TECHNICAL REPORT

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COMMUNITY SURVEY 2016

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CS 2016 Technical Report

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Abbreviations and acronyms

BTG	Behind The Glass
CAPI	Computer Assisted Personal Interviewing
CS	Community Survey
CSS	Citizen Satisfaction Survey
DO	District Office
DSC	District Survey Coordinator
DU	Dwelling Unit
DURF	Dwelling Unit Record Form
FOM	Field Operations Manager
FW	Fieldworker
FWS	Fieldwork Supervisor
GPS	Global Positioning System
HH	Household
HO	Head Office
NATJOC	National Joint Operations Committee
MAR	Minimum Acceptance Rule
MoS	Measure of Size
MRN_ID	Map Reference Number Identifier
OOS	Out of Scope
PAPI	Paper and Pencil Interviewing
PO	Provincial Office
PPS	Probability Proportional to Size
PSC	Provincial Survey Coordinator
SAPS	South African Police Services
Stats SA	Statistics South Africa

1. Introduction

This report describes the methods used in conducting the Community Survey 2016 (CS 2016) focussing on the technical aspects of the survey methodology. The report also provides an assessment of the quality of data collected during the survey as well as the quality of the survey estimates.

1.1. Background to the Community Survey

Statistics South Africa (Stats SA) has undertaken three population censuses since 1994 as per the Statistics Act No. 6 of 1999. These censuses have generated diverse demographic and socio-economic information at grassroots level that has guided the formulation of policies and interventions aimed at further development of the South African society.

The demand for data at lower geographic levels continues to increase and in light of this the Community Survey (CS) was initiated to bridge the gap between censuses in providing data at lower geographic levels in the country. The CS was first conducted in 2007 and is a large-scale household based survey aimed at providing reliable demographic and socio-economic data at local municipality level. CS 2016 is the second CS conducted by Stats SA and bridges the data gap between Census 2011 and the upcoming Census 2021.

1.2. Objectives of the Community Survey 2016

The goal of CS 2016 is to provide indicators that will inform the implementation, monitoring and evaluation of development programmes for communities at local municipality level.

The key objectives of CS 2016 are:

- To provide an estimate of the population count by local municipality.
- To provide an estimate of the household count by local municipality
- The measurement of demographic factors such as fertility, mortality and migration.
- The measurement of socio-economic factors such as employment, unemployment, and the extent of poverty in households.
- The measurement of access to facilities and services, such as piped water, sanitation and electricity for lighting.

2. The sample

2.1. Target population and survey population

The target population for CS 2016 is the non-institutional population residing in private dwellings in the country. The institutional and transient population are out of scope (OOS) for CS 2016. Therefore, people who are homeless or those residing in hospitals, prisons; military barracks, etc. are ineligible for CS 2016. Table 2.1 below lists the types of institutions which were excluded from the CS 2016 sampling frame.

Table 2.1: Institutions not included in CS 2016

Non-residential hotel
Hospital/ frail care centre
Old Age homes
Child care institution/ orphanage
Boarding school hostel
Initiation school
Convent/ monastery/ religious retreat
Defence force barracks/ camp/ ship in harbour
Prison/ correctional institution/ police cells
Community/ church hall (in cases of refuge for disaster)
Refugee camp/ shelter for the homeless

In addition, very small enumeration areas (EAs) that form part of the target population were excluded from the frame to improve operational efficiency during the survey. These small EAs were excluded on the basis of cost and the feasibility to conduct field operations within these areas as they are usually very remote and are sparsely populated. However, their exclusion contributes to under-coverage on the frame and an adjustment factor has to be included during weighting to account for this under-coverage (see chapter on weighting below). Therefore the survey population excludes the target population in very small EAs.

2.2. Sampling frame

The geo-referenced dwelling frame was used as the sampling frame for CS 2016. Each record on the geo-referenced dwelling frame indicates a Global Positioning System (GPS) location point spatially with the associated latitude and longitude. Each point on the dwelling frame is assigned to a structure, stand or a yard depending on the settlement type. For traditional settlement areas and urban formal areas where a clearly demarcated stand or yard can be observed the point was allocated the yard. However, in areas where a clearly demarcated stand could not be distinguished and on farms (to distinguish dwelling structures from other structures) points were allocated to each structure within the yard or stand. Each

point on the geo-referenced dwelling frame was classified according to its feature use. Only points classified as a “DU” were considered for CS 2016 sampling since these points would include households that are part of the target population. Points are classified as a “DU” if they have at least one DU associated with them. Therefore a point can have more dwelling units associated with it (for example, a block of flats). The number of DUs at a point is used for the selection of DUs within an EA and the geo-reference point is used to locate the sampled DUs within an EA.

EAs with no geo-reference points classified as DUs within them were considered vacant for the purposes of sampling for CS 2016 and therefore were excluded from the DU sampling frame. In addition, very small EAs (in terms of the target population) were excluded from the sampling frame. For CS 2016, EAs with less than eight DUs in the entire EA were very small and were therefore excluded from the DU sampling frame. These EAs are adjusted for during the survey weighting process in order to avoid estimation bias. Table 2.2 below gives the percentage of excluded DUs and population based on Census 2011 counts for these excluded EAs by province and nationally.

Table 2.2: Distribution of very small EAs excluded from CS 2016 sampling frame

	DU Sampling Frame			Census 2011		
	Total DUs	Excluded DUs	% Excluded	Population Count	Excluded Population	% Excluded
Western Cape	1 686 520	1038	0,06	5 647 123	12 777	0,23
Eastern cape	2 033 202	3767	0,19	6 439 198	11 017	0,17
Northern Cape	355 928	405	0,11	1 122 994	3 310	0,29
Free State	953 905	510	0,05	2 667 327	1 756	0,07
KwaZulu-Natal	2 418 648	1894	0,08	10 099 569	20 020	0,20
North West	1 171 603	728	0,06	3 446 747	7 339	0,21
Gauteng	3 884 866	1298	0,03	12 003 743	27 702	0,23
Mpumalanga	1 195 861	713	0,06	3 984 954	6 746	0,17
Limpopo	1 637 686	1218	0,07	5 328 140	5 372	0,10
South Africa	**15 338 219**	**11 571**	**0,08**	**50 739 794**	**96 040**	**0,19**

The set EA inclusion cut-off of eight DUs resulted in less than 0,08% of in-scope dwelling units being excluded from the DU sampling frame nationally. Based on Census 2011 population counts, nationally only 0,19% of the population was excluded based on this exclusion with the highest percentage of the population excluded provincially being in the Northern Cape at 0,29%.

2.3. The sample design

CS 2016 is based on a single-stage sample design whereby all eligible Census 2011 EAs were included in the initial frame and a selection of dwelling units within the eligible EAs was taken based on the sample design. EAs which do not include any DUs as part of the target

population were excluded from the sampling frame, including those EAs with a very small number of eligible DUs (see Table 2.1 above).

The EAs in the congested informal settlements were sub-divided into smaller parts called segments for ease of location and identification of structures during data collection. One or more segments were selected based on the required EA sample size. The dwelling units were then sampled from the selected segment(s) using the systematic sampling technique, and this resulted in a two stage design for EAs in the informal settlements.

2.3.1. EA sample size

The EA sample size was set at taking around eight percent of the total DUs within an EA on the geo-referenced dwelling frame. Taking a fixed proportion of DUs across EAs would have resulted in an equal probability selection method (epsem) and therefore a self-weighting single-stage design. The self-weighting samples are achieved when the final adjusted weights of all sampled units within a reporting domain are the same. However, this approach resulted in EAs that vary in sample sizes. EAs with low dwelling unit counts yielded low sample sizes while the large EAs yielded larger sample sizes. The sampling fraction in some smaller EAs and very large EAs was slightly adjusted to give a reasonable sample size for data collection. The lower limit for an EA sample size was set at five while the upper limit for EA sample size was set at 66 DUs per EA. This was because of fieldwork operational feasibility and it resulted in an average EA sample size of fourteen DUs nationally.

The i^{th} EA sample size was calculated as follows:

$$n_i = Integer\left(\frac{N_i}{12} + 0.5\right) \quad ; \quad \text{for } i = 1,2,3...,k-1,k \qquad (1)$$

Where:

k = total number of EAs on the sampling frame for CS 2016 (excluding small and large EAs),

n_i = is the number of dwelling units to be sampled within the i^{th} EA, and

N_i = is the total number of dwelling units within the i^{th} EA.

2.3.2. Selection of segments

As mentioned above congested informal EAs were divided into segments. After determining the required EA sample size, at least one segment was selected from each informal EA using the Probability Proportional to Size (PPS) sampling technique, with the number of DUs

within a segment used as the Measure of Size (MoS). Using PPS, larger segments (in terms of number of DUs within the segment) stand a greater chance of being sampled compared to smaller segments. The number of segments selected from each EA was based on the sample size required within that EA.

2.3.3. Dwelling units selection

The CS 2016 DU sample was drawn using the systematic sampling technique (SYS). SYS is the selection of sampling units at a fixed interval from a list, starting from a randomly determined point. This technique ensures the spread of the sampled units on the ground. Once the sample was selected within the EAs, the EA sample size was aggregated to local municipalities and provincial level to calculate the precision level of the proportion of unemployed persons at each level of reporting. As a result, the overall sample size of around 1,37 million dwelling units was selected nationally.

2.3.4. The CS 2016 sample distribution

The final sample size for CS 2016 was 1 370 809 DUs sampled from a total of 93 427 EAs in the country. Table 2.3 gives the distribution of the CS 2016 DU sample by province.

Table 2.3: Distribution of CS 2016 DU sample by province

Province	Number of In-scope EAs	Number of Sampled DUs
Western Cape	9 851	149 100
Eastern Cape	15 742	195 301
Northern Cape	2 742	36 125
Free State	5 595	83 645
KwaZulu-Natal	15 719	219 182
North West	6 726	102 120
Gauteng	19 022	331 125
Mpumalanga	7 197	105 058
Limpopo	10 833	149 153
South Africa	**93 427**	**1 370 809**

3. The questionnaire

The questionnaire that was used for the CS 2016 was finalised following extensive research, user consultations and testing to ensure that the questions asked met user requirements and the key objectives of CS 2016.

3.1. Questionnaire development

A number of factors were considered when developing the CS 2016 questionnaire. These included the impact on the respondent, the quality of the data collected and the length of the questionnaire. The Census 2011 questionnaire content was used as a basis for the development of the CS 2016 instrument. The decision to include new questions, any modifications to existing questions and whether to remove any questions took into account a number of factors such as user consultation feedback on importance of the data item, policy needs, data quality, costs, historical comparability, respondent burden, operational considerations and whether alternative data sources are available.

The CS 2016 questionnaire consisted of six main sections, 11 sub-sections and a total of 225 questions. A first draft of the paper questionnaire was developed in February 2015 and various versions were reviewed and updated thereafter based on discussions with stakeholders.

CS 2016 is the first national survey conducted by Statistics South Africa to use computer assisted personal interviewing (CAPI) as the main data collection method. The electronic CAPI version of the questionnaire was developed using the Survey Solutions application.[1] The Survey Solutions application is a software developed by the World Bank for development of CAPI questionnaires. Survey Solutions was chosen because of the ease with which a questionnaire can be developed using the application, with no specialised training or skills required to use the software. In addition, Survey Solutions allowed for in built interviewer checks, automated routing and collection of additional data (for example, capturing GPS coordinates for location of interview). The CAPI questionnaire was developed and revised concurrently with the paper questionnaire. The final questionnaire was approved in January 2016.

3.1.1. User consultation process

Interaction and discussions with users and stakeholders is a key element of the questionnaire development process. Engaging with them allows Stats SA to better

[1] See www.worldbank.org for more information on the Survey Solutions application.

understand and respond to the key priorities for development in society, determine the reaction to proposed changes in the questionnaire and incorporate users' inputs into the design of the questionnaire. In addition, user consultations also serve as an advocacy tool, allowing for a more informed understanding and increased support of CS 2016 activities from key stakeholders.

Initial consultations with subject-matter specialists within Stats SA were held where their data needs, the usability of the data items, the validity and reliability of response categories and questions were discussed using the Census 2011 questionnaire as a starting point. Based on this discussion a draft list of data items were compiled and presented to the Stats SA provincial staff, who also provided their input. Discussions were then held with national departments, such as the Department of Higher Education and Training, Environmental Affairs, Water and Sanitation and Human Settlements, where questions specific to their departmental priorities were discussed. In February and March 2015, provincial user consultations were held in all nine provinces with key stakeholders including representatives from provincial government departments, municipal offices, universities, research institutions and the private sector. In addition, comments on the draft questionnaire were solicited from academics and researchers working with census and survey data. An interactive web page located on the Stats SA website was also developed for data users to provide comments and inputs on the proposed CS 2016 topics.

3.2. Questionnaire testing

CS 2016 was the first national survey undertaken by Stats SA using CAPI as a mode of data collection in place of the traditional paper-assisted personal interviewing (PAPI). Testing of the CAPI questionnaire was a critical step in ensuring that the data collection instrument was designed correctly to collect the data that was needed. Tight project time lines did not allow for piloting of the survey instrument in a full-scale survey setting, however the questionnaire was assessed in a variety of smaller tests. Both the paper-based and electronic questionnaires were tested extensively in-house, before the CAPI version was formally subjected to two main testing processes, the Behind-the-glass (BTG) tests and the Integrated Test (the Integrated Test involved testing of the content and data collection related procedures in their entirety). The main objectives of the tests were to establish the following:

- Duration of interviews, i.e. how long it took to complete the questionnaire across varying respondent profiles.
- The design and flow of the questions.
- To identify any biases in the way questions were asked.

- To identify any recall issues when responding to the questionnaire.
- To get a sense of the challenges or difficulties that might arise in administering the questionnaire using a tablet.

The sections below describe the two types of testing that were undertaken for the CS 2016 questionnaire.

3.2.1. Behind-the-glass tests

As the term suggests a BTG test is a process whereby a face-to-face interview is conducted in a controlled environment. While the interview is conducted in one room between the interviewer and respondent, observers in an adjacent room observe the interview usually through a two-way mirror. Three BTG tests in total were conducted at different times during development of the questionnaire. Respondents who participated in the BTG tests were identified and recruited across various communities to ensure a diverse demographic and socio-economic respondent profile. The interviewers and observers that participated in the BTG tests were staff members involved in content development and operations for CS 2016. This allowed for the key stakeholders in the development and administering of the questionnaire to get a first-hand view of how the questionnaire fared in an interview setting and the issues related to its administration. The responsibility of interviewers during the BTG exercise was to conduct interviews focusing on the questions themselves, following the validation rules (skipping instructions), layout and flow of the questions.

Both new and revised questions were tested as rigorously as possible to ascertain their applicability and usefulness. Testing of each question, particularly the suitability of new data items and the design was a crucial process in the development of the questionnaire. The new questions covered areas such as emigration, levels of satisfaction and perceptions with regards to basic municipal services, mode and duration of travel to educational institutions or workplace, and agricultural activities undertaken by the households.

