

Microdata User Guide

Survey of Principals

2004/05

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1.0 Administration

The Survey of Principals (SOP) was conducted jointly by Statistics Canada and a team of researchers from Faculties of Education in universities across the country (Université de Montréal, University of Toronto, Simon Fraser University and Université de Sherbrooke). The survey is part of a research project sponsored by the Social Sciences and Humanities Research Council of Canada (SSHRC). SSHRC is an arms-length federal agency that promotes and supports university-based research and training in the social sciences and humanities.

Any questions about the data set or its use should be directed to:

Statistics Canada
Client Services
Centre for Education Statistics
Telephone: (613) 951-7608 or call toll free 1 800 307-3382
Fax: (613) 951-9040
E-mail: educationstats@statcan.ca

2.0 Authority

The SOP was conducted under the authority of the Statistics Act, Chapter S-19, Revised Statutes of Canada 1985. Collection plans for the survey conformed with the requirement of Treasury Board Circular 1986-19, Government Information Collection and Public Opinion Research, and were registered under collection registration number STC/ECT-165-75359.

3.0 Background

The SOP, the first survey of its kind in Canada, was conducted in 2004/2005 to collect data on the impact of different changes observed in education such as curriculum changes, budget reductions, new policy directives on teaching and the work of principals in elementary and secondary schools across Canada. The drive for the SOP came from a group of university researchers. The survey was conducted jointly by Statistics Canada and a team of researchers from Faculties of Education in universities across the country and is part of a research program sponsored by the Social Sciences and Humanities Research Council of Canada (SSHRC). The research program is titled “Current Trends in the Evolution of School Personnel in Canadian Elementary and Secondary Schools”. To learn more, please visit the project’s website:

www.teachcan.ca

4.0 Objectives

The main objective of this survey is to evaluate the impact of different changes observed in education such as curriculum changes, budget reductions, new policy directives on teaching and the work of principals in Canadian schools. The survey data includes information on principals, their situations and professional practices, the transformations which affect their training, their competencies, as well as their daily work and their interactions with students and other educational partners.

The data will be useful to researchers, policy-makers, provincial and territorial departments or ministries of education, school boards and districts, principals and teachers and will help shape the future of education policy.

5.0 Content

The target population of the Survey of Principals consists of all principals of elementary and secondary schools in Canada who held their jobs at the start of the 2004-05 school year, excluding principals of continuing education/adult day schools, trade/vocational schools, language and cultural educational schools, home schools, community education centres, social service centres, distance education centres, virtual schools and schools located in First Nations communities. It includes schools in all provinces and territories.

A sample of 4,800 schools was invited to participate in the survey. Participation in the survey was voluntary. Questionnaires were mailed out to school principals in late October 2004.

A reproduction of the questionnaire is available in Appendix A.

The questionnaire was divided in six sections:

- 1) **Socio-demographic information and characteristics of the school** (questions concerning the social characteristics of the principals such as age, level of education, years of experience, etc.; questions concerning the personnel and the public at the school, such as the social origin of the students, the percentage of students who drop out, the ethnicity of the teaching personnel, etc.);
- 2) **Perception of change and its impact** (questions concerning the way principals perceive the changes that have happened in the school setting these past ten years and the repercussions of these changes on their work and on the working of the school);
- 3) **Duties and responsibilities** (questions aimed at describing principals' work: not only the work that they say they actually accomplish but they work that ideally they would like to accomplish);
- 4) **Social relations in schools** (questions aimed at describing the relationships between the different actors present in the school);

5) **Professional integration and development** (questions looking at the recruitment, integration and professional development of new teachers and new principals. For example, we ask principals in what way new teachers at the school are welcomed into the school and in what way they also benefited from this welcome when they became principal);

6) **Projects and educational goals** (questions aimed at understanding the educational orientation of the school from the perspective of the educational objectives that are valued).

6.0 Uses

The microdata file has been made available to researchers from the Faculties of Education at the Université de Montréal, University of Toronto, Simon Fraser University and Université de Sherbrooke. The information will be used to evaluate the impact of different changes observed in education such as curriculum changes, budget reductions, new policy directives on teaching and the work of principals in Canadian schools. Plans are in place to eventually make the data available through the RDC's (Research Data Centres).

This survey will result in the publication of analytical studies related to the impact of different changes observed in education and will provide information that will help shape the future of education policy.

7.0 Data collection

Data collection took place from October 2003 to February 2004. Questionnaires were mailed to principals directly. The principals provided both the data available to them as well as their views on teaching conditions. They were asked to complete the questionnaire and mail it back using the envelope provided.

Although participation in the survey was voluntary, a reminder fax was sent to respondents, followed by telephone calls to encourage their participation. For cases in which the timing of the interviewer's call was inconvenient, an appointment was arranged to call back at a more convenient time.

If respondents were adamant about not having the time to complete the questionnaire, then they were offered the option of responding to as many of the six sections of the questionnaire as possible, based on a ranking in order of importance.

8.0 Data processing

This chapter presents a brief summary of the processing steps involved in producing the microdata file.

8.1 Data capture

Responses to survey questions were captured using Intelligent Character Recognition (ICR). The ICR technology combines automated data entry (which uses optical character, mark and image recognition) with supplementary manual capture by operators who ‘key from image’ some of the survey information using a heads-up data capture approach.

To ensure the quality of the captured data using ICR, all write-in fields were double keyed for accuracy and a 20% quality control procedure was employed. For every batch of captured questionnaires processed by the quality control operation, 20% of the questionnaires were sampled and the images of these selected questionnaires were compared to the actual data.

Range edits were programmed for the capture of the data. If information entered was outside of the range (too large or small) of expected values, or produced an inconsistency, then the data would have been verified and changed or not accepted.

8.2 Data editing and outlier detection

The data editing and outlier detection phases of processing involve the identification of erroneous or inconsistent values in the survey data, and the modification of such conditions.

The first type of error treated involved editing the survey records according to pre-specified edit rules to check for logical inconsistencies in the survey data. In these cases a strategy was designed to eliminate the minimum amount of data, establishing priorities so as to eliminate the values that were most likely to be in error. Several questions had multiple parts that should have added up to a total provided in another question or alternatively to a total of 100% in questions that asked for a breakdown by proportion. These questions were checked by a simple summing of responses. In other cases it was possible to infer that a response had to be less than a quantity provided for a related question. For these cases, errors were flagged whenever the second value was greater than the first. For example, the number of students in a specific school with access to special services cannot exceed that specific school’s enrolment. In the example mentioned, it was discovered that some principals had mistakenly reported in percentages and the proper value could be imputed based on the responses given; so, if the school’s enrolment is two hundred and the principal mistakenly reported that 50% of students had

access to special services instead of providing a number than the value of 100= 50%*200 could be imputed.

The second component of the editing process targeted the resolution of multiple answers to the Likert-type scale questions (Questions 1-3 in Section 4 for example). In responding to these questions, some respondents marked multiple categories. For each of these records with multiple responses, the leftmost or first answer was selected.

The third type of error treated involved editing the records with unusual values. Error detection was done both through pre-specified rules such as ratio checks and by a check of largest and smallest values. As an example of a specified rule, a flag was set up to highlight schools indicating that more than half of their student body arrived in Canada less than a year ago. Editing was based both on type of school and nearby similar schools.

9.0 Survey methodology

This chapter defines the population of interest, how it is identified and contacted as well as the method by which it will be surveyed.

