	Lockdown ended
Domestic air travel allowed International air travel is restricted to 5 airports only.	Domestic air travel allowed International air travel is restricted to 5 airports only.	Domestic air travel allowed with restrictions to Gauteng. International air travel is restricted to 5 airports only.	Domestic air travel allowed International air travel is restricted to 5 airports only.	Domestic air travel allowed International air travel is restricted to 5 airports only.	Domestic air travel allowed International air travel is restricted to 5 airports only.	Domestic air travel allowed International air travel is restricted to 5 airports only.

Source: www.gov.za

Appendix 2: Number of arrivals, departures and travellers in transit by year of travel 2016–2023



	2016	2017	2018	2019	2020	2021	2022	2023
Arrivals	15 880	15 900	15 945	15 984	11 847	2 084	4 904	10 526
Departures	14 376	14 428	14 423	14 232	10 572	1 905	4 279	8 974
Transit	834	791	748	780	581	44	198	346
Total	31 090	31 120	31 116	30 996	23 000	4 033	9 381	19 846

Source: Stats SA Tourism and migration data, 2023(c)