3.2.2. Integrated Test

The CS 2016 Integrated Test was undertaken during November and December 2015. This was a small scale test with the aim of testing certain aspects of the survey operations in an integrated manner in a typical survey field setting. A sample of 160 DUs was drawn within 38 EAs across two municipalities from the Brits/GaRankuwa area (i.e. City of Tshwane Metropolitan municipality and Madibeng municipality). The area was chosen on the basis that it covers different EA types and allowed for the testing of methodologies and operations under varying conditions.

The CS 2016 draft questionnaire was used for the Integrated Test. For the purposes of the Integrated Test, the reference night used in the questionnaire was revised to be within the fieldwork period (i.e. the night between 31 October and 1 November 2015 was used). In addition, other questions making reference to specific calendar periods were also revised so that they are applicable for administering during the Integrated Test.

The Integrated Test questionnaires were administered electronically using android operated tablets as planned for CS 2016. Overall, the findings from testing of the questionnaire during the Integrated Test indicated minimum errors in the form of inconsistencies and missing values on the data collected.

3.2.3. Overview of changes to the questionnaire based on the tests undertaken

During the BTG tests the questionnaire allowed for multiple households (within a DU) to be enumerated on the same questionnaire. The initial questionnaire, allowed for two types of rosters; the household and the person rosters. This, however, proved to be problematic in terms of the enumeration process because it created multiple roster layers in the questionnaire which led to fieldworker confusion. It was therefore decided that a census mode questionnaire be used in cases of multiple households.[2] This therefore meant that in cases of multiple households within DUs, only one household would be enumerated on the assigned questionnaire and a census mode questionnaire would be created and completed for the additional households within this DU. The Map Reference Number (MRN) identifier would be used to link the questionnaires, just like the barcode was used for paper based questionnaires. Based on the BTG tests and Integrated Test, additional instructions were added to the questionnaire, sections of the questionnaire were re-arranged and validation rules were revised for the final questionnaire used in CS 2016.

3.3. Questionnaire content

The target population of the survey was all persons in the sampled dwelling who were present on the reference night (i.e. the night between 6 and 7 March 2016). The final CAPI questionnaire was made up of three person rosters. One roster was utilised for the person information, one roster for emigration and one roster for mortality. Table 3.1: CS 2016 questionnaire structure3.1 below shows the structure utilised for the final CAPI questionnaire.

[2] The Census mode questionnaire is a blank questionnaire loaded onto the FWs tablet and is not linked to any of the sampled DUs. The FW while completing the questionnaire will then link the Census mode questionnaire to the appropriate DU being enumerated.

Table 3.1: CS 2016 questionnaire structure

Name of section	Description
Statistics Act No.6 of 1999 and prefilled hierarchical geographical information	Brief description of the Statistics Act reminding respondents about the confidentiality clause and the prefilled hierarchical geographical information as per the sample
Particulars of dwelling	Location and description of dwelling unit. This section was completed by the interviewer.
Person information	Questions on demographics, migration, general health and functioning, parental survival, education, employment, income and social grants and fertility. This section was completed for all household members and visitors who were present on the night of the 6/7th March 2016
Housing, household goods, services and crime, and agricultural activities	Perception questions on satisfaction with basic service, questions on housing, household goods and services, crime, agricultural activities and food security
Emigration and mortality	**Emigration:** Questions on sex, age, country of residence and year moved for each member of the household who have emigrated to another country since March 2006 and are still residing there **Mortality:** Questions on sex, age, year and month of death and maternal mortality for each member of the household who passed away 12 months prior to the reference night of the survey
Result codes and comments	Result code for each visit, date and time of next visit and comments. This section was completed by the interviewer.

The CAPI questionnaire consisted of 120 questions with enabling conditions and 44 questions with validation conditions. For some questions, for example, country of birth, automated lists of all the countries in the world, were uploaded on the CAPI questionnaire designer to reduce capturing errors when specifying country of birth.

3.4. Questionnaire approval and finalisation process

The questionnaire went through a number of iterations of modification and approval at various levels before the final questionnaire was approved. The draft questionnaire was presented to the CS 2016 technical committee and was revised based on the committee's comments and inputs from the user consultation processes. The questionnaire was approved by the technical committee in August 2015. This questionnaire was then presented to the Population Statistics Council in October 2015 where the committee approved the questionnaire for testing and made several inputs regarding the length of questionnaire and recommended further consultation with subject-matter specialists.

The paper-based questionnaire was further revised based on these inputs and findings from the tests and the final questionnaire was submitted to and reviewed by Stats SA's Questionnaire Clearance Committee (QCC) in January 2016. The QCC reviewed the overall

content of the questionnaire as well as proposed skips. It also made recommendations regarding the wording of questions, grammar and general editing. The final approved questionnaire from the QCC was then used to update the electronic questionnaire to be used for CS 2016 CAPI data collection.

4. Fieldwork Operations

CS 2016 introduced a number of technological innovations in terms of how fieldwork operations and data collection was implemented. The use of tablets and specialised software for navigation to sampled DUs including CAPI enumeration during CS 2016 was different from the conventional PAPI field operations survey processes. These innovations greatly improved the timeliness, efficiency and cost effectiveness of field operations for CS 2016.

4.1. Training Approach

One of the key factors for a successful survey is the quality of the field training operations. Training builds better communication skills, ensures consistent quality, improved focus, produces more effective and productive efforts and clarifies the concepts and processes of the survey to all field staff including Fieldworkers (FWs), the Fieldwork Supervisors (FWSs) and district and provincial staff members.

A 3-tier cascade approach was implemented with national, provincial and district level training being conducted. The duration of training was for 10 days at each level and the training teams consisted of Head Office (HO), Provincial Office (PO) and District Office (DO) personnel including Subject Matter Specialists (SMS) from all relevant work streams within the organisation. Provincial trainers were trained at national level (including FOMs, PSCs, etc.), who in turn trained the district trainers (i.e. FWSs and DSCs) at the provincial level. District trainers would subsequently train fieldworkers in their respective districts. Trainees at district level were recruited based on meeting the minimum requirements of having completed at least Matric and be willing and able to attend training within their identified areas. Overtraining was done at district level to ensure an adequate pool of trainees for recruitment of fieldworkers (20% over training was targeted within each district).

4.1.1. Training methodology

A multi-pronged training method was used to train field staff. This entailed a combination of instructor-led and practical methods. An instructor-led method of training was delivered using presentation slides. It covered training content such as:

- Publicity
- Navigation
- Enumeration procedures
- Computer Aided Personal Interview (CAPI) methodology
- Unpacking of multiple DUs at a point

Practical training was also given in the form of role plays and mock interviews between trainees. Practical training also included a field practice session where trainees were given a sample of DUs (not part of the CS 2016 main sample) to navigate to and enumerate. The following methods, techniques, tools and aids were used during training:

Table 4.1: Methods and techniques used during training

Level of training	Methods and Techniques	Tools	Aids	Duration
National / Provincial / District Training	• Instructor –led • Presentation • Video • Group discussions • Role play • Field practice • Simulation • Question and Answer • Evaluation Exercises	• Laptop • Projector • Flip chart • Tablets	• Presentation slides • Fieldworker manual • FWS/FW manual • User guide – how to use the tablet	10 days each

4.1.2. Training venues

Training at the national level was conducted at fully paid for conference venues which met all the requirements conducive for training, and at the Provincial level training venues within the provincial offices were utilised. At the District level, most venues were sourced free of charge and some at a minimal cost. Although training venues at District level were free or low-priced, great effort was put to ensure that these met the requirements conducive for training such as, but not limited to, adequate space, availability, safety and security, basic amenities such as water and sanitation, etc.

4.1.3. Quality control during training

The quality of training was carefully monitored to ensure quality and consistency at the various levels. A Head Office Support Team (HOST) was set up to assist and monitor training at the various provincial and district level training venues. The HOSTs had a set of objectives and indicators that they needed to reflect on during the training proceedings. The support team noted their findings, on a checklist they were provided with. The findings and actions taken were communicated to all stakeholders and also documented for future improvements. The team were required to perform the following tasks during training:

- Ensure that the program is on track, trainers and trainees were available and the required resources (such as projectors, adequate furniture, microphones, etc.) were in place for a conducive learning environment;
- Assist with training where necessary.

- Evaluation of overall training in terms of the content, delivery of training material and tools used for training.
- Administer assessment exercises and invigilate during the assessments.

Another aspect of quality control during training was the administration of assessment exercises aimed at measuring trainees' knowledge, skill and aptitude towards fieldwork. These assessments were used during the recruitment process to select the best performing trainees.

4.2. Fieldwork approach

During fieldwork, the FWs were expected to use the tablet to navigate to points where the sampled DUs allocated to them were located. Once at the point they were required to list the DUs at that point and identify the sampled DUs from this listing using the Dwelling Unit Record Form (DURF) loaded on the tablet. Once the sampled DU was identified they then enumerated the DU using the CAPI questionnaire loaded on the tablet.

4.2.1. Process of navigating to sampled DUs

Go-survey was the application used to navigate to the geo referenced point where the sampled DU was located. The tablet of each FW had the application with a built-in map with the geo referenced points allocated to that specific FW so that they could keep track of points in their work load. The application had an inbuilt GPS location system that guided the FW in real time to the point they were navigating too.

4.2.2. Completion of DURF

The purpose of the DURF was similar to the listing summary book used in conventional PAPI surveys. It was used to assist FWs in listing the DUs at a point (when there were multiple DUs at that point) and identifying sampled DUs for enumeration from this listing. The FWs completed the DURF by observing the actual structures at that the point on the ground and listing them using a similar methodology to conventional listing approaches for surveys at Stats SA.

4.2.3. Completion of questionnaire for households

The CS 2016 questionnaire was allocated to each sampled DU together with the DURF for that particular DU and loaded on the tablet. Fieldworkers would digitally record all the information of the members in a roster for a particular household in the CAPI questionnaire

loaded on the tablet. Completed questionnaires were submitted to supervision and quality control twice a day using the synchronisation functionality on Survey Solutions. Where there were multiple DUs and HHs identified, provision was made for additional questionnaires to be available on the tablet (in the form of Census mode questionnaires). These questionnaires were then linked to the main questionnaire through the MRN _ID identifier.

4.3. Quality control during fieldwork

A number of steps were taken during fieldwork to ensure quality of data being collected by FWs. The first level of supervision and support in the field was the FWSs. Each FWS was responsible for approximately 19 FWs. The FWS was responsible for managing all CS 2016 materials and resources in their respective FWS units. The FWS was also responsible for supervision of FWs, quality assurance through remote monitoring and ensuring coverage of the area assigned to them. Supervisors also monitored the progress of their FWs on a continuous basis through a tablet using remote supervision software and intervened when issues were picked up. FWSs reported to the DSCs in their area and had to submit daily progress reports.

4.3.1. Role of DSCs

The DSCs were responsible for the final approval of the questionnaires coming from the field in terms of completeness, accuracy and consistency. Approved questionnaires were submitted electronically to the Head Office database where further checks were done. Rejected questionnaires were sent back to FW tablets electronically and would appear on the FWs tablet the next time they synchronised. The DSC was responsible for the assignment of the workload to FWs and the reassignment of workloads when FWs resigned or left work prior to the end of the data collection period. Payment of salaries to field staff was triggered when the work done by the FW or FWS is complete and of acceptable quality and the data collection tablet and field gear had been returned. The DSC was responsible for signing off on payment for FWSs and FWs reporting to them.

4.3.2. Verification process for Out of Scope DUs

The Out of Scope Dwelling (OOS) units are those DUs that do not contain any households as part of the target population and therefore no questionnaires and data can be collected for these DUs. It is important to verify any DU that is classified as OOS by the FW (for instance those DUs classified as vacant, demolished, unoccupied, new dwellings under construction, misclassifications and unoccupied dwelling structures) since it contributes to a decrease in the realised sample. DUs that were classified as OOS were verified by the FWS and Head Office officials deployed to the districts. The verification process was done through

physical observation of the DU (actual visit to the DUs). After the OOS DUs were verified, a verification form was signed by the FWS/Head Office official and submitted to the DSC for approval of the questionnaire.

4.3.3. Handling of refusals

Surveys in general have to deal with a certain level of non-response. Households in some of the sampled units might refuse to participate in the survey. It is important to have a strategy to try and convince these households to participate in the survey, as a refusal leads to no data being collected from an eligible household in the sample. For CS 2016, when the FW encountered a refusal, they had to complete a refusal form to report it to their FWS, including the physical address of the dwelling, contact details of the non-responding household or respondent and the reasons for refusal (if possible).

The FWs were to report or inform the refusal to the FWSs. The message to the FWS was to include the physical address of the DU and if possible the contact details of the respondent(s) and the reasons as to why the respondent was refusing. The FWS would then attempt to contact the household and elicit a response. If the household still refused, then the matter was escalated to the DSC who issued a refusal letter to the respondent informing them of the consequences of not responding in line with the Statistics Act of 1999. Many of the households, after receiving the refusal letters made appointments with the district office to be enumerated. For CS 2016 there were no cases that were reported to South African Police Services (SAPS) for investigation regarding refusals.

Refusals could also occur at community level, where an entire community might not want to participate for reasons such as staging a service delivery protest against the government or a gated community (such as a town house complex) might not allow access to the complex. Statistics South Africa had an enforcement strategy in place to deal with these types of refusals. The strategy involved a coordinated effort between Statistics South Africa and key stakeholders within the security enforcement agencies to provide assistance [the project was registered with the National Joint Operation Committee (NATJOC)] as well as communicating with community leaders, security management agencies, estate managers and home owners associations prior to the beginning survey and during the survey to gain their support.

5. Data management and data processing

The CS 2016 has enabled Statistics South Africa in using a technology-driven approach in its operations. This implies that the flow of field operations has been dependant on different systems using pre-prepared data (i.e. geo-referenced mapping information), the transaction data (i.e. monitoring the field operations), the administration data and the statistical data (i.e. related to the questionnaire). All the data sources mentioned above are inter-linked, thus providing a support mechanism of control and efficient management of the full survey value chain.