9.1 Target population

The target population of the Survey of Principals (SOP) consists of all principals of elementary and secondary schools in Canada who held their jobs at the start of the 2004/05 school year, excluding principals of continuing education/adult day schools, trade/vocational schools, language and cultural educational schools, home schools, community education centres, social service centres, distance education centres, virtual schools and schools located in First Nations communities. It includes schools in all provinces and territories.

9.1.1 Frame

The target population is accessed through the survey frame. For the 2005 SOP the frame was a list of schools, not a list of principals, as a list of principals was not available. The frame used is the 2002 Institution File: an administrative database of all Canadian elementary and secondary schools maintained by the Centre for Education Statistics (CES) of Statistics Canada. The Institution File contains a variety of information about each school including contact information, the minimum and maximum grades of the school, how the school is funded, and the number of students in the school. CES gathers information from the most up to date sources reporting on elementary and secondary schools in Canada every year in order to update the previous year's Institution File. Requests are then sent out to provincial ministries and/or school principals to update each school's information on the file. The Institution File that was used to create the survey frame for the SOP contained all updates received through to the summer of 2004 for those schools already on the frame. The SOP frame was also modified to eliminate out of

scope schools that were identified during work on the Information and Communications Technologies in Schools Survey (ICTSS) of 2003-2004, which used an earlier version of the same Institution File as its frame.

9.2 Sample design

Based on the objectives, constraints and budget for this survey, it was decided to select a sample of schools as opposed to a census of schools. In order to obtain reliable estimates within certain subpopulations of interest for this survey, the list of schools was stratified based on the region and grade level of the schools. The following six regions and three grade levels were considered for stratification:

Six regions

- Atlantic Provinces: Newfoundland and Labrador, New Brunswick, Nova Scotia and Prince Edward Island
- Quebec
- Ontario
- Prairie Provinces: Manitoba, Saskatchewan and Alberta
- British Columbia
- Territories: Yukon , North West Territories and Nunavut

Three grade levels

- Elementary
- Secondary
- Mixed

In the end, there were 16 strata: three grade levels per region for all regions except the territories, where all schools were considered together.

Table 9.1
Stratification

1- Atlantic-Elementary
2- Atlantic-Secondary
3- Atlantic Mixed
4- Quebec-Elementary
5- Quebec-Secondary
6- Quebec-Mixed
7- Ontario-Elementary
8- Ontario-Secondary
9- Ontario-Mixed
10- Prairies-Elementary
11- Prairies-Secondary
12- Prairies-Mixed
13- B.C.-Elementary
14- B.C.-Secondary
15- B.C.-Mixed
16- Territories

For this survey, a sample of 2,000 respondents was targeted. Using the regional response rates from ICTSS, it was determined that a sample of 4,800 schools would likely be enough to provide the desired 2,000 respondents.

The sample of 4,800 schools was allocated to the 16 strata in order to aim to obtain coefficients of variation (CVs) less than or equal to 16% for proportions as small as 10% in as many strata as possible. Considering the small number of schools in the territories, a census of the schools was taken in that stratum. The remaining schools were allocated to the other 15 strata using a two-phase approach. A first phase of allocation, proportional to the square-root of the number of schools in each region, was followed by a second phase proportional to the number of schools in each grade level within each region. Compared to the other potential allocations, this one provided better overall CVs at the regional and national level without having any significant impact on the reliability of the estimates in the smaller strata. Tables 9.2 and 9.3 show the population size and the sample allocated by region and grade level.

Table 9.2
Number of schools by region and grade level

Population	Elementary	Secondary	Mixed	Total
Atlantic	689	317	202	1,208
Quebec	2,216	604	139	2,959
Ontario	4,182	1,134	231	5,547
Prairies	1,525	745	1,165	3,435
British Columbia	1,305	494	175	1,974
Territories	47	20	54	121
Total	9,964	3,314	1,966	15,244

Table 9.3
Sample size by region and grade level

Sample	Elementary	Secondary	Mixed	Total
Atlantic	349	161	102	612
Quebec	716	195	45	956
Ontario	981	266	54	1,301
Prairies	455	223	348	1,026
British Columbia	518	196	70	784
Territories	47	20	54	121
Total	3,066	1,061	673	4,800

Sample selection

Within each of the 16 strata created by region and grade level, the schools were sorted by the key auxiliary variables: language of instruction, funding type (public/private), size (of enrolment) and location (urban/rural), in that order. The sample was then obtained using a systematic sampling of schools within each stratum. This method of sample selection ensures that the schools chosen are representative of the explicit main variables (region and grade level), as well as the implicit key variables that were used to sort the frame prior to selection.

The user should note that the schools listed on the frame were the sampled units but the school principals were the responding units. In the case where a principal was in charge of multiple schools selected in the sample, the principal had to respond for each of his or her chosen schools given that certain questions are school specific.

10.0 Data quality

This chapter provides the user with information about the various factors affecting the quality of the survey data. In a standard sample survey, there are two main types of errors: sampling errors and non-sampling errors. A sampling error is the difference between an estimate derived from a sample and the estimate that would have been obtained from a census that used the same collection procedures. All other types of errors are referred to as non-sampling errors. These include frame coverage problems, non-response and processing errors, which are discussed in the sections below.

10.1 Response rates

Survey response rates are measures of the effectiveness of the collection process and are also good indicators of the quality of the estimates produced. With the time constraints of the job and the volume of surveys confronting them it is difficult to achieve high response rates when the respondents are school principals. Therefore, several methods were put in place to encourage response. School boards were notified in advance of the survey and a fax reminder was sent 21 days after sending out questionnaires for those schools which had not yet responded. Telephone follow-ups were started 10 days after the fax reminder follow-ups were done. Submission of answers via facsimile machine, as opposed to the required mail-back option, was offered at this time in order to increase the response rate. The final resolved rate was 56%, where resolved cases are those where contact with the potential respondent has been made or the out-of-scope status of the schools was determined. A respondent was defined as anyone who had completed at least Section 1 of the survey. There were 2,230 responding principals out of the 4,658 in-scope principals in the sample for a response rate of 47.9%. There were 2144 principals out of the 2230 who responded that allowed their data to be shared with the universities sponsoring this study for a sharing rate of 96.1%.

Table 10.1
Number of resolved cases

Sample Sent	Resolved cases			Unresolved cases (no answer)	Resolved Rate
	Out-of-scope	Refusals	Responses		
4,800	142	329	2,230	2,099	56%

Table 10.2
Response rates by region and grade level

Region	Grade Level	Inscope Schools	Respondents		Sharers	
			Count	Rate %	Count	Rate %
Canada	Total	4,658	2,230	47.9	2,144	96.1
	Elementary	2,978	1,408	47.3	1,352	96.0
	Mixed	649	297	45.8	283	95.3
	Secondary	1,031	525	50.9	509	97.0
Atlantic	Total	596	345	57.9	330	95.7
	Elementary	341	199	58.4	192	96.5
	Mixed	99	50	50.5	48	96.0
	Secondary	156	96	61.5	90	93.8
Quebec	Total	939	437	46.5	421	96.3
	Elementary	705	320	45.4	306	95.6
	Mixed	44	19	43.2	19	100.0
	Secondary	190	98	51.6	96	98.0
Ontario	Total	1,260	575	45.6	546	95.0
	Elementary	950	426	44.8	406	95.3
	Mixed	49	22	44.9	19	86.4
	Secondary	261	127	48.7	121	95.3
Prairies	Total	998	501	50.2	482	96.2
	Elementary	446	229	51.3	220	96.1
	Mixed	336	152	45.2	144	94.7
	Secondary	216	120	55.6	118	98.3
British Columbia	Total	749	315	42.1	309	98.1
	Elementary	493	211	42.8	205	97.2
	Mixed	67	28	41.8	28	100.0
	Secondary	189	76	40.2	76	100.0
Territories	Total	116	57	49.1	56	98.2
	Elementary	43	23	53.5	23	100.0
	Mixed	54	26	48.1	25	96.2
	Secondary	19	8	42.1	8	100.0

Responses rates for individual questions are known as item response. Item response rates were very good; all were over 96% with the exception of two questions with rates between 85% and 90%.