5.1. Data management

5.1.1. Database used

It is important to mention the data sources used as their inputs contribute in post-enumeration data management. The sources of data used were:

- **Geo-reference spatial frame** used for sampling and field navigation through the Go-survey system;
- **Human resources recruitment system** which provided the main source of applicants fieldworkers (ESRI platform);
- **Leaner Management system** which provided the assessment of training and scoring of successful candidates (SQL-server database);
- **Survey Solution**s application developed by the World Bank and used for CAPI, interview management and data capturing (PostgreSQL database);
- **Minimum Acceptance Rule (MAR)** system applied in SQL server as tool of quality management using minimum criteria (SQL server);
- **SAS BI system** providing the monitoring and performance management at each level of fieldwork;
- **SAS** was used for structure edits, weighting, consistency edits and preliminary analysis; and
- **SuperCross** is used for tabulation of data

During field operations, the different databases (i.e. CAPI and Go-survey) were updated instantly using a mobile platform which synchronised information captured and the location where the interview took place. On a daily basis, the data was manually exported from the central repository cloud (CAPI and Go-Survey) to Stats SA Head Office servers as there were no live links. The following files were exported:

- CS2016Household_QN (Sampled household questionnaire)

- CS2016Household_QN_CensusMode (Additional household questionnaire)
- CS2016Persons (Persons in sampled household questionnaire)
- CS2016Persons_CensusMode (Persons in additional household questionnaire)
- CS2016Mortality (Death records in sampled household questionnaire)
- CS2016Mortality_CensusMode (Death records in additional household questionnaire)
- CS2016Emigrant (Emigrants records in sampled household questionnaire)
- CS2016Emigrant_CensusMode (Emigrants records in additional household questionnaire)
- interview_actions_Main (Transaction on sampled household questionnaire)
- interview_actions_CensusMode (Transaction on additional household questionnaire)
- interview_comments_Main (Comments by fieldworkers on sampled household questionnaire)
- interview_comments_CensusMode (Comments by fieldworkers on additional household questionnaire)
- DURF_CS_2016_FINAL (Listing records of both sampled dwelling units (DU) and additional dwelling unit)
- interview_actions_DURF (Transaction on listing records)
- interview_comments_DURF (Comments on listing records)
- National_Samplepts_20160218 (DUs linked to map reference number as the main sample)

The above datasets were exported into the following three streams of production:

- The checking of minimum acceptability rule,
- The SAS BI dashboard performance monitoring of the fieldwork, and
- The final dataset for editing, weighting and analysis.

The following table provides the number of records associated with each of the input files:

Table 5.1: Number of records per input file for data processing

Table Name	Number of records	Unit
CS2016Household_QN	1 370 811	Number of questionnaires
CS2016Household_QN_CensusMode	80 877	Number of questionnaires (Census mode)
CS2016Persons	3 228 724	Number of persons
CS2016Persons_CensusMode	170 324	Number of persons (Census mode)
CS2016Mortality	30 820	Number of deaths
CS2016Mortality_CensusMode	1 202	Number of deaths (Census mode)
CS2016Emigrants	6 314	Number of emigrants
CS2016Emigrants_CensusMode	609	Number of emigrants (Census mode)
interview_actions_CensusMode	724 508	Number of transactions (Census mode)
interview_actions_DURF	5 911 357	Number of transactions (DURF)
interview_actions_Main	11 588 716	Number of transactions (DURF)
interview_comments_CensusMode	215 909	Number of comments (Census mode)
interview_comments_DURF	321 897	Number of comments (DURF)
DURF_CS_2016_FINAL	1 303 180	Number of dwelling units
GeoHierarchy_EA2011_2016 (EAs)	103 576	Number of Enumeration Areas

5.1.2. Minimum acceptability rules (MAR)

Sample identification criteria:

The minimum acceptability rules was a procedure attempting to detect questionnaires (households or persons) that may have been falsely or erroneous captured by the fieldworkers. Every day, an export of all records in CAPI was loaded into SQL-server database. The MAR procedure checked if there was minimum information allowing the identification of the questionnaire (EA, map reference number, dwelling unit, household number). Most importantly, the map reference number and the dwelling unit had to match the sampled units. In addition, the procedure ascertained if the final result code was for a responding household. In case of non-respondents, the procedure returned the questionnaire to the field for a follow-up attempt to try and reduce non-response. In case of out-of-scope dwellings, the procedure returned the questionnaire to the FWS for confirmation of the out-of-scope status of the questionnaire.

Distance criteria:

In cases where the interview was indicated to have taken place far from the geographical reference coordinates of the sampled DU (i.e. more than 30 metre radius), then the fieldworker was requested (at least 4 times) to confirm if the interview was completed for the correct sampled DU using two sources of information (i.e. Go-Survey navigation system and

Survey Solution CAPI captured geo-coordinates against the sampled geo-coordinates). The distance was calculated using the Spherical Law of Cosines which provides accurate measures of distances as small as a few meters on the earth's surface (see Table 5.2 below). In the formula, R is used as correction factor into metric measurement where R = 6 371 000. A set of decision rules were used by choosing the distance within the 30 metre radius from either source of distance measured as acceptable. For a dwelling unit situated in a new informal settlement with large number of dwellings, the distance is acceptable provided it is within a 1 km radius (Table 5.3).

Figure 5.1: Distance formulae used to determine distance between interview and sampled coordinates

Distance formula	Distance = Arccos($\sin\varphi_1 \cdot \sin\varphi_2 + \cos\varphi_1 \cdot \cos\varphi_2 \cdot \cos\Delta\lambda$) $\cdot$ R
$X = (x_1, x_2)$ =latitude in degrees $Y = (y_1, y_2)$ =longitude in degrees	$\cos^{-1}\left(\sin(\frac{x_1 * \pi}{180}) * \sin\left(\frac{x_2 * \pi}{180}\right) + \cos(\frac{x_1 * \pi}{180}) * \cos\left(\frac{x_2 * \pi}{180}\right) * \cos(\frac{y_2 * \pi}{180} - \frac{y_1 * \pi}{180})\right) * 6371000$

Table 5.2: Decision table on acceptable distance

	Go survey	**CAPI**	**Decision**
Distance	Distance within 30 m (or within 1 km for Segment)	Distance within 30 m (or within 1 km for Segment)	Accept the questionnaire using both distance
	Distance NOT within 30 m (or NOT within 1 km for Segment)	Distance within 30 m (or within 1 km for Segment)	Accept the questionnaire using CAPI
	Distance within 30 m (or within 1 km for Segment)	Distance NOT within 30 m (or NOT within 1 km for Segment)	Accept the questionnaire using GO survey
	Distance NOT within 30 m (or NOT within 1 km for Segment)	Distance NOT within 30 m (or NOT within 1 km for Segment)	Reject the questionnaire

Household acceptability criteria:

The household record was considered as acceptable when it had the minimum number of variables with responses. The household variables used for these criteria are grouped into the following categories:

- **Category 1** (H06_TYPE OF MAIN DWELLING, H07_TENURE STATUS, H13_MAIN SOURCE OF WATER, H21_TOILET FACILITY, H25_ACCESS TO ELECTRICITY, H-32 REFUSE DISPOSAL), and

- **Category 2** (H-33 HOUSEHOLD GOODS, H-34 INTERNET SERVICES, H-39 INVOLVEMENT IN AGRICULTURAL ACTIVITIES).

The rule of acceptability used for a household record was that there should be at least two valid responses in category 1 and two valid responses in category 2.

Person acceptability criteria:

The person record was considered as acceptable when it had the minimum number of variables with responses. The person variable used for this criterion was grouped into the following categories:

- **Category 1** (F01_PERSON NAME, F02_SEX, P01_DATE OF BIRTH OR F03_AGE, P02_RELATIONSHIP TO HEAD OF HOUSEHOLD, P03_MARITAL STATUS, P04_POPULATION GROUP), and
- **Category 2** (P08_PROVINCE OF BIRTH, P19a_MOTHER ALIVE, P19b_FATHER ALIVE and P20_ATTENDANCE AT AN EDUCATIONAL INSTITUTION),
- **Category 3** (P-05_LANGUAGE, P-06_RELIGIOUS AFFILIATION/BELIEF, P-27_EMPLOYMENT STATUS (P-27a, P-27b, P-27c)).

The rule of acceptability used for a person record was that there should be at least two valid responses in category 1, at least two valid responses in category 2 and at least one valid response in category 3. Note that particular attention was given to variables required for calibration where any invalid value was returned to the field for correcting where appropriate. The variables used for calibration were age (or date of birth), sex and population group.

5.2. Data processing of questionnaires

5.2.1. Transactional accounting from CAPI to SQL-server /SAS

The accounting of the questionnaires in the Survey Solutions system was tracked through transaction stages. Therefore, a valid questionnaire should had in its transaction “FirstAnswerSet” and “Completed” indicated. If a questionnaire had been accepted by the MAR, it had to still go through the “ApproveBySupervisor” as an additional stage for verification. If the questionnaire had been sent back to the fieldworker, it had as an additional stage “RejectedBySupervisor” (Table 5.3).

Table 5.3: Transaction stages for the CAPI questionnaire

Stages
SupervisorAssigned
InterviewerAssigned
InterviewerAssigned
FirstAnswerSet
Restarted
Completed
ApproveBySupervisor
RejectedBySupervisor
RejectByHeadquarter
ApproveByHeadquarter

There were questionnaires that were assigned to fieldworkers but little or no information was completed on them at the end of the fieldwork period and they were moved to the completed stage (e.g. non-responses). Also, there were questionnaires that were returned to fieldworkers for correction or to provide feedback but no response was received up until the end of the data collection period (see Table 5.4). Overall, there were 1 454 674 questionnaires in CAPI, 1 370 809 corresponded to the sampled DUs and 83 865 as CS 2016 additional questionnaire (using census mode). However, the accounting of the final export from CAPI to SQL server and SAS provided only 1 451 688 questionnaires (i.e. 2 986 questionnaires were not exported as they were without any information.

Table 5.4: Questionnaire accounted for at the end of field operations

	CS 2016 MAIN sample questionnaire (MAIN mode)	CS 2016 additional questionnaire (Census Mode)	Total questionnaire
Questionnaires assigned with little or no information collected	41 033	216	41 249
Completed questionnaires with no minimum acceptability rule applied	114 470	8 399	122 869
Rejected questionnaires using minimum acceptability rule without any feedback from fieldworkers	111 036	10 559	121 595
Approved Questionnaires using the minimum acceptability rule	1 104 124	64 440	1 168 564
Rejected by HQ without any feedback from fieldworkers	146	251	397
Total	**1 370 809**	**83 865**	**1 454 674**

5.2.2. Structural data editing

The process of structure edits was to make sure that the all survey questionnaires are uniquely identifiable, valid and have the minimum acceptable criteria. The following steps were undertaken during structural editing:

1. Combining the questionnaire datasets from the CS 2016 main survey mode with the additional questionnaires in the census mode;
2. Correction of the key variables (i.e. map reference number (MRN_ID) and the dwelling unit number (DUNo)). Specifically cleaning the misplacement of the digit error, blank digit or use of underscore between digit when required;
3. Checking if map reference numbers and dwelling unit numbers matched the original sample;
4. Determination of the distance between the visited points and the original sample location geo-coordinates;
5. In cases where the distance was within 30 m radius, updating of any missing map reference number and dwelling unit number were completed as determined to be within nearby acceptable distance from the original sample points.
6. In cases where there was a new additional dwelling unit number at the sampled map reference number, verification of the additional records captured in the dwelling unit reference frame (DURF database) was undertaken;
7. Checking if there was an existence of multiple DU at valid sample points and verifying if there were duplicate dwelling units or household numbers.
8. Checking if there were cases violating the MAR;

9. Determination of the FINAL RESULTS CODE per questionnaire (based on the possibility of up to 4 visits at the household);
10. Determination of the usability of the questionnaire for subsequent statistical analysis process where each questionnaire was classified as usable or not depending on whether it matched the original sample, it was within the nearby acceptable distance and it had the minimum acceptable number of responses;
11. The validation of different records by checking the unique ID, the fact that one household should have at least a person or more; that the emigrants' records or mortality's records are associated to one unique household.

Table 5.5 matches the original sample against the questionnaires received. Distance was used as supporting criteria in order to be able to match the sample in case the primary keys had been changed in error by the fieldworker. In addition, only the completed questionnaires with valid information are used for weighting and tabulation (see Table 5.6 below). There were some completed questionnaires which were excluded because they did not match the sample, lacked minimum acceptable criteria or were far from the geo-reference point (i.e. these questionnaires could not be reconciled with the CS 2016 sample).

Table 5.5: Questionnaire records after MAR

Survey Mode	MAR status	Distance in metres	No weights calculated	Weights calculated	Total
CS additional questionnaire (census mode)	Acceptable Minimum criteria	<=30	12 509	51 164	63 673
		>30	8	66	74
	Not acceptable minimum criteria	<=30	17 006		17 006
		>30	124		124
CS main sampled questionnaire (main mode)	Acceptable Minimum criteria	<=30	2 719	843 033	845 752
		>30	708	90 364	91 072
	Not acceptable minimum criteria	<=30	342 753		342 753
		>30	91 234		91 234
Total			**467 061**	**984 627**	**1 451 688**

Note that there were 184 households with invalid information on at least one of the key demographic variables required for calibration and therefore these were excluded from the household weighted file.

Table 5.6: Questionnaire records after structural editing

Responding categories	Final results code	No weights		Weights allocated Weights allocated		Total
		CS additional questionnaire (Census Mode)	CS main sampled questionnaire (Main Mode)	CS additional questionnaire (Census Mode)	CS main sampled questionnaire (Main Mode)	
Responses	11 Completed	12 988	6 057	50 913	928 904	998 862
	12 Partly completed	398	2 278	317	4 493	7 486
Non-responses	21 Non-Contact	3 001	50 900			53 901
	22 Refusal	1 393	36 345			37 738
	23 Other Non-Contact	314	7 658			7 972
Out of scope	31 Unoccupied dwelling	3 762	97 731			101 493
	32 Vacant dwelling	1 545	48 978			50 523
	33 Demolished	591	33 777			34 368
	34 New Dwelling Under Construction	241	9 562			9 803
	35 Status change	455	11 412			11 867
	36 Frame error	1 576	73 654			75 230
	No results provided (BLANK)	3 383	59 062			62 445
	Total	**29 647**	**437 414**	**51 230**	**933 397**	**1 451 688**

5.2.3. Consistency data editing

The strategy for ensuring consistency editing was to check consistency within the thematic section of the questionnaire only key variables. The Survey Solutions system also allowed validation rules to be built in at the time of interview which minimised the number of consistency edits required at this stage. Therefore, most of the edits at this stage dealt with “unspecified” cases or for derived variables.

There was however some imputation of variables with extreme errors or inconsistencies forced by the fieldworkers. The CS 2016 analysis report will elaborate more on these variables. The edits rules applied were mostly deduced directly from the logic consistency between different variables (i.e. logical imputation). There are however few cases where dynamic imputation methods were used where additional deduction of information was made from a matrix of predicting variables by borrowing the information from valid records to update those records without valid information (i.e. hot deck imputation).

The other aspects of consistency edits are the derived variables. For instance, the geographical distribution of population or household is determined using the map reference number which is associated to the geo-reference coordinate points feature representing the

dwelling unit. Therefore, the aggregated counts linked to the derived variables of the local municipalities, district municipalities and provinces. There are important derived variables such as age which was directly derived from the date of birth at person level.

5.3. Edited Data Files

The final data files are representative of the different statistical unit of observation as per the questionnaire. The following are the different final records to be used for tabulation and analysis in SAS.

Table 5.7: Number of records per final edited data file

Final Dataset in SAS	Number of records
CS2016_PERSON_WEIGHTED20160627	3 328 867
CS2016_MORTALITY_WEIGHTED	30 064
CS2016_HOUSEHOLD_WEIGHTED	98 4627
CS2016_EMIGRANTS_WEIGHTED	5 205
CS2016_PERSON_AUDITTRAIL	14 788 329
CS2016_MORTALITY_AUDITTRAIL	2 309
CS2016_EMIGRANTS_AUDITTRAIL	658
CS2016_HOUSEHOLD_AUDITTRAIL	832 205

6. Sample Realisation

Post the data collection and structural editing process, the household and person files were made available for the calculation of sample weights. Prior to the weighting process, it is important to verify the number of records (i.e. DUs and HHs enumerated) on the data files received against the actual sampled DUs on the initial sample file. This will allow for each record on the DU sample file to be reconciled with data returning from the field and will also assist in correctly accounting for each of the sample records during the weighting process. The household file received for weighting had 1 434 884 household records after structural editing was completed. The file was taken through a process of checks to ensure that there were no missing, invalid or duplicate identifiers for each record on the file. The household records were then validated against the DU sample file to link each of the valid households to their sampled DUs, and identify and remove any erroneously enumerated households (i.e. households enumerated but had no corresponding sampled DUs). Finally, the household file was compared against the person file to validate that all respondent households had corresponding valid person records in the person file. Respondent households with no persons matching on the person file were recoded to non-respondent households. The final household file used for weighting was made of 1 422 928 records. The final result codes for each record were mapped to one of the three final response status categories as shown in Table 6.1 where 1=Respondent (i.e. having a completed or partly completed questionnaire for the household), 2=Non-respondent (i.e. where the household did not respond and/or there was no questionnaire completed), and 3=Out-of-scope (i.e. where no eligible household was found to be enumerated).

Table 6.1: Mapping of the final result codes to the response categories

Final Result Code	Label	Frequency	Percentage
11	Complete	979 967	68,87
12	Partly complete	4 811	0,34
21	Non-contact	51 918	3,65
22	Refusal	36 807	2,59
23	Other non-response	7 724	0,54
24	'Empty Households' - Responding households without valid persons (assigned during data preparation for weighting).	797	0,06
25	Sampled DUs without corresponding dwelling on household file (assigned during data preparation for weighting).	5 925	0,42
31	Unoccupied dwelling	98 693	6,94
32	Vacant dwelling	49 367	3,47
33	Demolished dwelling	33 886	2,38
34	New Dwelling Under Construction	9 638	0,68
35	Status change	11 568	0,81
36	Classification error	74 287	5,22
Missing or invalid	Missing or Invalid Code	57 540	4,04
Total		**1 422 928**	**100,00**

6.1. Out-of-scope (OOS) rate

The out-of-scope (OOS) rate is defined as the proportion of DUs in which no eligible household was found to the total number of sampled dwelling units (including any additional DUs identified during data collection). There are several reasons why dwelling units may not contain eligible households. At the time of enumeration the dwelling unit could have been vacant or unoccupied, the dwelling unit could have been demolished or converted into a shop, or the structure could have been erroneously classified as a dwelling unit on the frame.

Let d_g be the total number of dwelling units, sampled from the geographic area g and $d_g^{(os)}$the corresponding number of dwelling units with no eligible household. The OOS rate for geographic area g is then given by:

$$Out\ of\ Scope\ Rate_g = \frac{d_g^{(os)}}{d_g} \times 100 \quad (2)$$

Table 6.2 lists the OOS rates for CS 2016 nationally and provincially (see Appendix B for OOS rates at local municipality level).

Table 6.2: National and provincial level OOS rates

Province	OOS Rate
Western Cape	27,79
Eastern Cape	29,99
Northern Cape	33,74
Free State	24,79
KwaZulu-Natal	17,58
North West	24,90
Gauteng	21,49
Mpumalanga	25,63
Limpopo	25,51
South Africa	**24,29**

Nationally, the OOS rate for CS 2016 was 24,29%, which is high relative to other surveys conducted by Statistics South Africa using the conventional Master Sample listings (for example, the OOS rate for QLFS quarter 1 of 2016 was 16,11% nationally). The high OOS rates could be due to quality of the geo-referenced dwelling frame used for CS 2016. Although an update process was conducted to improve the quality of the Dwelling Frame prior to its use in CS 2016, the high OOS rates are indicative that the frame required a more intensive verification of the classification of DUs. Going forward, the verification of the frame is an important step for future surveys that will be using the geo-referenced dwelling frame.

Most provinces also experienced similar OOS rates. However, the Northern Cape and Western Cape had relatively higher OOS rates at 33,74% and 27,79% respectively.

KwaZulu-Natal had a substantially lower OOS rate compared to other provinces (at 17,58%). The lower OOS rate in KwaZulu-Natal could be due to the fact that the geo-referenced frame for this province had been used previously for the KZN Citizen Satisfaction Survey (CSS) which was conducted a few months before CS 2016. Therefore the frame had undergone through an additional update and verification process which may have contributed to the improvements in terms of the OOS rate reduction in this province.

Appendix B, lists the OOS rates by local municipality in the country. Table 6.3 below analyses the municipal OOS rates by classifying municipalities according to the level of OOS using the categories given in Figure 6.1.

Figure 6.1: Model for classification of OOS rates

OOS Rate	Label	Interpretation
[0% - 15%]	Up to 15%	Acceptable
(15% - 25%]	More than 15%, up to 25%	High
(25% - 35%]	More than 25%, up to 35%	Very High
(35% - 45%]	More than 35%, up to 45%	Very High
(45% - 55%]	More than 45%, up to 55%	Extremely High
(55% - 65%]	More than 55%, up to 65%	Extremely High

Only 11 municipalities nationally had an OOS rate of 15% or less with 6 of these municipalities from KwaZulu-Natal. Most of the other municipalities had an OOS rate of between 15% and 35% (71 with an OOS rate between 15% and 25% and 85 with an OOS rate between 25% and 35%).

Table 6.3: Distribution of municipal OOS rates by category

Province	Out-of-Scope Rate (OOSR) Categories						Overall
	OOSR ≤ 15%	15% < OOSR ≤ 25%	25% < OOSR ≤ 35%	35% < OOSR ≤ 45%	45% < OOSR ≤ 55%	55% < OOSR ≤ 65%	
Western Cape	0	6	6	5	7	1	25
Eastern Cape	0	4	15	14	5	1	39
Northern Cape	1	3	6	8	4	5	27
Free State	2	4	6	3	4	1	20
KwaZulu-Natal	6	29	16	0	0	0	51
North West	0	6	8	5	0	0	19
Gauteng	2	3	5	0	0	0	10
Mpumalanga	0	7	9	2	0	0	18
Limpopo	0	9	14	1	0	1	25
South Africa	**11**	**71**	**85**	**38**	**20**	**9**	**234**

There were 29 municipalities nationally with extremely high OOS rates, with 9 of them with an OOS rate of between 55% and 65%. Table 6.4 below lists these 9 municipalities with their extremely high OOS rates. Prince Albert local municipality in the Western Cape had the highest OOS rate at almost 65%, while 5 municipalities in the Northern Cape (Kareeberg, Karoo Hoogland, Hantam, Khâi-Ma and Ubuntu) had extreme OOS rates of above 58%. Note that high OOS rates do not impact on the quality of the data collected from the field, however, it is an indicator of the quality of the sample frame used and reduces the effective sample size, and therefore the precision level of estimates within given domains.

Table 6.4: Top 9 Municipalities with Extremely High OOS Rates

Province	Municipality	Out-of-Scope Rate
Western Cape	Prince Albert	64,99
Northern Cape	Kareeberg	64,72
Northern Cape	Karoo Hoogland	63,51
Eastern Cape	Baviaans	61,00
Northern Cape	Hantam	59,22
Northern Cape	Khâi-Ma	58,57
Northern Cape	Ubuntu	58,51
Limpopo	Mookgopong	58,11
Free State	Tokologo	56,30

6.2. Response rate

The response rate is defined as the proportion of eligible households which completed a questionnaire with usable information to the total number of eligible households in the survey including non-respondent households (i.e. eligible households for which a questionnaire was not completed). There are many different reasons for household non-response; for example members of the particular household might refuse to participate in the survey, or the household could not be contacted during the data collection period, or the household did not provide usable information, etc.

Let n_g be the number of eligible households from the geographic area g and n_g^r the corresponding number of respondent households (where eligible households include both respondent and non-respondent households, but exclude out-of-scope households). The response rate is then given by:

$$Response\ Rate_g = \frac{n_g^r}{n_g} \times 100 \quad (3)$$

Figure 6.2 illustrates a model that is used to determine the minimum acceptable level of response for surveys conducted by Stats SA for household based surveys.

Figure 6.2: Model for response rates

Response Rate	Label	Interpretation
[80% - 100%]	80% or Higher	Acceptable
[60% - 80%)	60% up to 80%	Low
[40% - 60%)	40% up to 60%	Extremely Low

Table 6.5 lists the response rates for CS 2016 nationally and provincially (see Appendix B for response rates at local municipality level).

Table 6.5: National and provincial level response rates

Province	Response Rate
Western Cape	76,02
Eastern Cape	95,01
Northern Cape	89,72
Free State	90,74
KwaZulu-Natal	95,51
North West	91,59
Gauteng	87,25
Mpumalanga	92,00
Limpopo	97,21
South Africa	**90,52**

Nationally, the response rate for CS 2016 was 90,52% which was well within the minimum acceptable threshold of 80% response rate. Across most provinces, the response rates were also above the minimum acceptable criteria except for the Western Cape where the provincial response rate was 76,02%. Appendix B, lists the response rates by local municipality in the country.

Table 6.6 below analyses the municipal response rates by classifying them based on the model above. Almost all municipalities achieved a response rate of 80% or higher nationally (222 of 234 municipalities).

Table 6.6: Distribution of municipal response rates by category

Province	Response Rate (RR) Categories			Overall
	RR ≥ 80%	60% ≤ RR < 80%	40% ≤ RR < 60%	
Western Cape	20	4	1	25
Eastern Cape	38	1	0	39
Northern Cape	24	3	0	27
Free State	20	0	0	20
KwaZulu-Natal	51	0	0	51
North West	17	2	0	19
Gauteng	10	0	0	10
Mpumalanga	18	0	0	18
Limpopo	24	1	0	25
South Africa	**222**	**11**	**1**	**234**

There were 11 municipalities which achieved a response rate of between 60% and 80% (low response rate) while one municipality in the Western Cape achieved an extremely low response rate. Table 6.7 below lists these 12 municipalities with low to extremely low response rates.

Table 6.7: 12 Municipalities with low and extremely low response rates

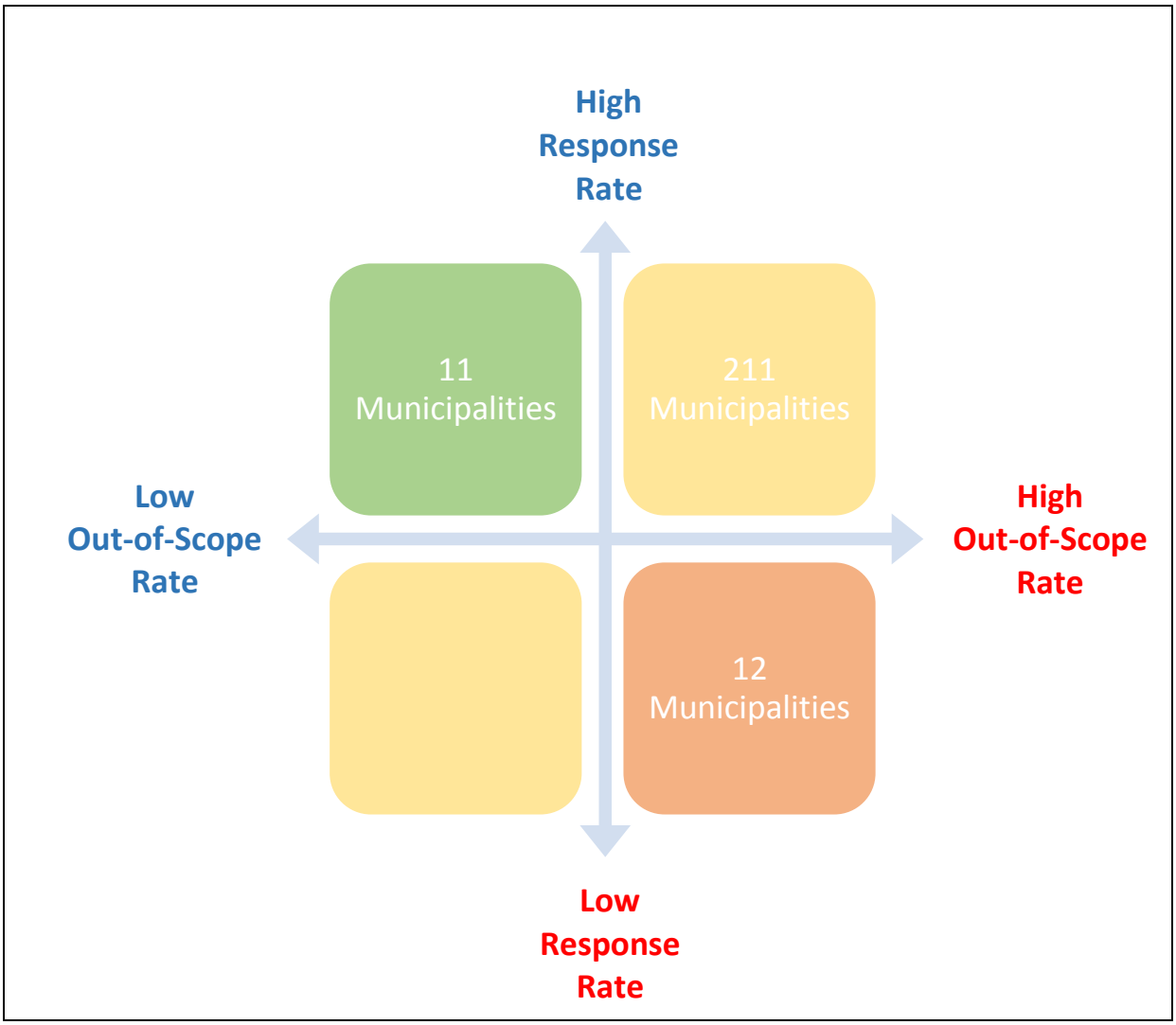
Province	Municipality	Response Rate
Western Cape	Stellenbosch	45,63
Northern Cape	Hantam	64,10
Eastern Cape	Sundays River Valley	68,08
Western Cape	Drakenstein	71,45
Western Cape	City of Cape Town	71,65
North West	Tlokwe City Council	72,70
Northern Cape	Karoo Hoogland	74,37
North West	Kgetlengrivier	75,42
Western Cape	Knysna	76,90
Limpopo	Mookgopong	77,40
Northern Cape	Thembelihle	78,05
Western Cape	Mossel Bay	79,82

Stellenbosch municipality in the Western Cape achieved a substantially lower response rate (45,63%) compared to other municipalities nationally. Of the 11 other municipalities with low response rates (i.e. between 60% and 80%) four of them were from Western Cape (namely, Drakenstein, City of Cape Town Metro, Knysna and Mossel Bay).