10.2 Sampling errors

The estimates derived from this survey are based on a sample of schools. The difference between the estimates obtained from the sample and the results from a complete census taken under similar conditions is called the sampling error of the estimate. Since it is an unavoidable fact that estimates from a sample survey are subject to sampling error, sound statistical practice calls for researchers to provide users with some indication of the

magnitude of this sampling error. This section of the documentation outlines the measures of sampling error which Statistics Canada commonly uses and which it urges users producing estimates from this microdata file to use also.

The basis for measuring the potential size of sampling errors is the standard error of the estimates derived from survey results. However, because of the large variety of estimates that can be produced from a survey, the standard error of an estimate is usually expressed relative to the estimate to which it pertains. The commonly used CV of an estimate is obtained by expressing the standard error of the estimate as a percentage of the estimate itself. For more information on CVs please refer to Section 12.4 and chapter 13.

10.3 Non-sampling errors

There are many sources of non-sampling errors and these may occur at almost any phase of a survey operation. Employees responsible for collection may misunderstand survey instructions, respondents may misunderstand questions, or answers may have been marked incorrectly on the questionnaire. Errors may also be introduced at any point when the data is manipulated, including during the processing and tabulation of data.

For the SOP, quality assurance measures were established in order to reduce the presence of non-sampling errors as much as possible. Consultations took place in the fall of 2003 with 30 principals (individually and through focus groups) to test the questionnaire. These consultations took place in Moncton, Montreal and Toronto. The sample composition of the focus groups took the following characteristics into consideration: language of school, school level, schools with a high concentration of visible minorities, school funding, gender and years of experience of the principal. In addition, about 200 principals from different locations in Canada were invited to participate in a pilot survey in the spring of 2004. Changes to the questionnaire were made following the focus groups and pilot test. These changes focused on reducing respondent burden and improving data quality.

For more information on collection and processing procedures, refer to Chapters 7.0 and 8.0. Some of these measures provide indicators of the extent of non-sampling errors associated with the survey and are outlined below.

10.4 Coverage

The quality of the frame was assessed by examining undercoverage and overcoverage, as well as duplication of records. Difficulties arose in assessing the undercoverage of the frame as it was determined that most of the other lists to which the Institution File could be compared were either closely linked to the administrative files used to create the SOP frame, related to a previous version of these files, or lacking a common unique key. While the school frame was up-to-date for schools open at the start of the 2003-2004 school year with information for those schools being updated in the summer of 2004, there was some undetermined degree of undercoverage of schools that may have opened

during the period between the start of the 2003-2004 school year and the start of the 2004-2005 school year.

10.5 Data capture

The answers provided on the questionnaire by the principals were captured using electronic imaging. The only exceptions were questions where the principals could write in their own answers as text or on certain questionnaires where there were problems with the electronic capture of the data such as for some faxed questionnaires; in these cases data were captured with traditional keying on microcomputers. Text recognition software was used to capture the data and all answers captured, either manually or electronically, were subject to double verification.

10.6 Data editing and outlier detection

The data editing and outlier detection processes were described in Chapter 8.0.

A large portion of editing centered on Section 1 of the questionnaire as this section had the most problem areas. Questions 10 to 13 and 15 received extensive editing. Given the poor quality of the data regarding part-time employees in question 9 and question 14 in section 1, the data in these questions were not corrected and should not be used for analytical purposes. Approximately 80% of the records in Section 1 of the questionnaire had at least one correction made to the data.

The final question concerning sharing of data was also examined in depth. Some capture errors were detected including cases for which there were marks either outside of the box, in the box and not captured or alternatively missing when the signature was present. These records were adjusted manually after consideration on a case by case basis.

11.0 Weighting

11.1 Base weight

In a probability sample, the sample design itself determines initial weights which must be used to produce unbiased estimates of the population. Each unit must be weighted by the inverse of its probability of selection. In the case of a 2% simple random sample, this probability would be 0.02 for each unit and so the initial weights would be $1/0.02=50$. For this survey, the probability of selection varied by stratum (region by grade level) and the initial weights were calculated as follows:

Base weight W(1):

$$W(1) = \frac{\text{Number of schools in the stratum on the frame}}{\text{Number of schools in the stratum in the sample}}$$

11.2 Non-response adjustment

Non-response is a major source of error for a survey such as the SOP. As this class of errors is not generally random, it is important that it be minimized and also that a proper adjustment strategy be derived to compensate for the presence of systematic non-response patterns that would otherwise result in severely biased estimates. Various strategies such as refinement of the questionnaire following a field pre-test, initiating contact through a letter of introduction, non-respondent follow-up and allowing the return of surveys via mail or fax were put in place during data collection to improve response.

Several methods of treating non-response were examined and compared. Logistic regression indicated that the variables most closely related to non-response were region, grade level and size. Different manual groupings and probabilistic clusters of schools were compared using (CVs) to assess which would best reduce non-response bias. A diagnostic measure presented in the paper “A Better Understanding of Weight Transformation through a Measure of Change”¹ was used to assess the differences between the leading methods. This diagnostic measure produces a particular quantity indicating the relative reduction in non-response bias achieved by a weight-assignment model. In the end, a model that created 54 classes from the intersection of the three significant variables: region (Atlantic, Quebec, Ontario, Prairies, British Columbia, and Territories), grade level (Elementary, Secondary and Mixed) and size (Small, Medium and Large) was determined to be the best option for adjusting the weights to compensate for non-response. This model had the added bonus that no additional calibration was required as outlined in the next section. Therefore, the non-response adjustment for respondents in a given adjustment class is as follows:

Non-response adjustment W(2):

$$W(2) = \frac{\text{Number of sample units in that adjustment class in the sample}}{\text{Number of responding sample units in that adjustment class}}$$

1 Dufour, J., Gagnon, F., Morin, Y., Renaud, M. and C.-E. Särndal (2001). A Better Understanding of Weight Transformation Through a Measure of Change. *Survey Methodology*, 27, 97-108.

11.3 Calibration

Calibration estimation techniques are widely used in social surveys. They produce estimates of totals for key variables that are consistent with known population counts. This approach can also improve the quality of survey estimates if a relationship exists between the key variables used in the calibration and the variables used for the estimation. For this survey, the requirements were that totals match to the population counts by region and grade level. Since the sample was stratified at these levels and non-response classes were also defined at these levels as outlined above, no additional calibration was required.