6.3. Classification of municipalities based on response rates and out of scope matrix

High non-response rates reduce the achieved sample and will result in increased variance of survey estimates. In addition, if non-respondents are different from respondents based on the characteristic of interest this will also lead to an increase in the bias of survey estimates. Assuming the sampled DUs were correctly classified as out-of-scope, a high OOS rate will also reduce the achieved sample size and increase the variance of the survey estimates in the given domain.

Figure 6.3: Classification of municipalities based on response rate and out of scope matrix



Looking at the response rate and OOS rate together for each municipality and classifying them based on the matrix given in Figure 6.3 above, we find that 11 municipalities have an acceptable level of response rate as well as OOS rates. These municipalities are listed in Table 6.8 below.

Table 6.8: 11 Municipalities with acceptable levels of response rates and OOS rates

Province	Municipality	Response Rate	Out-of-Scope Rate
KwaZulu-Natal	Greater Kokstad	97,55	8,95
KwaZulu-Natal	Dannhauser	97,29	13,29
KwaZulu-Natal	Newcastle	95,40	10,30
KwaZulu-Natal	The Msunduzi	93,91	13,17
Gauteng	Emfuleni	93,54	11,89
Gauteng	Ekurhuleni	93,53	14,71
KwaZulu-Natal	eThekwini Metro	92,97	12,21
KwaZulu-Natal	Ubuhlebezwe	92,73	11,83
Free State	Matjhabeng	89,54	13,28
Northern Cape	Sol Plaatjie	88,56	12,65
Free State	Mangaung	84,44	14,70

Most of the remaining municipalities (211) fell within the second quadrant with acceptable levels of response rates but high levels of OOS rates. There were 12 municipalities who fell in the third quadrant achieving low levels of response and having high OOS rates. These municipalities are listed in Table 6.9 below.

Table 6.9: 12 municipalities with low levels of response rates and OOS rates

Province	Municipality	Response Rate	Out-of-Scope Rate
Western Cape	Mossel Bay	79,82	47,14
Northern Cape	Thembelihle	78,05	30,35
Limpopo	Mookgopong	77,40	58,11
Western Cape	Knysna	76,90	39,93
North West	Kgetlengrivier	75,42	28,47
Northern Cape	Karoo Hoogland	74,37	63,51
North West	Tlokwe City Council	7270	16,17
Western Cape	City of Cape Town	71,65	23,94
Western Cape	Drakenstein	71,45	23,12
Eastern Cape	Sundays River Valley	68,08	31,94
Northern Cape	Hantam	64,10	59,22
Western Cape	Stellenbosch	45,63	20,28

NB: In order to fully understand the relationship as shown in Figure 6.3 above, between the response rates and OOS rates for municipalities in each of the four quadrants, we recommend that this analysis be read in conjunction with the report from the CS 2016 Evaluation Survey which was intended to assess under coverage and other non-sampling errors during CS 2016.

7. The Sample Weights

The main goal of CS 2016 is to produce estimates of key indicators at local municipality level. The sample was designed such that direct survey estimates for these indicators could be produced at municipal level. The weighting approach is based on the sample design. This chapter describes the approach that was used to determine the design weights for sampled DUs, including the additional DUs that were not on the sampling frame initially but were enumerated. The chapter also describes the adjustment factors applied to the design weights to account for the excluded population from the sampling frame (from small EAs excluded from the frame), non-response, and benchmarking to the known local municipality population and household control totals.

7.1. Design weights

Based on the sample design, EAs on the sampling frame were either segmented or non-segmented (see chapter on The Sample above). The design weights for segmented and non-segmented EAs are different since they are treated differently during the sample design.

7.1.1. Design weights for sampled dwelling units

The design weight for each sample unit is derived during the sample design process. For non-segmented EAs the design weight is equal to the inverse of the probability of selection (i.e. inverse of the sampling rate (ISR)). The probability of selection for DUs within non-segmented EAs is given by:

$$\pi_{ij} = \frac{n_i}{N_i} \tag{4}$$

Where π_{ij} is the probability of the jth DU in non-segmented EA i being selected, n_i is the number of sampled DUs in non-segmented EA i and N_i is the total number of DUs in non-segmented EA i.

Within segmented EAs, a sample of one or more of the segments in the EA was selected with probability proportional to the number of DUs in the segments (PPS) and then a sample of DUs in the selected segments was taken. Therefore the probability of selection for DUs within segmented EAs is given by:

$$\pi_{ikj} = \frac{s_i \times n_{ik}}{N_i} \tag{5}$$

Where π_{ikj} is the probability of the jth DU in segment k of segmented EA i being selected, s_i is the number of segments sampled from segmented EA i, n_{ik} is the number of sampled

DUs selected in segment k of segmented EA i and N_i is the total number of DUs in segmented EA i.

The design weight is then defined as the inverse of the probability of selection at the EA level, accounting for the selection of all the sampling units, i.e. the selection of segments from segmented EAs and the selection of DUs within selected segments as well as the selection of DUs within non-segmented EAs as denoted below.

$$W_d = \begin{cases} \frac{1}{\pi_{ij}} \; ; \; Non-segmented\ EAs \\ \frac{1}{\pi_{ikj}} \; ; \; Segmented\ EAs \end{cases} \quad (6)$$

7.1.2. Design weights for additional dwelling units

During enumeration, additional dwelling units were identified and enumerated that did not appear on the sampling frame. These additional DUs are in scope as part of the target population for CS 2016. However, they did not have a chance of being selected into the sample since they did not appear on the sampling frame. In order to properly account for these additional DUs in the estimates, they would need to receive a weight in relation to the conditional probability that one or more of the DUs on the frame at the same point were selected into the sample.

Additional DUs were only considered to be eligible if they satisfied the following criteria:

(1) The additional DU was within one of the points that were part of the CS 2016 sample, or

(2) The additional DU had a DU number greater than the DU Count on the frame for the given point.

The criteria above ensured that DUs erroneously enumerated were not included during the weighting process. Criterion (1) ensured that those DUs that were not within any of the points on the sample were excluded and Criterion (2) ensured that non-sampled DUs (from the frame) within the points on the sample were excluded.

7.1.2.1. Non-segmented EAs

For non-segmented EAs where all DUs within the EA were selected into the sample (i.e. take all EAs), the additional DUs identified would also appear in the sample with certainty and therefore are assigned a design weight of 1.

$$W_{add} = 1 \; ; \; for\ additional\ DUs\ in\ take\ all\ EAs \quad (7)$$

For non-segmented EAs where a sample of DUs within the EA was selected, if the number of DUs on the sampling frame for that point was greater than or equal to the sampling rate (or interval) that was applied in that EA, then the point would appear in the sample with certainty (since at least one DU within that point would have been part of the sample). Therefore any additional DUs linked to that point would also appear in the sample with certainty and have a design weight of 1.

$$W_{add} = 1 \; ; \; For\ points\ where\ number\ of\ DUs\ on\ the\ frame \geq sampling\ rate \quad (8)$$

For those EAs where the number of DUs on the sampling frame for a point in the sample is less than or equal to the sampling rate or interval, then the additional DUs at that point would have been in the sample if any of the DUs on the frame were in the sample. Therefore the design weight assigned to these additional DUs will be the design weight of the sampled DUs (see (4) above) divided by the total number of DUs at this point on the sampling frame, as given below.

$$W_{add} = \frac{W_d}{N_{ir}} \; ; \; For\ points\ where\ number\ of\ DUs\ on\ the\ frame < sampling\ rate \quad (9)$$

Where:

W_{add} = Design weight assigned to additional DUs.

W_d = Design weight of the sampled DUs (see (6) above)

N_{ir} = the total number of DUs on the sampling frame for point r in EA i.

7.1.2.2. Segmented EAs

Within segmented EAs, a two-stage PPS design was implemented, where one or more segments within an EA was sampled with PPS and at the second stage a sample of DUs was selected within the sampled segments. Each segment in an EA had one point with the count of the number of DUs within that segment. Therefore the design weight assigned to additional DUs within a sampled segment will be equal to the inverse of the probability of selection for that segment, as given below.

$$W_{add} = \frac{N_i}{s_i \times N_{ik}} \quad (10)$$

Where:

N_i = Total number of DUs from the sampling frame within EA i

s_i = Number of sampled segments within EA i

N_{ik} = Total number of DUs from the sampling frame within segment k in EA i

7.2. Design weight adjustments

7.2.1. Synthetic weight adjustment

During the design of a sample, it is common practice to adopt the strategy of excluding very small EAs from the sampling frame to improve operational efficiency during the survey. These small EAs were excluded on the basis of cost and the feasibility to conduct field operations within these areas as they are usually very remote and are sparsely populated. However, these excluded EAs form part of the target population and therefore have to be accounted for during the weighting process to reduce any bias due to coverage error in the estimates due to their exclusion.

A synthetic adjustment factor to account for the contribution from the excluded DUs were applied to the design weights. The adjustment factor is calculated using the DU counts at the geographic area level within the local municipalities to reduce the risk of potential synthetic bias. Let N_{mg} be the number of DUs within the target population from the g^{th} geographic area within the m^{th} local municipality and N_{mg}^{f} the corresponding number of DUs on the sampling frame. Then the synthetic weight adjustment factor that was used (by local municipality and geographic area) is given by:

$$Synth\_Wgt_{mg} = \frac{N_{mg}}{N_{mg}^{f}} \tag{11}$$

7.2.2. Non-response adjustment

In order to account for unit non-response during surveys, an adjustment is usually made to the design weights based on the assumption that the characteristics of responding units are similar to those of the non-responding units within adjustment cells.

The non-response adjustment factor is defined as the ratio of the eligible units, i.e. respondent and non-respondent units in the sample, to the respondent units. The adjustment for total non-response was computed at two levels of non-response; at EA non-response and household non-response levels. Non-response at EA level occurs when an EA has eligible DUs but there are no responding HHs within the entire EA. While household level non-response occurs when a particular household in an eligible EA does not respond.

7.2.2.1. EA non-response adjustment

The EA non-response adjustment factor will be based on the classification of EAs into one of the three response categories. The classification of the EAs will be based on the classification of the DUs and their households within the respective EAs in the following manner:

- **Responding EAs:**
  - EAs that have at least one eligible DU with a responding household;
- **Non-Responding EAs**
  - EAs that have eligible DUs but with no responding households;
- **Out-of-Scope EAs**
  - EAs that have no eligible DUs.

The EA non-response adjustment factor will be defined as the ratio of the total sum of weights within the respondent and non-respondent EAs and the sum of weights within the respondent EAs at geographic level within the Local Municipality. Let p_{gm}^{r} be the sum of weights within the respondent EAs from the g^{th} geographic area within the m^{th} local municipality and p_{gm}^{nr} the corresponding sum of weights within the non-respondent EAs. The EA non-response adjustment factor at geographic area within the local municipality will be defined as:

$$EA\_NR\_ADJ_{gm} = \frac{(p_{gm}^{r}+p_{gm}^{nr})}{p_{gm}^{r}} \quad (12)$$

7.2.2.2. Household non-response adjustment

The household records were assigned to one of three response categories; responding, non-responding or out-of-scope households. Only the in-scope household records will contribute in computing the household non-response adjustment factor. The in-scope households are all responding and non-responding households from the eligible DUs. The adjustment was computed at EA level.

Let p_i be the weighted number of eligible households in the dwelling sample from EA i and p_i^r be the weighted number of responding households from EA i (segmented or non-segmented EA). The household non-response adjustment factor will be defined as:

$$HH\_NR\_ADJ_i = \frac{p_i}{p_i^r} \quad (13)$$

7.2.3. Adjusted design weight

The adjusted design weight for analysis (W_a) will be defined as a product of the design weight and the adjustment factors described above, i.e. synthetic weight adjustment and non-response adjustment factors at EA and household level.

$$W_a = W_d \times SYNTH\_WGT_{mg} \times EA\_NR\_ADJ_{mg} \times HH\_NR\_ADJ_i \quad (14)$$

7.3. Calibration

The final step undertaken in constructing the sample weights at person and household level for CS 2016 was to calibrate the adjusted design weights such that the respective aggregate totals matched the distribution of the population across key demographic variables (i.e. age, gender and population group) nationally, provincially and at municipal level. The control totals used for this calibration process were independently derived by the Demography Division at Stats SA using demographic models. The calibration cells were defined based on the distribution of the survey data to avoid defining cells that may be too sparse (i.e. little or no survey data) for robust estimates to be defined. The calibration process was based on the generalised regression weighting approach.

The person and household level weights were controlled for through the calibration process at three geographic levels:

- National: Five-year age groups x Gender x Population Group
- Provincial: Four broad age groups x Gender[3]
- Municipal: Four broad age groups x Gender

The sub-sections below provide more details on the calibration of the person and household level weights.

7.3.1. Calibration of person level weights

The population estimates used for the calibration of the adjusted design weights for CS 2016 were the population totals as at 31 March 2016 (based on the projected 2015 mid-year population series). The population totals were used in benchmarking the survey estimates as described below:

[3] Note that municipalities are nested within provinces therefore calibrating at municipal level will also control for provincial level totals which are just an aggregate of all municipalities in the province.

- National level totals were defined by the cross-classification of age, race and gender. Age represents the 16 five-year age groups of 0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74 and 75+. Population group represents the 4 groups of African/Black, Coloured, Indian/Asian and White. Gender represents the 2 groups of male and female. The cross-classification resulted in 128 calibration cells at the national level.
- Local municipal level totals were defined by the cross-classification of local municipality, age and gender. The country has 234 local municipalities. Age represents four (4) broad age groups of 0-14, 15-34, 35-64, and 65+. Gender represents the 2 groups of male and female. The cross-classification of the areas with age and gender resulted in 1 872 calibration cells at municipal level.

7.3.2. Calibration of household level weights

The household estimates used for the calibration of the adjusted design weights in constructing the household level sample weights were the household totals as at 31 March 2016 (based on the projected 2015 mid-year population series). The household totals were used in benchmarking the survey estimates as described below:

- National level totals were defined by the cross-classification of the 'head of household' age, gender and population group. Age represents 4 broad age groups of 10-14, 15-34, 35-64, and 65+. Population group represents the 4 groups of African/Black, Coloured, Indian/Asian and White. Gender represents the 2 groups of male and female. The cross-classification resulted in 32 calibration cells at the national level.
- Individual local municipality level totals were defined within the provinces by the 'head of household' age and gender. The country has 234 local municipalities. Age represents 4 broad age groups of 10-14, 15-34, 35-64, and 65+. Gender represents the 2 groups of male and female. The cross-classification of the areas with age and gender resulted in 1 872 calibration cells at municipal level.