11.4 Final weight

In general the final weight is the product of the factors that correspond to different sample selection steps or adjustments such as initial weights, non-response adjustments and calibration. In this survey, specifically, there are only the base weights and non-response adjustments, as no calibration was necessary. Therefore the final weight variable, named “cw” on the file, is calculated as follows:

$$\text{Final Weight} = W(1) \times W(2)$$

12.0 Guidelines for tabulation, analysis and release

This chapter provides an overview of the guidelines to be observed by users tabulating, analysing, publishing or otherwise releasing any data derived from the SOP microdata file. In particular, users of microdata following these guidelines should be able to produce the same figures as those produced by Statistics Canada.

12.1 Rounding guidelines

In order that estimates for publication or other release derived from the SOP microdata files correspond to those produced by Statistics Canada, users are urged to adhere to the following guidelines regarding the rounding of such estimates.

Estimates in the main body of a statistical table are to be rounded to the nearest hundred units using the normal rounding technique. In normal rounding, if the first digit to be dropped is from 0 to 4, the last digit to be kept is not changed. If the first digit to be dropped is from 5 to 9, the last digit to be retained is increased by one. For example, in normal rounding to the nearest hundred, if the last two digits are between 00 and 49, they are changed to 00 and the preceding digit (the hundreds digit) is left unchanged. If the last digits are between 50 and 99 they are changed to 00 and the preceding digit is incremented by 1.

Marginal sub-totals and totals in statistical tables are to be derived from their corresponding unrounded components and are then to be rounded themselves to the nearest 100 units using normal rounding.

Averages, proportions, rates and percentages are to be computed from unrounded components (i.e. numerators and/or denominators) and then are themselves **to be rounded to one decimal** using normal rounding. In normal rounding to a single digit, if the final or only digit to be dropped is 0 to 4, the last digit to be retained is not changed. If the first or only digit to be dropped is 5 to 9, the last digit to be retained is increased by 1.

Sums and differences of aggregates (or ratios) are to be derived from their corresponding unrounded components and then are to be rounded themselves to the nearest 100 units (or the nearest one decimal) using normal rounding.

In instances where, due to technical or other limitations, a rounding technique other than normal rounding is used, resulting in estimates to be published or otherwise released that differ from corresponding estimates published by Statistics Canada, users are urged to note the reason for such differences in the publication or release document(s).

Under no circumstances are unrounded estimates to be published or otherwise released by users.

12.2 Weighting guidelines

For the SOP, a sample of schools was selected using a stratified design (see Section 9.2 for more details) and a response rate of 48% was obtained at collection. Consequently, base weighting as well as non-response weighting must be taken into account when producing estimates. The base weight and the non-response adjustment are combined to form the final weight variable, called “Final Weight”, that is available to users.

When producing point estimates, including the production of ordinary statistical tables, users must apply the survey weight as outlined in Chapter 11. If the survey weight is not used, the estimates derived from the microdata cannot be considered to be representative of the target population and will not correspond to those produced by Statistics Canada. The weight assigned to each principal (school) can be viewed as the number of principals (schools) on the frame represented by that particular respondent.

For some analysis techniques, for example linear regression, logistic regression, analysis of variance or any other analysis where a measure of significance is required, it is recommended that an adjusted weight be used. The method used to adjust weights rescales them so that the average weight is 1 and the sum of all weights is equal to the number of respondents.

For example, suppose that analysis of all secondary school principals is required. The steps to re-scale the weights are as follows:

- Select all respondents from the file who have been classified as secondary school principals
- Calculate the **average** weight for these records by summing the final principal weights from the microdata file for these records and then dividing by the number of respondents who were classified as secondary school principals.
- For each of these respondents, calculate a **rescaled** weight equal to the final principal weight, divided by the **average** principal weight
- Perform the analysis for these respondents using the **rescaled** weight.

This method of rescaling weights can be useful for interpreting results provided by standard statistical software. While many analysis procedures found in statistical packages allow weights to be used, the meaning or definition of the weight in these procedures differs from that which is appropriate in the framework of a survey such as the SOP. The result is that while in many cases the point estimates produced by the packages are correct, the variance estimates that are calculated are poor. Furthermore, these estimates might not match those available from Statistics Canada due to the way certain software packages treat the weight field. Re-scaling weights can make the variances calculated by standard software packages more meaningful. One benefit of rescaling the weights is that an overestimation of a level of significance, which is very sensitive to sample size, is avoided while maintaining the same distributions as those obtained when using the final weight.

When using some standard statistical software to calculate estimates based on rescaled weights, the variability of the estimates inherent in the selection probabilities and non-response mechanism may not be taken into account. Therefore the variance estimates calculated in this way may underestimate the true variance. The calculation of precise variance estimates requires detailed knowledge of the survey stratification and assumed non-response behaviour of the survey population as well as the corresponding adjustment procedure adopted. For in depth information on calculating variance estimates for the SOP, refer to Chapter 13.0.

12.3 Categorical vs. quantitative estimates:

The unit of analysis in the SOP file is the principal. Although other estimates can be derived from the SOP, the weights attached to each record were designed to provide reliable estimates of proportions based on counts of principals (that is, counts of schools). For example the estimated proportion of principals who report being born in a certain year is more reliable than the estimated proportion of students in schools with a principal born in that year.

Before discussing how the SOP data can be tabulated and analysed, it is useful to describe the two main types of point estimates of population characteristics that can be

generated from the SOP microdata file. To simplify the discussion, it is assumed in the following descriptions that the proper set of respondents is used. In addition, the reference to a **domain** in the following discussion refers to a group of principals for which an estimate is to be generated (for example, one such domain would be the set of French speaking principals located in a particular province or territory).

12.3.1 Categorical estimates

Categorical estimates are estimates of the number or percentage of the surveyed population possessing certain characteristics or falling into some defined category.

Examples of categorical questions:

Q: What language do you speak most often at home?

R: English / French / Other-Specify

Q: Does your school have a written student evaluation policy?

R: Yes / No

12.3.2 Quantitative estimates

Quantitative estimates include estimates of totals or of means, medians and other measures of central tendency of quantities based upon some or all of the members of the surveyed population. They also specifically involve estimates of the form \hat{X}/\hat{Y} , where \hat{X} is an estimate of the surveyed population quantity total and \hat{Y} is an estimate of the number of principals in the surveyed population contributing to that total quantity, or other more complex estimates such as regression coefficients.

An example of a quantitative estimate is the average number of years of experience as an elementary school principal. The numerator is an estimate of the total years of experience of all principals as an elementary school principal and the denominator is an estimate of the total number of elementary school principals.

Examples of quantitative questions:

Q: What is the approximate total school enrolment (number of students)?

R: Total |_|_|_|_|

Q: Among your school's students and teaching staff (full-time and part-time) approximately how many of them have a mother tongue other than English or French?

R: Students |_|_|_|_| Teaching Staff |_|_|_|_|

12.3.3 Tabulation of categorical estimates

Number of principals possessing a certain characteristic

When all respondents in the domain answered the question related to the characteristic of interest (i.e. no item non-response is observed), the estimate can be obtained from the

microdata file by summing the final weights of all records in the domain possessing this characteristic.

If item non-response exists in the domain for the relevant question, the estimate can be derived in two steps, as described below. This approach is appropriate only if the observed item non-response is small (preferably less than 5%).

Step 1: Calculate the proportion of responding principals in the domain with this property (see procedure below for proportions).

Step 2: Multiply this proportion by the sum of weights for all principals in the domain.

Proportions of principals possessing a certain characteristic

(a) Add up the final weights of principals in the domain having the characteristic of interest (\hat{X}),

(b) Add up the final weights of all principals in the domain (\hat{Y}), excluding those who did not respond to the question used to identify the characteristic,

(c) Divide estimate a) by estimate b) (\hat{X} / \hat{Y}).

12.3.4 Tabulation of quantitative estimates

Estimating population totals

Population totals of quantitative variables refer to values such as the total number of students or total number of teachers. When there is no item non-response for the variable of interest for all the respondents (principals) in the domain, estimates of population totals can be obtained from the microdata file as follows:

(a) Multiply the value of the variable of interest by the final weight for each principal in the domain.

(b) Sum this quantity over all principals in the domain.

As is the case of categorical estimates, if item non-response exists in a particular domain for the variable of interest, then the estimate must be derived in two steps, as described below.

Step 1: Obtain the average value of the quantity of interest for responding principals in the domain by using the procedure below for ratios.

Step 2: Multiply this average by the sum of weights for all principals (responding and non-responding) in the domain.

Also note that this two step approach is only appropriate if the item non-response pertaining to the relevant question in the domain of interest is small.

Ratios of the form \hat{X}/\hat{Y} :

Ratio estimates represent several types of estimates. They include proportions, means (e.g., mean age of principals) and ratios of two quantitative variables (e.g., ratio of the number of students divided by the number of teachers). Ratio estimates can be obtained in the following way:

(a) Multiply the value of the variable of interest for the numerator by the final weight and sum this quantity over all records in the domain to obtain the numerator (\hat{X}), excluding those who did not respond to the variables of interest that define the numerator and the denominator.

(b) Multiply the value of the variable of interest for the denominator by the final weight and sum this quantity over all records in the domain to obtain the denominator (\hat{Y}), excluding those who did not respond to the variables of interest that define the numerator and the denominator.

(c) Divide estimate a) by estimate b) (\hat{X} / \hat{Y}).

For example, to estimate the average age of principals for elementary schools:

- Multiply the age of each elementary school principal by the final weight, then sum up this quantity over all elementary school principals (\hat{X}), excluding principals that did not provide their year of birth.
- Sum up the final weights of all elementary school principals (\hat{Y}), excluding principals that did not provide their year of birth.
- Divide the first estimate by the second estimate (\hat{X} / \hat{Y}).

Another example is the estimation of the ratio of years of experience as a principal over the total years of experience as a teacher, vice principal, principal or pedagogical consultant:

- Multiply the number of years of experience as a principal by the final weight, then sum up this quantity over all principals (\hat{X}), excluding principals that did not respond to the question regarding their years of experience.
- Multiply the total number of years of experience in the entire career as a teacher, vice principal, principal or pedagogical consultant by the final weight, then sum up this quantity over all principals (\hat{Y}), excluding principals that did not respond to the question regarding their years of experience.
- Divide the first estimate by the second estimate (\hat{X} / \hat{Y}).

12.4 Coefficient of variation release guidelines

Before releasing and/or publishing any estimate from the SOP, users should first determine the quality level of the estimate. The standard quality levels are: acceptable, marginal and unacceptable. Data quality is typically affected by both sampling and non-sampling errors.

In establishing the standard quality level of an estimate, the user should first determine the number of respondents that contributed to the calculation of the estimate. If this number is five or less, the weighted estimate should not be released, in order to respect policies regarding confidentiality. For weighted estimates, based on greater than five, respondents, users should determine the CV of the estimate as described in Chapter 13 and follow the guidelines below. These quality level guidelines should be applied to weighted rounded estimates. Any estimate of marginal or unacceptable quality level must be accompanied by a warning to caution subsequent users.

Table 12.1
Quality level guidelines based on the CV of a particular estimate

Quality Level of Estimate	Guidelines
1) Acceptable	<p>Estimates are based on more than 5 respondents and CVs in the range of 0.0% to 16.5%.</p> <p>No warning is required.</p>
2) Marginal	<p>Estimates are based on more than 5 respondents and CVs in the range of 16.6% to 33.3%.</p> <p>Estimates should be flagged with the letter M (or some similar identifier). They should be accompanied by a warning to caution subsequent users about the high level of error associated with the estimates.</p>
3) Unacceptable	<p>Estimates based on 5 or fewer respondents should not be released, in order to respect Agency policies regarding confidentiality.</p> <p>For estimates based on more than 5 respondents, but with very high CVs in excess of 33.3%, Statistics Canada recommends not releasing these estimates, due to their unacceptable level of quality. However, if the user chooses to do so, then these estimates should be flagged with the letter U (or some similar identifier) and the following warning should accompany the estimates:</p> <p>“Please be warned that these estimates [flagged with the letter U] do not meet Statistics Canada’s quality standards. Conclusions based on these data will be unreliable and, most likely, invalid. These data and any consequent findings should not be published. If the user chooses to publish these data or findings, then this disclaimer must be published with the data.”</p>

13.0 Variance calculation

As mentioned in Chapter 10 the SOP is a sample survey and estimates are subject to both sampling error and non-sampling error. Sampling error causes variability, it measures the extent to which an estimate from different possible samples of the same size and design, using the same estimator, differ from one another. The purpose of this chapter is to illustrate how the sampling variance is measured for the SOP and the importance of correctly incorporating the sample design.

13.1 Importance of the variance

The variance of an estimate is a good indicator of the estimate's quality. An estimate accompanied by a high variance is considered to be unreliable. In order to quantify the degree of variance, a relative measure of the variability is used, namely the CV.

The CV is defined as the ratio of the square root of the variance of the estimate (also known as the standard error) to the estimate itself. Suppose we have an estimate \hat{Y} then the CV of this estimate is:

$$\alpha_{\hat{Y}} = \frac{\sqrt{VAR(\hat{Y})}}{\hat{Y}}$$

The CV, as opposed to the variance, allows the analyst to compare estimates of different magnitudes on a common scale. As a result, it is possible to assess the quality of any estimate using the CV.

13.2 Calculating variance and CV of an estimate

In order to calculate the variance of estimates for this survey, the user has to take into account the survey design (stratified random sample) and the non-response adjustment. This is equivalent to calculating the variance for a two-phase design where the non-response is considered the second phase. The Generalized Estimation System (GES), a program developed at Statistics Canada, was used to compute the variance of all estimates released for this survey. It should be noted that the text, tables and equations refer to estimated variances and CVs even if this is not stated explicitly.

No tool has been developed for external users to compute for themselves the variance of SOP estimates. Users wishing to estimate variances and CVs may contact Statistics Canada and ask that CV estimates be derived on a cost-recovery basis.

However, as an indication of the quality of the estimates for this survey, tables of CVs produced for a variety of estimates are presented below. The CVs presented are estimates for proportions only. For example, in Table 13.1.1, the CV for the proportion of principals who responded “To a little extent” or “Not at all” for the aspect “Student

Table 13.1.1
Estimated CVs by region for question 4 in Section 2.

"To what extent do you believe that the changes that occurred in the previous decade will have a positive impact on the following aspects at your school?"