7.4. Final sample weight

The final person level sample weight (W_p^S), for person level analysis, is defined as the product of the adjusted design weight (W_a) and the person level calibration factor ($\mathrm{Cal\_Factor_p}$) calculated during the calibration process.

$$W_p^S = W_a \times \mathrm{Cal\_Factor_p} \tag{15}$$

The final household integrated sample weight (W_k^S), for household level analysis, is defined as the product of the adjusted design weight (W_a) and the household level calibration factor ($\mathrm{Cal\_Factor_k}$) calculated during the calibration process.

$$W_k^S = W_a \times \mathrm{Cal\_Factor_k} \tag{16}$$

8. Estimation

For sample surveys, the most common measure of the quality of the survey estimates that is reported is the level of precision of the estimate. This statistic looks at a particular quality dimension of the survey estimate, i.e. the reliability of the survey estimate in estimating the population value. The statistical precision of the survey estimate can be expressed using different types of statistics, most commonly standard errors (SE), the coefficient of variation (CV) or confidence intervals (CI) are used to express the precision level of descriptive survey estimates in estimating the given population values. There are several factors that can affect the precision of survey estimates, namely, the size of the sample taken relative to the population size, the sample design used and how variable the underlying characteristic of interest is in the given population.

8.1. Data Quality Indicators

To ascertain the precision of the CS 2016 estimates the SEs, CVs and CIs for key analysis variables were calculated. Most of the variables for analysis are based on proportions or percentages and these statistics are calculated based on the standard formulas as illustrated below for a single stage sample design as implemented for the CS 2016 survey.

Suppose analysis is being conducted in a particular domain a for characteristic$c$. Let d_{i_a} be an indicator variable for record i in analysis domain a such that:

$$d_{i_a} = \begin{cases} 1\,; if\ record\ i\ has\ characteristic\ c \\ 0\,; if\ record\ i\ does\ not\ have\ characteristic\ c \end{cases} \quad (17)$$

Then an unbiased estimate of the proportion of the domain population with characteristic c can be written as:

$$\hat{p}_{ac} = \frac{\sum_{i=1}^{n_a} w_{i_a} \times d_{i_a}}{\sum_{i=1}^{n_a} w_{i_a}} \quad (18)$$

Where;

$w_{i_a} = sample\ weight\ for\ record\ i\ in\ domain\ a$

$n_a = number\ of\ records\ in\ domain\ a$

Then an unbiased estimate of the standard error of $\hat{p}_{ac}$ can be approximated as:

$$\widehat{se}(\hat{p}_{ac}) = \sqrt{\frac{\hat{p}_{ac}(1-\hat{p}_{ac})}{n_a - 1}} \quad (19)$$

Then the approximate 95% confidence interval for the sample proportion can then be written as:

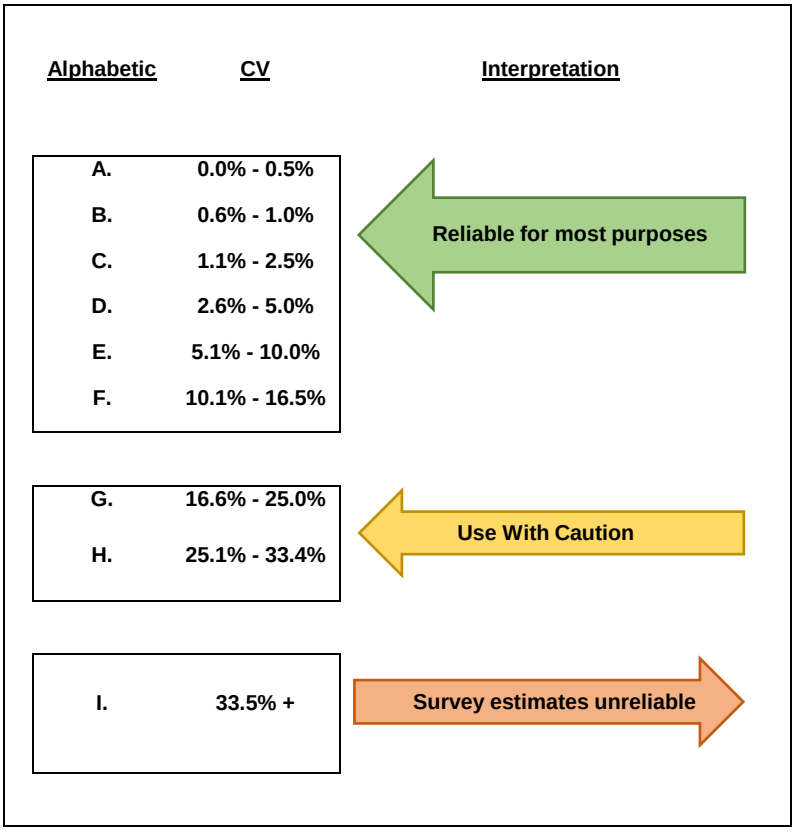
$$CI(\hat{p}_{ac}) = \hat{p}_{ac} \pm \left(1.96 \times \widehat{se}(\hat{p}_{ac})\right) \quad (20)$$

While the Coefficient of Variation for the sample proportions is:

$$CV(\hat{p}_{ac}) = \frac{\widehat{se}(\hat{p}_{ac})}{\hat{p}_{ac}} \quad (21)$$

The statistics of precision described below are the SE, which is function of the sample size and domain size. The SE given below were estimated using the Taylor Series Linearization method in the SAS Enterprise Guide 7.1 program. The CV is the ratio of the standard error of a survey estimate to the value of the estimate itself and is a measure of relative variability of the estimator. From (19) above, we can see that the SE of the estimate is inversely proportional to the sample size in the given domain (i.e. a larger sample results in a smaller SE). This relationship also holds for the CV and CI for the survey estimate since they are functions of the SE. Figure 8.1 illustrates a model that is generally used to determine the reliability of survey estimates, based on the CVs obtained for survey estimates.

Figure 8.1: Level of CV for survey estimates



8.2. Estimates of Key Variables

The key variables as listed in Table 8.1 below were considered for determining the quality of the indicators produced from CS 2016. These variables cover the priority indicators as determined by the CS 2016 analysis team at household and person levels. The quality indicators were produced for the survey estimates of percentages and incorporated the complex sample design features of CS 2016.

Table 8.1: Key variables used in determining the data quality

Dataset	Variables Analysed (as listed on the dataset)	Description of the variables

Person	*Attendance*	**Attendance at an educational institution**
		• At national level,
		  ○ By age group (4 broad age groups)
		  ○ By gender
		  ○ By population group
		• At province level,
		  ○ By age group (4 broad age groups)
		  ○ By gender
		• At municipal level,
		  ○ By gender

	EducLevel	**Highest Level of Education Completed (No schooling, Primary education, Secondary education, Bachelor's degree)**
		• At national level,
		  ○ By age group (4 broad age groups)
		  ○ By gender
		  ○ By population group
		• At province level,
		  ○ By age group (4 broad age groups)
		  ○ By gender
		• At municipal level,
		  ○ By gender

Household	*MainDwellType*	**Type of main dwelling**
		• At national level,
		  ○ By age group of household head
		  ○ By gender of household head
		  ○ By population group of household head
		• At province level,
		  ○ By age group of household head
		  ○ By gender of household head
		• At municipal level,
		  ◦ By gender of household head

	WaterSource	**Main source of water for drinking**
		• At national level,
		  ○ By age group of household head
		  ○ By gender of household head
		  ○ By population group of household head
		• At province level,
		  ○ By age group of household head
		  ○ By gender of household head
		• At municipal level,
		  ○ By gender of household head

	Variables for cross-classification (as listed on the dataset)	**Description of the variables**
	Sex	Gender of person
	Population_Group	Population group
	Age_Broad_Groups	4 Broad Age Groups: 0-14, 15-34, 35-64, 65+
	MN_Code_2011	Local municipality/Metro name

In relation to the CVs of the key variables as outlined in the tables below, two observations related to the sample size are made. Firstly, for some of the categorical variables, the sample size for some of the variables is too small to yield a reasonable and reliable interpretation for the population. Secondly, when cross tabulating the key variables with geographic and demographic variables, the cell sizes for some of the cross tabulations are too small such that the reliability of the estimates becomes questionable. These observations are elaborated further and demonstrated below.

8.2.1. Person Level Indicators

This section analyses the CVs obtained for the following key indicators at person level:

- Attendance at an educational Institution
- Highest level of education completed

The CVs are analysed at national, provincial and municipal levels overall and within the domains of gender, race and age group (4 broad age groups) for each of the key indicators.

8.2.1.1. Attendance at an educational Institution

National Estimates

Table 8.2 looks at the measures of precision achieved at the national level for attendance at an educational institution. The estimates are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable for publication.

Table 8.2: National estimates of attendance at an educational institution including measures of precision

Attendance at an educational institution	Raw count of persons	Weighted count of persons	Percentage	Standard error of percentage	Lower confidence limit of percentage	Upper confidence limit of percentage	Coefficient of variation of percentage
Yes	1 152 859	19 410 853	34,93	0,03	34,87	34,99	0,09
No	2 171 150	36 157 630	65,07	0,03	65,01	65,13	0,05
Total	**3 324 009**	**55 568 483**	**100,00**				

Table 8.3 below looks at the national level percentage estimates for attendance at an educational institution within the demographic domains of age group, gender and population group.

Table 8.3: National estimates of attendance at an educational institution including measures of precision for key demographic domains

Demographic Variable	Domain	Attendance at an educational institution	Percentage	Standard error of percentage	Coefficient of variation of percentage
Age Group	0-14	Yes	74,62	0,05	0,07
		No	25,38	0,05	0,20
	15-34	Yes	31,48	0,05	0,15
		No	68,52	0,05	0,07
	35-64	Yes	3,49	0,02	0,66
		No	96,51	0,02	0,02
	65+	Yes	1,46	0,02	1,59
		No	98,54	0,02	0,02
Gender	Male	Yes	35,51	0,04	0,12
		No	64,49	0,04	0,07
	Female	Yes	34,38	0,04	0,12
		No	65,62	0,04	0,06
Population Group	Black/African	Yes	37,13	0,03	0,08
		No	62,87	0,03	0,05
	Coloured	Yes	27,43	0,11	0,39
		No	72,57	0,11	0,15
	Indian/Asian	Yes	25,50	0,23	0,92
		No	74,50	0,23	0,31
	White	Yes	23,98	0,15	0,64
		No	76,02	0,15	0,20

The national estimates within the key demographic domains fall well within the CV reliability thresholds. However, higher CVs should be noted relative to the overall estimates given in Table 8.2 above. For some domains the CVs are substantially higher, for example the estimated percentage of persons aged 65 years and over that are attending an educational institution is 1,41% but has a CV of 1.62 nationally. This is due to the relatively small sample size within the given domain.

Provincial Estimates

Table 8.4 looks at the measures of precision achieved at the provincial level for attendance at an educational institution. The estimates are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable for publication.

Table 8.4: Provincial estimates of attendance at an educational institution including measures of precision

Province	Attendance at an educational institution	Raw count of persons	Weighted count of persons	Percentage	Standard error of percentage	Lower confidence limit of percentage	Upper confidence limit of percentage	Coefficient of variation of percentage
Western Cape	Yes	75 414	1 765 291	28,16	0,11	27,96	28,37	0,38
	No	204 555	4 502 861	71,84	0,11	71,63	72,04	0,15
Eastern Cape	Yes	171 378	2 833 523	40,53	0,08	40,37	40,69	0,21
	No	291 626	4 157 925	59,47	0,08	59,31	59,63	0,14
Northern Cape	Yes	26 190	358 634	30,07	0,17	29,73	30,41	0,58
	No	56 078	833 970	69,93	0,17	69,59	70,27	0,25
Free State	Yes	69 263	979 560	34,59	0,12	34,36	34,82	0,34
	No	126 149	1 852 431	65,41	0,12	65,18	65,64	0,18
KwaZulu-Natal	Yes	241 197	4 312 671	39,00	0,07	38,87	39,13	0,17
	No	418 101	6 744 689	61,00	0,07	60,87	61,13	0,11
North West	Yes	82 410	1 227 737	32,79	0,11	32,58	33,00	0,33
	No	165 279	2 516 948	67,21	0,11	67,00	67,42	0,16
Gauteng	Yes	216 868	3 911 835	29,27	0,06	29,14	29,39	0,21
	No	506 776	9 453 817	70,73	0,06	70,61	70,86	0,09
Mpumalanga	Yes	98 688	1 545 593	35,73	0,10	35,52	35,93	0,29
	No	171 156	2 780 488	64,27	0,10	64,07	64,48	0,16
Limpopo	Yes	171 451	2 476 009	42,76	0,08	42,60	42,92	0,19
	No	231 430	3 314 501	57,24	0,08	57,08	57,40	0,14
Total		**3 324 009**	**55 568 486**	**100,00**				

Municipal Estimates

If we apply the model as given in Figure 8.1 for the precision estimates of attendance at an educational institution at municipal level, municipalities can be categorised as given in Table 8.5 below.

Table 8.5: Municipalities by CV thresholds for attendance at an educational institution

Province	Attendance at an educational institution	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
Western Cape	Yes	25	0	0
	No	25	0	0
Eastern Cape	Yes	39	0	0
	No	39	0	0
Northern Cape	Yes	27	0	0
	No	27	0	0
Free State	Yes	20	0	0
	No	20	0	0
KwaZulu-Natal	Yes	51	0	0
	No	51	0	0
North West	Yes	19	0	0
	No	19	0	0
Gauteng	Yes	10	0	0
	No	10	0	0
Mpumalanga	Yes	18	0	0
	No	18	0	0
Limpopo	Yes	25	0	0
	No	25	0	0
South Africa	**Yes**	**234**	**0**	**0**
	No	**234**	**0**	**0**

As shown in Table 8.5 above, all municipalities within the country provide sufficiently reliable estimates for the categories for attendance at an educational institution (see Appendix C for CVs at municipal level).

8.2.1.2. Highest level of education completed

National estimates

Table 8.6 looks at the measures of precision achieved at the national level for highest level of education completed. The estimates are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable for publication.

Table 8.6: National estimates of highest level of education completed including measures of precision

Highest level of education	Raw count of persons	Weighted count of persons	Percentage	Standard Error	Lower confidence limit of percentage	Upper confidence limit of percentage	Coefficient of variation of percentage
No schooling	1 254 640	19 896 975	36,12	0,03	36,06	36,18	0,08
Primary education	1 205 871	19 805 788	35,95	0,03	35,90	36,01	0,08
Secondary education	766 068	13 871 772	25,18	0,03	25,13	25,24	0,11
Bachelor's Degree	60 160	1 336 095	2,43	0,01	2,40	2,45	0,54
Other	9 023	175 597	0,32	0,00	0,31	0,33	1,39
Total	**3 295 762**	**55 086 227**	**100,00**				

The national level percentage estimates for highest level of education completed within the demographic domains of age group, and population group are given in Appendix E. The national estimates within these key demographic domains generally fall within the CV reliability thresholds for most of the categories of highest level of education completed. However, for age group 0–14 the CV achieved for secondary education completed is greater than 33,5% and therefore is unreliable. This is due to the small number of units realised within this particular cell.

Provincial estimates

Table 8.7 looks at the measures of precision achieved at the provincial level for highest level of education completed. The estimates are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable for publication.

Table 8.7: Provincial estimates of highest level of education completed including measures of precision

Province	Highest level of education	Raw count of persons	Weighted count of persons	Percentage	Standard Error,	Lower confidence limit of percentage	Upper confidence limit of percentage	Coefficient of variation of percentage
Western Cape	No schooling	82 256	1 829 898	29,64	0,10	29,43	29,85	0,35
	Primary education	112 958	2 371 047	38,40	0,11	38,19	38,62	0,29
	Secondary education	72 304	1 712 368	27,74	0,11	27,52	27,95	0,39
	Bachelor's Degree	7 211	235 798	3,82	0,06	3,70	3,94	1,57
	Other	941	24 719	0,40	0,02	0,37	0,43	4,09
Eastern Cape	No schooling	203 769	2 900 305	41,66	0,08	41,50	41,83	0,20
	Primary education	182 554	2 808 905	40,35	0,08	40,19	40,51	0,20
	Secondary education	67 602	1 135 809	16,32	0,07	16,19	16,45	0,40
	Bachelor's Degree	6 131	102 413	1,47	0,02	1,43	1,52	1,59
	Other	823	13 629	0,20	0,01	0,18	0,21	4,49
Northern Cape	No schooling	33 740	443 615	37,61	0,18	37,25	37,97	0,49
	Primary education	31 270	468 249	39,70	0,19	39,32	40,07	0,48
	Secondary education	15 102	246 991	20,94	0,17	20,61	21,27	0,80
	Bachelor's Degree	1 035	16 808	1,42	0,05	1,33	1,52	3,48
	Other	238	3 936	0,33	0,02	0,29	0,38	7,32
Free State	No schooling	74 470	997 090	35,48	0,12	35,25	35,71	0,33
	Primary education	74 136	1 075 901	38,29	0,12	38,05	38,52	0,32
	Secondary education	42 000	675 485	24,04	0,11	23,82	24,26	0,47
	Bachelor's Degree	2 715	53 095	1,89	0,05	1,80	1,98	2,48
	Other	501	8 505	0,30	0,02	0,27	0,33	5,40
KwaZulu-Natal	No schooling	258 883	4 415 503	40,04	0,07	39,92	40,17	0,16
	Primary education	226 808	3 683 302	33,40	0,06	33,28	33,52	0,18
	Secondary education	160 096	2 726 426	24,73	0,06	24,61	24,84	0,23
	Bachelor's Degree	10 354	181 705	1,65	0,02	1,61	1,68	1,08
	Other	1 143	19 635	0,18	0,01	0,17	0,19	3,30
North West	No schooling	102 206	1 458 632	39,38	0,11	39,16	39,60	0,28
	Primary education	90 235	1 371 447	37,03	0,11	36,81	37,25	0,30
	Secondary education	48 566	802 997	21,68	0,10	21,49	21,88	0,46
	Bachelor's Degree	3 129	59 090	1,60	0,04	1,52	1,67	2,29
	Other	726	11 584	0,31	0,01	0,29	0,34	4,14
Gauteng	No schooling	207 363	3 777 897	28,65	0,06	28,53	28,78	0,22
	Primary education	249 405	4 346 773	32,97	0,06	32,84	33,09	0,19
	Secondary education	232 987	4 450 618	33,76	0,07	33,62	33,89	0,20
	Bachelor's Degree	21 417	549 241	4,17	0,04	4,09	4,24	0,87
	Other	2 671	60 242	0,46	0,01	0,43	0,48	2,82
Mpumalanga	No schooling	110 362	1 679 929	39,15	0,11	38,95	39,36	0,27
	Primary education	93 296	1 486 674	34,65	0,10	34,45	34,85	0,30
	Secondary education	60 786	1 058 713	24,67	0,10	24,48	24,87	0,40
	Bachelor's Degree	2 521	52 575	1,23	0,03	1,16	1,29	2,81
	Other	723	12 937	0,30	0,01	0,28	0,33	4,29
Limpopo	No schooling	181 591	2 394 106	41,60	0,08	41,43	41,76	0,20
	Primary education	145 209	2 193 490	38,11	0,08	37,95	38,27	0,22
	Secondary education	66 625	1 062 366	18,46	0,07	18,32	18,59	0,37
	Bachelor's Degree	5 647	85 370	1,48	0,02	1,44	1,53	1,45
	Other	1 257	20 410	0,35	0,01	0,33	0,38	3,02
Total		**3 295 762**	**55 086 227**	**100,00**				

Municipal estimates

If we apply the model as given in Figure 8.1 for the precision estimates highest level of education completed at municipal level, municipalities can be categorised as given in Table 8.8 below.

Table 8.8: Municipalities by CV thresholds for highest level of education completed

Province	Highest level of education	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
Western Cape	No schooling	25	0	0
	Primary education	25	0	0
	Secondary education	25	0	0
	Bachelor's Degree	16	6	3
	Other	1	11	12
Eastern Cape	No schooling	39	0	0
	Primary education	39	0	0
	Secondary education	39	0	0
	Bachelor's Degree	24	12	3
	Other	3	18	16
Northern Cape	No schooling	27	0	0
	Primary education	27	0	0
	Secondary education	27	0	0
	Bachelor's Degree	4	14	9
	Other	2	5	17
Free State	No schooling	20	0	0
	Primary education	20	0	0
	Secondary education	20	0	0
	Bachelor's Degree	13	6	1
	Other	4	9	6
KwaZulu-Natal	No schooling	51	0	0
	Primary education	51	0	0
	Secondary education	51	0	0
	Bachelor's Degree	30	21	0
	Other	4	18	27
North West	No schooling	19	0	0
	Primary education	19	0	0
	Secondary education	19	0	0
	Bachelor's Degree	13	6	0
	Other	6	10	3
Gauteng	No schooling	10	0	0
	Primary education	10	0	0
	Secondary education	10	0	0
	Bachelor's Degree	9	1	0
	Other	6	4	0
Mpumalanga	No schooling	18	0	0

Province	Highest level of education	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
	Primary education	18	0	0
	Secondary education	18	0	0
	Bachelor's Degree	13	5	0
	Other	7	5	6
Limpopo	No schooling	25	0	0
	Primary education	25	0	0
	Secondary education	25	0	0
	Bachelor's Degree	24	1	0
	Other	12	10	2
South Africa	**No schooling**	**234**	**0**	**0**
	Primary education	**234**	**0**	**0**
	Secondary education	**234**	**0**	**0**
	Bachelor's Degree	**146**	**72**	**16**
	Other	**45**	**90**	**89**

As shown in Table 8.8 above, most municipalities within the country provide sufficiently reliable estimates for the categories for highest level of education completed. However, there are some categories (i.e. Bachelor's degree and Other) for some municipalities where the estimates are less reliable and cautioned should be exercised due to the small cell sizes (see Appendix D for CVs at municipal level).

8.2.2. Household level indicators

This section analyses the CVs at national, provincial and municipal levels obtained for the following key indicators at household level:

- Type of main dwelling
- Water source

8.2.2.1. Type of main dwelling

National and provincial estimates

Table 8.9 looks at the measures of precision achieved at both national and provincial levels for the type of main dwelling. The national and provincial estimates for this variable are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable.

Table 8.9: National and Provincial estimates of the type of main dwelling including measures of precision

Province	Type of main dwelling	Raw count of persons	Weighted count of persons	Percentage	Standard error of percentage	Lower confidence limit of percentage	Upper confidence limit of percentage	Coefficient of variation of percentage
Western Cape	Formal	70 419	1 593 891	82,43	0,15	82,14	82,72	0,18
	Informal	14 976	330 324	17,08	0,15	16,8	17,37	0,85
	Traditional	453	9 401	0,49	0,03	0,43	0,54	5,62
Eastern Cape	Formal	80 117	1 154 843	65,13	0,15	64,83	65,42	0,23
	Informal	9 297	146 713	8,27	0,1	8,08	8,47	1,2
	Traditional	44 742	471 699	26,6	0,13	26,34	26,86	0,5
Northern Cape	Formal	18 838	295 318	83,5	0,29	82,93	84,08	0,35
	Informal	2 952	50 104	14,17	0,28	13,62	14,72	1,98
	Traditional	609	8 245	2,33	0,11	2,12	2,54	4,66
Free State	Formal	50 440	791 485	83,62	0,16	83,29	83,94	0,2
	Informal	8 757	139 585	14,75	0,16	14,44	15,06	1,08
	Traditional	1 125	15 509	1,64	0,05	1,54	1,74	3,18
KwaZulu-Natal	Formal	126 132	2 090 067	72,68	0,11	72,46	72,9	0,16
	Informal	15 318	265 334	9,23	0,08	9,08	9,38	0,83
	Traditional	37 926	520 244	18,09	0,09	17,91	18,28	0,52
North West	Formal	58 630	977 031	78,26	0,2	77,87	78,64	0,25
	Informal	12 959	248 342	19,89	0,19	19,51	20,27	0,98
	Traditional	1 513	23 146	1,85	0,05	1,75	1,96	2,9
Gauteng	Formal	195 753	4 029 069	81,39	0,09	81,22	81,57	0,11
	Informal	46 004	910 375	18,39	0,09	18,22	18,56	0,48
	Traditional	503	10 763	0,22	0,01	0,2	0,24	5,15
Mpumalanga	Formal	64 716	1 048 973	84,68	0,16	84,36	85	0,19
	Informal	7 743	149 786	12,09	0,15	11,79	12,39	1,26
	Traditional	2 427	39 992	3,23	0,07	3,08	3,37	2,28
Limpopo	Formal	99 869	1 423 523	88,92	0,11	88,7	89,14	0,13
	Informal	6 011	95 675	5,98	0,09	5,8	6,16	1,53
	Traditional	6 094	81 746	5,11	0,07	4,97	5,24	1,36
South Africa	**Formal**	**764 914**	**13 404 199**	**79,22**	**0,05**	**79,12**	**79,31**	**0,06**
	Informal	**124 017**	**2 336 239**	**13,81**	**0,04**	**13,72**	**13,89**	**0,30**
	Traditional	**95 392**	**1 180 745**	**6,98**	**0,03**	**6,93**	**7,03**	**0,36**

Municipal estimates

Applying the model as given in Figure 8.1 for the precision estimates of type of main dwelling at municipal level, municipalities can be categorised according to the level of reliability of the estimates as given in Table 8.10 below.

Table 8.10: Municipalities by CV thresholds for type of main dwelling

Province	Type of main dwelling	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
Western Cape	Formal	25	0	0
	Informal	18	3	4
	Traditional	2	11	10
Eastern Cape	Formal	39	0	0
	Informal	26	10	2
	Traditional	24	7	4
Northern Cape	Formal	27	0	0
	Informal	15	8	4
	Traditional	3	3	14
Free State	Formal	20	0	0
	Informal	20	0	0
	Traditional	4	6	9
KwaZulu-Natal	Formal	51	0	0
	Informal	33	12	5
	Traditional	51	0	0
North West	Formal	19	0	0
	Informal	19	0	0
	Traditional	9	4	6
Gauteng	Formal	10	0	0
	Informal	10	0	0
	Traditional	3	2	5
Mpumalanga	Formal	18	0	0
	Informal	18	0	0
	Traditional	14	2	2
Limpopo	Formal	25	0	0
	Informal	23	2	0
	Traditional	17	3	5
South Africa	**Formal**	**234**	**0**	**0**
	Informal	**182**	**35**	**15**
	Traditional	**127**	**38**	**55**

The majority of the municipalities across provinces have reliable estimates in the three categories of type of main dwelling. There are municipalities distributed across provinces with estimates for informal and traditional main dwelling types (i.e. 35 and 38 municipalities respectively) that have higher CVs and these estimates should be used with caution. Furthermore, there are 15 municipalities who have survey estimates that are unreliable for informal dwelling types and 55 municipalities that are unreliable for traditional dwelling types. See Table 8.11 for the list of such municipalities.

Table 8.11: Municipalities with unreliable estimates for type of main dwelling

Province	Municipality	Type of main dwelling	Weighted count of Households	Percentage	Coefficient of variation of percentage
Western Cape	Beaufort West	Informal	66	0,44	45,84
	Kannaland	Informal	162	2,57	38,00
	Laingsburg	Informal	47	1,62	70,26
	Prince Albert	Informal	8	0,19	100,45
	Bitou	Traditional	202	0,92	57,15
	Cederberg	Traditional	140	0,91	43,01
	Drakenstein	Traditional	151	0,21	42,83
	George	Traditional	498	0,79	37,31
	Knysna	Traditional	82	0,32	41,41
	Laingsburg	Traditional	24	0,85	99,78
	Matzikama	Traditional	81	0,39	50,07
	Oudtshoorn	Traditional	50	0,21	53,28
	Stellenbosch	Traditional	366	0,70	47,43
	Swellendam	Traditional	24	0,20	100,02
Eastern Cape	Baviaans	Informal	101	2,18	39,91
	Inkwanca	Informal	169	2,78	38,36
	Baviaans	Traditional	96	2,07	44,99
	Camdeboo	Traditional	47	0,36	72,48
	Inkwanca	Traditional	119	1,97	46,55
	Inxuba Yethemba	Traditional	28	0,15	75,40
Northern Cape	Kamiesberg	Informal	121	3,63	36,08
	Kareeberg	Informal	131	3,56	51,38
	Karoo Hoogland	Informal	25	0,55	79,78
	Richtersveld	Informal	53	1,25	52,69
	Dikgatlong	Traditional	117	0,79	38,55
	Kareeberg	Traditional	81	2,21	56,26
	Kgatelopele	Traditional	19	0,31	99,96
	Khâi-Ma	Traditional	41	0,99	70,57
	Magareng	Traditional	15	0,22	100,05
	Mier	Traditional	27	1,32	99,37
	Phokwane	Traditional	33	0,17	63,18
	Richtersveld	Traditional	2	0,05	100,38
	Siyancuma	Traditional	17	0,17	79,91
	Sol Plaatjie	Traditional	129	0,18	36,58
	Thembelihle	Traditional	61	1,30	71,69
	Tsantsabane	Traditional	36	0,30	79,02
	Ubuntu	Traditional	11	0,18	100,18
	Umsobomvu	Traditional	15	0,15	100,06
Free State	Kopanong	Traditional	43	0,23	79,77
	Letsemeng	Traditional	10	0,07	100,08
	Masilonyana	Traditional	48	0,21	61,75
	Metsimaholo	Traditional	46	0,08	71,84
	Mohokare	Traditional	13	0,11	100,03

Province	Municipality	Type of main dwelling	Weighted count of Households	Percentage	Coefficient of variation of percentage
	Moqhaka	Traditional	108	0,20	34,15
	Naledi	Traditional	133	1,59	39,08
	Ngwathe	Traditional	108	0,26	38,75
	Tswelopele	Traditional	13	0,10	100,00
KwaZulu-Natal	Emadlangeni	Informal	97	1,45	57,72
	Ezingoleni	Informal	29	0,27	64,40
	Mpofana	Informal	174	1,50	46,37
	Msinga	Informal	220	0,54	36,05
	Nkandla	Informal	91	0,42	42,45
North West	Kgetlengrivier	Traditional	45	0,24	99,92
	Lekwa-Teemane	Traditional	63	0,38	73,38
	Mamusa	Traditional	57	0,37	49,51
	Maquassi Hills	Traditional	68	0,28	54,83
	Naledi	Traditional	130	0,63	35,20
	Ventersdorp	Traditional	21	0,12	100,01
Gauteng	Lesedi	Traditional	438	1,12	35,48
	Midvaal	Traditional	51	0,13	71,71
	Mogale City	Traditional	165	0,11	41,81
	Randfontein	Traditional	163	0,29	34,84
	Westonaria	Traditional	87	0,19	42,55
Mpumalanga	Dipaleseng	Traditional	30	0,20	75,36
	Victor Khanye	Traditional	288	1,18	33,81
Limpopo	Bela-Bela	Traditional	17	0,08	84,52
	Modimolle	Traditional	116	0,63	42,22
	Molemole	Traditional	93	0,31	37,31
	Mookgopong	Traditional	249	2,40	69,83
	Thabazimbi	Traditional	253	0,71	38,88

These high CVs are due in general to the relatively small numbers of particular dwelling types in some municipalities. In order to improve the reliability of estimates for the type of main dwelling variable, analysts should consider collapsing sparse categories (see Appendix F for CVs at municipal level).