Box	Aspect	Response Description	Canada	Atlantic	Que.	Ont.	Prairies	B.C.	Territories
						%			
2245	Student Learning	“To a little extent” or “Not at all”	4.8	9.5	13.2	8.7	9.7	11.0	17.9
		“To a great extent” or “To a certain extent”	1.0	2.4	1.7	2.2	2.1	2.7	5.9
2246	Student Integration into society	“To a little extent” or “Not at all”	3.3	7.2	11.4	5.3	6.6	8.3	13.8
		“To a great extent” or “To a certain extent”	1.5	3.3	2.0	3.6	3.2	3.5	8.1
2247	The professionalism of teachers	“To a little extent” or “Not at all”	3.1	9.6	8.4	5.6	6.8	5.7	18.5
		“To a great extent” or “To a certain extent”	1.6	2.5	2.7	3.3	3.0	5.1	7.7
2248	Your duties as school principal	“To a little extent” or “Not at all”	3.8	8.9	9.5	6.6	8.1	8.4	22.5
		“To a great extent” or “To a certain extent”	1.3	2.6	2.4	2.8	2.5	3.5	6.2
2249	The effectiveness of the school system	“To a little extent” or “Not at all”	3.2	7.4	7.2	6.1	6.4	7.4	14.8
		“To a great extent” or “To a certain extent”	1.6	3.1	3.1	3.1	3.1	4.0	8.9
2250	Relationships with parents	“To a little extent” or “Not at all”	3.1	7.7	8.6	5.2	6.5	7.8	13.7
		“To a great extent” or “To a certain extent”	1.6	3.0	2.6	3.5	3.0	3.7	9.2
2251	Recognition of the school’s mission statement	“To a little extent” or “Not at all”	3.1	7.6	10.0	5.3	5.9	7.4	14.1
		“To a great extent” or “To a certain extent”	1.5	3.1	2.2	3.5	3.4	3.9	9.3

Learning” for Question 4 in Section 2 of the questionnaire is 4.8%.

The following estimates are based on the 2,144 respondents identified as sharers. The CVs for cells containing an ‘x’ have been suppressed due to the fact that five or less records contributed to the corresponding cell point estimates for these cells.

Table 13.1.2
Estimated CVs by grade level and location for question 4 in Section 2.

"To what extent do you believe that the changes that occurred in the previous decade will have a positive impact on the following aspects at your school?"

Box	Aspect	Response Description	Canada	Grade Level			Location	
				Elementary	Mixed	Secondary	Rural	Urban
				%				
2245	Student Learning	“To a little extent” or “Not at all”	4.8	6.4	12.2	8.6	9.3	5.6
		“To a great extent” or “To a certain extent”	1.0	1.2	3.6	2.3	1.8	1.3
2246	Student Integration into society	“To a little extent” or “Not at all”	3.3	4.2	9.3	6.4	6.2	3.9
		“To a great extent” or “To a certain extent”	1.5	1.9	4.8	3.1	2.9	1.8
2247	The professionalism of teachers	“To a little extent” or “Not at all”	3.1	4.1	9.7	5.6	6.4	3.6
		“To a great extent” or “To a certain extent”	1.6	1.9	4.5	3.4	2.7	1.9
2248	Your duties as school principal	“To a little extent” or “Not at all”	3.8	4.8	11.5	7.1	7.1	4.5
		“To a great extent” or “To a certain extent”	1.3	1.6	3.9	2.8	2.4	1.6
2249	The effectiveness of the school system	“To a little extent” or “Not at all”	3.2	4.2	8.9	5.8	6.2	3.7
		“To a great extent” or “To a certain extent”	1.6	1.9	5.0	3.4	2.7	1.9
2250	Relationships with parents	“To a little extent” or “Not at all”	3.1	4.2	8.2	5.8	5.8	3.8
		“To a great extent” or “To a certain extent”	1.6	1.8	5.3	3.5	2.9	1.9
2251	Recognition of the school's mission statement	“To a little extent” or “Not at all”	3.1	4.0	8.4	6.1	6.1	3.7
		“To a great extent” or “To a certain extent”	1.5	1.9	4.9	3.2	2.8	1.9

Table 13.2.1
Estimated CVs by region for question 2 in Section 3.

"Please rate your overall level of satisfaction with: "

Box	Topic	Response Description	Canada	Atlantic	Que.	Ont.	Prairies	B.C.	Territories
%									
3262	Support from my supervisors	"Somewhat unsatisfied" or "Very unsatisfied"	5.4	11.8	11.3	12.9	10.3	11.7	29.0
		"Very satisfied" or "Somewhat satisfied"	0.9	2.0	2.1	1.7	2.0	2.6	4.8
3263	My workload	"Somewhat unsatisfied" or "Very unsatisfied"	2.0	4.1	4.1	3.6	4.9	5.4	12.2
		"Very satisfied" or "Somewhat satisfied"	2.3	5.5	5.2	4.9	3.9	5.3	8.4
3264	Level of remuneration	"Somewhat unsatisfied" or "Very unsatisfied"	2.3	4.0	4.2	5.1	4.6	6.8	18.9
		"Very satisfied" or "Somewhat satisfied"	2.0	5.9	5.0	3.5	4.1	4.1	5.5
3265	The acknowledgement of my occupation	"Somewhat unsatisfied" or "Very unsatisfied"	2.7	5.3	4.9	5.8	5.2	8.2	14.5
		"Very satisfied" or "Somewhat satisfied"	1.7	4.2	4.4	3.1	3.8	3.4	7.7
3266	Impact on my family life	"Somewhat unsatisfied" or "Very unsatisfied"	1.7	3.6	3.8	3.2	3.4	4.4	10.5
		"Very satisfied" or "Somewhat satisfied"	2.9	6.6	5.9	5.6	6.0	6.6	11.6
3267	Legal standards framing my work	"Somewhat unsatisfied" or "Very unsatisfied"	2.9	5.0	7.3	5.1	5.8	8.2	14.0
		"Very satisfied" or "Somewhat satisfied"	1.8	4.8	3.2	3.7	3.5	3.8	9.9
3268	My accountability	"Somewhat unsatisfied" or "Very unsatisfied"	4.8	9.0	10.4	8.4	10.9	14.6	19.2
		"Very satisfied" or "Somewhat satisfied"	1.0	2.6	2.1	2.1	1.6	1.9	5.6
3269	My professional development	"Somewhat unsatisfied" or "Very unsatisfied"	6.0	11.3	14.6	10.7	13.1	15.8	24.9
		"Very satisfied" or "Somewhat satisfied"	0.8	2.0	1.5	1.7	1.5	1.8	6.2
3270	My professional autonomy	"Somewhat unsatisfied" or "Very unsatisfied"	4.5	9.4	11.0	7.6	11.2	11.1	14.6
		"Very satisfied" or "Somewhat satisfied"	1.0	2.4	2.0	2.3	1.7	2.6	5.7

Table 13.2.2
Estimated CVs by grade level and location for question 2 in Section 3.

"Please rate your overall level of satisfaction with: "

Box	Aspect	Response Description	Canada	Grade Level			Location	
				Elementary	Mixed	Secondary	Rural	Urban
						%		
3262	Support from my supervisors	"Somewhat unsatisfied" or "Very unsatisfied"	5.4	7.0	14.6	10.7	10.0	6.5
		"Very satisfied" or "Somewhat satisfied"	0.9	1.1	3.2	1.8	1.7	1.1
3263	My workload	"Somewhat unsatisfied" or "Very unsatisfied"	2.0	2.5	7.0	4.1	3.8	2.4
		"Very satisfied" or "Somewhat satisfied"	2.3	3.0	5.4	4.6	4.3	2.7
3264	Level of remuneration	"Somewhat unsatisfied" or "Very unsatisfied"	2.3	2.9	7.5	4.8	4.4	2.8
		"Very satisfied" or "Somewhat satisfied"	2.0	2.6	5.2	3.9	3.7	2.4
3265	The acknowledgement of my occupation	"Somewhat unsatisfied" or "Very unsatisfied"	2.7	3.3	7.6	6.0	5.3	3.2
		"Very satisfied" or "Somewhat satisfied"	1.7	2.3	4.2	3.3	3.0	2.1
3266	Impact on my family life	"Somewhat unsatisfied" or "Very unsatisfied"	1.7	2.1	5.3	3.3	3.0	2.1
		"Very satisfied" or "Somewhat satisfied"	2.9	3.6	7.8	6.1	5.8	3.3
3267	Legal standards framing my work	"Somewhat unsatisfied" or "Very unsatisfied"	2.9	3.7	9.3	5.2	5.6	3.3
		"Very satisfied" or "Somewhat satisfied"	1.8	2.2	4.7	3.9	3.1	2.1
3268	My accountability	"Somewhat unsatisfied" or "Very unsatisfied"	4.8	6.0	16.0	9.3	8.8	5.8
		"Very satisfied" or "Somewhat satisfied"	1.0	1.3	2.0	2.0	1.8	1.2
3269	My professional development	"Somewhat unsatisfied" or "Very unsatisfied"	6.0	8.0	15.0	11.3	11.7	7.0
		"Very satisfied" or "Somewhat satisfied"	0.8	0.9	2.8	1.6	1.5	0.9
3270	My professional autonomy	"Somewhat unsatisfied" or "Very unsatisfied"	4.5	5.8	13.6	8.4	8.2	5.5
		"Very satisfied" or "Somewhat satisfied"	1.0	1.3	2.8	2.2	2.1	1.2

Table 13.3

Estimated CVs by region for question 6 in Section 4.

"Listed below are different problems that may occur in a school.

To what extent does each of the following hinder the proper functioning of your school?"

Box	Problem	Response Description	Canada	Atlantic	Que.	Ont.	Prairies	B.C.	Territories
%									
4224	Conflicts among students	"To a little extent" or "Not at all"	2.0	4.5	5.4	4.1	3.6	3.5	10.2
		"To a great extent" or "To a certain extent"	2.3	5.1	4.0	4.2	5.4	7.8	9.3
4225	Bullying among students	"To a little extent" or "Not at all"	1.9	4.5	5.2	4.1	3.4	2.8	9.1
		"To a great extent" or "To a certain extent"	2.4	5.2	4.2	4.2	5.7	9.2	10.5
4226	Health problems students	"To a little extent" or "Not at all"	1.2	2.4	2.4	2.3	2.4	2.6	7.2
		"To a great extent" or "To a certain extent"	4.2	9.7	9.2	7.8	8.4	11.0	16.3
4227	Deterioration of socio-economic status of student's families	"To a little extent" or "Not at all"	2.2	4.9	6.3	3.8	4.2	5.2	15.8
		"To a great extent" or "To a certain extent"	2.2	4.6	3.5	4.8	4.8	5.6	6.7
4228	Infractions against property (vandalism, theft) by students	"To a little extent" or "Not at all"	1.1	2.4	3.0	2.1	2.3	2.3	8.8
		"To a great extent" or "To a certain extent"	4.3	10.0	7.6	8.7	9.4	13.2	13.1
4229	Students possessing weapons	"To a little extent" or "Not at all"	0.9	1.8	2.8	1.6	1.7	2.2	3.4
		"To a great extent" or "To a certain extent"	10.9	26.7	23.1	19.1	21.3	32.3	x
4230	Students' use of alcohol or drugs	"To a little extent" or "Not at all"	1.2	2.6	3.5	2.1	2.4	3.1	6.1
		"To a great extent" or "To a certain extent"	3.7	8.8	7.5	7.3	7.8	10.2	10.5
4231	Students' disrespect for teachers	"To a little extent" or "Not at all"	1.6	3.6	4.3	3.6	2.8	2.9	7.0
		"To a great extent" or "To a certain extent"	2.9	6.2	5.5	5.0	6.7	9.9	11.8
4232	Verbal abuse of physical assault of a staff member by a student	"To a little extent" or "Not at all"	1.1	2.5	3.0	2.2	2.0	2.1	6.1
		"To a great extent" or "To a certain extent"	5.1	10.5	8.6	9.8	11.7	19.2	18.6
4233	Student absenteeism	"To a little extent" or "Not at all"	1.5	3.1	3.0	2.9	3.2	3.7	16.2
		"To a great extent" or "To a certain extent"	2.9	6.8	7.0	5.3	5.6	7.2	6.5
4234	Sexism/Sexual harassment among students	"To a little extent" or "Not at all"	1.0	2.0	2.5	1.9	1.7	2.0	4.3
		"To a great extent" or "To a certain extent"	6.4	13.9	12.9	10.9	13.4	23.0	27.6
4235	Racism/Racial conflicts among students	"To a little extent" or "Not at all"	1.0	2.1	2.5	1.8	2.1	2.0	3.3
		"To a great extent" or "To a certain extent"	6.9	17.9	17.0	11.5	12.4	20.1	x
4236	Staff's use of alcohol or drugs	"To a little extent" or "Not at all"	0.9	1.9	2.6	1.6	1.6	2.1	3.1
		"To a great extent" or "To a certain extent"	13.5	28.3	29.5	23.6	27.7	x	x
4237	Teacher turnover	"To a little extent" or "Not at all"	1.4	2.9	5.1	2.5	2.1	3.2	9.1
		"To a great extent" or "To a certain extent"	3.4	8.8	4.7	7.3	9.6	9.6	11.5
4238	Teacher absenteeism	"To a little extent" or "Not at all"	1.1	1.9	3.6	2.1	1.9	2.6	3.6

4239	Disruption of classes by students	"To a great extent" or "To a certain extent"	4.2	13.3	6.2	9.1	10.1	11.5	21.1
		"To a little extent" or "Not at all"	1.5	3.5	3.1	3.2	2.9	3.0	10.9
		"To a great extent" or "To a certain extent"	3.3	6.5	8.0	5.6	6.7	9.4	11.0
4240	Student tardiness	"To a little extent" or "Not at all"	1.4	3.1	3.1	2.9	2.7	3.5	12.9
		"To a great extent" or "To a certain extent"	3.2	7.5	7.8	5.7	6.7	8.2	7.2
		"To a little extent" or "Not at all"	1.4	2.4	3.7	2.9	2.5	2.8	6.1
4241	Students dropping out	"To a great extent" or "To a certain extent"	5.2	16.7	8.3	11.5	10.1	19.2	10.3
		"To a little extent" or "Not at all"	1.5	3.0	4.1	2.8	2.9	3.1	8.0
		"To a great extent" or "To a certain extent"	3.2	7.2	5.7	6.5	6.6	9.5	8.9
4243	Conflicts between parents and teachers	"To a little extent" or "Not at all"	1.1	2.1	2.8	2.1	2.3	2.3	4.4
		"To a great extent" or "To a certain extent"	4.4	11.5	8.6	8.2	8.4	12.3	20.6
		"To a little extent" or "Not at all"	1.1	2.1	3.2	2.3	2.1	2.1	3.6
4244	Complaints from parents students	"To a great extent" or "To a certain extent"	4.2	11.3	7.3	7.8	8.8	12.6	19.0

In general, the following rules should be applied when calculating and using CVs.