8.2.2.2. Water source

National and provincial estimates

Table 8.12 looks at the measures of precision achieved at both national and provincial level for the household water source. Both the national and provincial estimates are well within the thresholds based on the model given in Figure 8.1 and therefore are reliable for publication.

Table 8.12: National and provincial estimates of the type of main dwelling including measures of precision

Province	Water source	Raw count of persons	Weighted count of persons	Percentage	Standard error of percentage	Coefficient of variation of percentage
Western Cape	Piped water inside dwelling	64 896	1 487 774	76,93	0,16	0,21
	Piped water inside yard	11 485	232 892	12,04	0,12	1,01
	Piped water from access point outside the yard	9 085	204 414	10,57	0,12	1,12
	No access to piped water	394	8 797	0,45	0,03	5,99
Eastern Cape	Piped water inside dwelling	35 324	592 428	33,41	0,17	0,49
	Piped water inside yard	32 650	433 028	24,42	0,14	0,56
	Piped water from access point outside the yard	35 726	429 037	24,19	0,13	0,55
	No access to piped water	30 466	318 902	17,98	0,11	0,63
Northern Cape	Piped water inside dwelling	9 429	154 529	43,69	0,38	0,88
	Piped water inside yard	8 047	129 197	36,53	0,37	1,02
	Piped water from access point outside the yard	4 585	64 272	18,17	0,29	1,58
	No access to piped water	340	5 710	1,61	0,14	8,83
Free State	Piped water inside dwelling	20 957	357 926	37,81	0,23	0,61
	Piped water inside yard	35 101	519 086	54,83	0,23	0,42
	Piped water from access point outside the yard	3 776	62 136	6,56	0,12	1,76
	No access to piped water	491	7 490	0,79	0,04	4,99
KwaZulu-Natal	Piped water inside dwelling	61 544	1 076 667	37,44	0,13	0,34
	Piped water inside yard	61 430	965 066	33,56	0,12	0,36
	Piped water from access point outside the yard	39 772	616 299	21,43	0,11	0,49
	No access to piped water	16 642	217 811	7,57	0,06	0,85
North West	Piped water inside dwelling	15 739	300 221	24,04	0,20	0,82
	Piped water inside yard	36 340	616 426	49,36	0,22	0,45
	Piped water from access point outside the yard	19 897	310 170	24,84	0,18	0,72
	No access to piped water	1 140	21 950	1,76	0,06	3,56
Gauteng	Piped water inside dwelling	140 404	2 972 973	60,05	0,11	0,19
	Piped water inside yard	81 372	1 568 039	31,67	0,11	0,34
	Piped water from access point outside the yard	19 885	396 334	8,00	0,06	0,79
	No access to piped water	647	13 792	0,28	0,02	5,40
Mpumalanga	Piped water inside dwelling	18 238	359 033	28,98	0,21	0,73
	Piped water inside yard	40 937	630 078	50,86	0,21	0,42
	Piped water from access point outside the yard	12 960	207 087	16,72	0,15	0,92
	No access to piped water	2 758	42 663	3,44	0,08	2,24
Limpopo	Piped water inside dwelling	13 216	210 302	13,14	0,12	0,91
	Piped water inside yard	50 589	721 579	45,07	0,16	0,36
	Piped water from access point outside the yard	40 230	562 950	35,16	0,16	0,45
	No access to piped water	7 951	106 251	6,64	0,08	1,19
South Africa	**Piped water inside dwelling**	**379 747**	**7 511 853**	**44,39**	**0,06**	**0,14**
	Piped water inside yard	**357 951**	**5 815 391**	**34,36**	**0,05**	**0,16**
	Piped water from access point outside the yard	**185 916**	**2 852 700**	**16,86**	**0,04**	**0,25**
	No access to piped water	**60 829**	**743 366**	**4,39**	**0,02**	**0,47**

Municipal estimates

Applying the model as given in Figure 8.1 for the precision estimates of water source at municipal level, municipalities can be categorised according to the level of reliability of the estimates produced as given in Table 8.13 below.

Table 8.13: Municipalities by CV thresholds for water source

Province	Water source	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
Western Cape	Piped water inside dwelling	25	0	0
	Piped water inside yard	24	1	0
	Piped water from access point outside the yard	15	6	4
	No access to piped water	1	13	11
Eastern Cape	Piped water inside dwelling	35	4	0
	Piped water inside yard	38	1	0
	Piped water from access point outside the yard	30	6	3
	No access to piped water	22	5	11
Northern Cape	Piped water inside dwelling	27	0	0
	Piped water inside yard	27	0	0
	Piped water from access point outside the yard	10	12	5
	No access to piped water	1	5	18
Free State	Piped water inside dwelling	20	0	0
	Piped water inside yard	20	0	0
	Piped water from access point outside the yard	16	4	0
	No access to piped water	2	7	9
KwaZulu-Natal	Piped water inside dwelling	41	10	0
	Piped water inside yard	51	0	0
	Piped water from access point outside the yard	49	2	0
	No access to piped water	43	6	2
North West	Piped water inside dwelling	18	1	0
	Piped water inside yard	19	0	0
	Piped water from access point outside the yard	17	2	0
	No access to piped water	7	6	6
Gauteng	Piped water inside dwelling	10	0	0
	Piped water inside yard	10	0	0
	Piped water from access point outside the yard	10	0	0
	No access to piped water	3	4	3
Mpumalanga	Piped water inside dwelling	18	0	0
	Piped water inside yard	18	0	0
	Piped water from access point outside the yard	18	0	0

Province	Water source	CV Thresholds		
		CV ≤ 16.5% (Reliable)	16.6% ≤ CV < 33.4% (Use with caution)	CV ≥ 33.5% (Unreliable)
	No access to piped water	11	5	2
Limpopo	Piped water inside dwelling	23	2	0
	Piped water inside yard	25	0	0
	Piped water from access point outside the yard	24	1	0
	No access to piped water	19	5	1
South Africa	**Piped water inside dwelling**	**217**	**17**	**0**
	Piped water inside yard	**232**	**2**	**0**
	Piped water from access point outside the yard	**189**	**33**	**12**
	No access to piped water	**109**	**56**	**63**

The majority of the municipalities across provinces have reliable estimates in the four categories of water source. There are however, some municipalities distributed across provinces with estimates that should be used with caution (see Table 8.13 above). Furthermore, there are municipalities who have survey estimates that are unreliable for certain categories of water source (see Table 8.14 for the list of these municipalities).

Table 8.14: Municipalities with unreliable estimates for water source

Province	Municipality	Type of main dwelling	Weighted count of Households	Percentage	Coefficient of variation of percentage
Western Cape	Bergrivier	No access to piped water	155	0,81	38,47
	Bitou	No access to piped water	494	2,25	36,68
	Drakenstein	No access to piped water	68	0,09	51,98
	Kannaland	Piped water from access point outside the yard	107	1,68	45,45
	Laingsburg	No access to piped water	31	1,09	92,02
	Laingsburg	Piped water from access point outside the yard	27	0,93	99,70
	Langeberg	No access to piped water	359	1,26	35,76
	Matzikama	No access to piped water	192	0,92	34,25
	Mossel Bay	No access to piped water	146	0,46	43,03
	Prince Albert	No access to piped water	28	0,67	76,51
	Prince Albert	Piped water from access point outside the yard	30	0,73	72,19
	Stellenbosch	No access to piped water	251	0,48	61,38
	Swellendam	No access to piped water	89	0,77	53,81
	Swellendam	Piped water from access point outside the yard	169	1,45	43,43
	Witzenberg	No access to piped water	194	0,54	42,85
Eastern Cape	Baviaans	No access to piped water	55	1,19	58,13
	Baviaans	Piped water from access point outside the yard	218	4,69	48,36
	Blue Crane Route	No access to piped water	295	2,99	40,59
	Camdeboo	Piped water from access point outside the yard	95	0,72	43,02
	Gariep	No access to piped water	12	0,13	100,04
	Ikwezi	No access to piped water	14	0,46	100,14

Province	Municipality	Type of main dwelling	Weighted count of Households	Percentage	Coefficient of variation of percentage
	Ikwezi	Piped water from access point outside the yard	102	3,44	69,85
	Inkwanca	No access to piped water	40	0,66	99,61
	Inxuba Yethemba	No access to piped water	120	0,66	45,22
	Kouga	No access to piped water	61	0,17	54,37
	Makana	No access to piped water	587	2,59	33,69
	Maletswai	No access to piped water	50	0,36	55,59
	Nxuba	No access to piped water	48	0,75	64,18
	Tsolwana	No access to piped water	36	0,40	56,51
Northern Cape	!Kheis	No access to piped water	119	2,73	42,92
	//Khara Hais	No access to piped water	171	0,64	39,95
	Dikgatlong	No access to piped water	177	1,20	33,65
	Emthanjeni	No access to piped water	12	0,10	43,79
	Gamagara	No access to piped water	122	0,77	51,20
	Hantam	No access to piped water	56	0,82	71,85
	Kamiesberg	No access to piped water	40	1,21	70,88
	Kamiesberg	Piped water from access point outside the yard	94	2,84	60,18
	Kareeberg	No access to piped water	58	1,57	70,81
	Kareeberg	Piped water from access point outside the yard	228	6,20	40,18
	Karoo Hoogland	Piped water from access point outside the yard	81	1,74	46,88
	Khâi-Ma	No access to piped water	96	2,33	52,19
	Khâi-Ma	Piped water from access point outside the yard	66	1,62	64,54
	Magareng	No access to piped water	64	0,92	58,97
	Mier	No access to piped water	62	3,06	57,14
	Nama Khoi	No access to piped water	142	0,97	46,38
	Renosterberg	No access to piped water	28	0,79	99,73
	Renosterberg	Piped water from access point outside the yard	154	4,31	34,88
	Richtersveld	No access to piped water	96	2,29	41,18
	Sol Plaatjie	No access to piped water	303	0,42	49,16
	Thembelihle	No access to piped water	79	1,67	59,21
	Ubuntu	No access to piped water	14	0,23	100,12
	Umsobomvu	No access to piped water	4	0,04	100,18
Free State	Kopanong	No access to piped water	90	0,49	43,61
	Letsemeng	No access to piped water	65	0,46	61,44
	Mafube	No access to piped water	85	0,45	48,57
	Mantsopa	No access to piped water	83	0,49	42,84
	Metsimaholo	No access to piped water	67	0,11	51,30
	Mohokare	No access to piped water	35	0,28	70,88
	Moqhaka	No access to piped water	223	0,42	35,70
	Naledi	No access to piped water	32	0,38	70,66
	Tswelopele	No access to piped water	191	1,40	33,93
KwaZulu-Natal	Umdoni	No access to piped water	100	0,38	44,00
	uMhlathuze	No access to piped water	117	0,11	38,29
North West	Kgetlengrivier	No access to piped water	131	0,70	35,98
	Lekwa-Teemane	No access to piped water	43	0,26	58,24
	Mamusa	No access to piped water	87	0,56	38,83
	Maquassi Hills	No access to piped water	104	0,43	46,42
	Naledi	No access to piped water	113	0,55	41,67
	Ventersdorp	No access to piped water	183	1,07	36,72
Gauteng	Lesedi	No access to piped water	214	0,55	36,58
	Midvaal	No access to piped water	60	0,16	58,82
	Mogale City	No access to piped water	614	0,42	40,12
Mpumalanga	Dipaleseng	No access to piped water	70	0,47	48,44
	Lekwa	No access to piped water	148	0,40	36,42
Limpopo	Bela-Bela	No access to piped water	307	1,44	40,90

From Table 8.14 above, categories of water source with relatively smaller sample sizes in these municipalities have high CVs and therefore the estimates are unreliable. In order to improve the reliability of estimates for the type of main dwelling variable, analysts should consider collapsing sparse categories (see Appendix G for CVs at municipal level).

8.3. Note on analysis of domains

The analysis given in the sections above show that survey estimates for all categories of the key variables at national and provincial level are reliable. At municipal level, however there are some categories where caution needs to be exercised when interpreting the survey estimates, due to the relatively small number of units within these cells (see Table 8.11 and 8.14 above). In addition, when cross tabulating these variables with other analysis variables for analysing particular domains the cell sizes will be further reduced. This effect will be greater at local municipality level and therefore analysts are cautioned that any analysis of particular domains especially at local municipality level need to have adequate sample sizes within each cell in order to obtain reliable survey estimates. If cell sizes are too small, analysts should try to collapse some cells to increase the cell sizes.

9. Appendices

Appendix A:	Response Rates at Local Municipality Level
Appendix B:	Out-of-Scope Rates at Local Municipality Level
Appendix C:	Precision Estimates at Local Municipality Level for Educational Attendance
Appendix D:	Precision Estimates for Highest Level of Education by Key Demographic Variables Nationally
Appendix E:	Precision Estimates at Local Municipality Level for Highest level of Education
Appendix F:	Precision Estimates at Local Municipality Level for Main Dwelling Type
Appendix G:	Precision Estimates at Local Municipality Level for Main Source of Water

NB: All appendices are available on the CS 2016 webpage. If you are using an electronic version of this report, please click here to access the appendices.

10. References

1) Project Charter, Community Survey 2016. Statistics South Africa.

2) Data Collection Methodology, Community Survey 2016. Statistics South Africa.

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4) Field Training Plan, Community Survey 2016. Statistics South Africa.

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6) Weighting Accountability Report, Community Survey 2016. Statistics South Africa.

7) Dwelling Units Sampling Report, Community Survey 2016. Statistics South Africa.

8) Standard on Calculation of Response Rates for Household Surveys. December 2011. Statistics South Africa.

9) Standard on Classification of Result Codes for Enumeration of Households. March 2016. Statistics South Africa.