Rule 1: Estimates of proportions or percentages of principals possessing a characteristic

The CVs given in the preceding tables are for proportions. Hence, they can be used directly as they are given. For other similar estimates of proportions (e.g., for other questions), the CVs in the tables above could be used as an indication but the user should contact Statistics Canada to obtain CVs calculated for those specific characteristics. Note that all CV estimates for proportions are only valid if the item non-response is small.

Rule 2: Estimates of number of principals possessing a characteristic (aggregates)

The estimated CV for the number of principals possessing a characteristic is in theory the same as that of the proportion it represents (the corresponding proportion of principals possessing a characteristic) and very close but slightly greater if item non-response is small. This relationship should not be utilised when the item non-response for the question relating to the characteristic is large and/or the size of the domain of interest is relatively small.

For example, suppose we have an estimate $\hat{Y} = 1,000$ principals possessing a certain characteristic out of the estimated total $\hat{X} = 5,000$ principals in the domain of interest, then the CV for \hat{Y} should be close to the CV of the proportion $\frac{\hat{Y}}{\hat{X}}$.

Rule 3: Estimates of differences between aggregates, percentages and ratios

The standard error of a difference between two estimates is approximately equal to the square root of the sum of squares of each standard error considered separately. In other words, the standard error of the difference $\hat{d} = \hat{X}_1 - \hat{X}_2$ is approximated by:

$$\hat{\sigma}_d = \sqrt{(\hat{X}_1 \hat{\alpha}_1)^2 + (\hat{X}_2 \hat{\alpha}_2)^2}$$

where $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are the CVs of \hat{X}_1 and \hat{X}_2 respectively. The CV of \hat{d} is given by dividing its standard error by \hat{d} itself:

$$\hat{\alpha}_d = \frac{\hat{\sigma}_d}{\hat{d}}$$

This is a good approximation for the CV of a difference between separate and uncorrelated characteristics, but it will tend to overstate the CV if \hat{X}_1 and \hat{X}_2 are positively correlated and understate the CV if \hat{X}_1 and \hat{X}_2 are negatively correlated. Estimates of CVs for correlated \hat{X}_1 and \hat{X}_2 may be obtained from Statistics Canada on a cost-recovery basis.

Rule 4: Estimates of ratios

The standard error of the ratio of the estimates is approximately equal to the square root of the sum of squares of each CV considered separately, multiplied by the ratio itself. That is, the CV of such a ratio $\hat{R} = \hat{X}_1 / \hat{X}_2$ is:

$$\hat{\alpha}_R = \sqrt{\hat{\alpha}_1^2 + \hat{\alpha}_2^2}$$

where $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are the CVs of \hat{X}_1 and \hat{X}_2 respectively. As with the CV estimate of Rule 3, this estimate will tend to overstate the CV if \hat{X}_1 and \hat{X}_2 are positively correlated and understate the CV if \hat{X}_1 and \hat{X}_2 are negatively correlated.

Rule 5: Estimates of differences of ratios

This is simply a combination of Rules 3 and 4. The CVs for the two ratios are first determined using Rule 4 and then the CV of their difference is found using Rule 3.

13.3 Using the coefficient of variation to obtain confidence limits

Although CVs are widely used, a more intuitively meaningful measure of sampling error is the confidence interval of an estimate. A confidence interval constitutes a statement on the level of confidence that the true value for the population lies within a specified range of values. The interpretation of a 95% confidence interval is that if the survey were carried out an infinite number of times with the same sampling and non-response rates, then 95% of the response sets would generate estimates whose confidence intervals would contain the true value.

Confidence intervals for an estimate, \hat{X} , are generally expressed as two numbers, one below and one above the estimate, as in $(\hat{X} \pm k)$, where k is determined depending upon the level of confidence desired and the standard error of the estimate. As the true standard error of the estimates is unknown, confidence intervals are estimated based on the set of respondents.

Using the standard error of an estimate, confidence intervals for estimates may be obtained under the assumption that with a large enough sample size, large enough population size and large enough difference between these two numbers (N-n) the various estimates obtained for a population characteristic are normally distributed about the true population value. Under these assumptions, the chances are about 68 in 100 that the difference between a sample estimate and the true population value would be less than one standard error, about 95 out of 100 that the difference would be less than two standard errors, and about 99 out of 100 that the differences would be less than three standard errors. These different degrees of confidence are referred to as the confidence levels.

If the user wants to determine confidence intervals, the following formula will convert to a confidence interval (CI \hat{X}):

$$CI \hat{X} = (\hat{X} \pm z \hat{\alpha}_{\hat{X}})$$

where $\hat{\alpha}_{\hat{X}}$ is the determined CV for \hat{X} and

- $z = 1$ if a 68% confidence interval is desired;
- $z = 1.65$ if a 90% confidence interval is desired;
- $z = 1.96$ if a 95% confidence interval is desired;
- $z = 2.58$ if a 99% confidence interval is desired.

Example of using the coefficient of variation to obtain confidence limits

The following example refers to Question 4 in Section 2. (See Table 13.1.1)
A 95% confidence interval for the estimated proportion of principals in Canada who believe that changes in the previous decade would have a positive impact on student learning to a little extent or not at all would be calculated as follows:

$$\hat{X} = 17.4\% \text{ (or } 0.174 \text{ expressed as a proportion)}$$
$$z = 1.96$$

The coefficient of variation of \hat{X} is 4.8% (or 0.048, expressed as a proportion).

$$CI \hat{X} = \{0.174 - (1.96) (0.174) (0.048), 0.174 + (1.96) (0.174) (0.048)\}$$

$$CI \hat{X} = \{0.174 - 0.016, 0.174 + 0.016\}$$

$$CI \hat{X} = \{0.158, 0.190\}$$

Hence, with a 95% level of confidence, it can be said that between 15.8% and 19.0% of principals nationally believe that changes in the previous decade would have a positive impact on student learning to a little extent or not at all.

13.4 Hypothesis tests

Standard errors may also be used to perform hypothesis testing, a procedure for making inferences about possible differences between population parameters using sample estimates. The sample estimates can be counts, averages, percentages, ratios, etc. Tests may be performed at various levels of significance, where a level of significance is the probability of concluding that the characteristics are different when, in fact, they are identical.

Let \hat{X}_1 and \hat{X}_2 be sample estimates for two characteristics of interest. As in Rule 3 of Section 13.2, let the standard error for the difference $\hat{X}_1 - \hat{X}_2$ be $\hat{\sigma}_d$. If the quantity $(\hat{X}_1 - \hat{X}_2)/\hat{\sigma}_d$ is between -1.96 and +1.96, then there is no significant difference between the characteristics at the 5% level of significance. However, if this ratio is smaller than -1.96 or larger than +1.96, the observed difference is significant at the 5% level of significance. Recall from Rule 3 of Section 13.2 that this method can only be reliably applied when the two characteristics of interest are uncorrelated, otherwise the quantity $(\hat{X}_1 - \hat{X}_2)/\hat{\sigma}_d$ may be inaccurate.

An alternative way to determine whether two estimates are significantly different is to compare the confidence intervals surrounding the two estimates. When two confidence intervals overlap, it can be concluded that there is no significant difference reported between the corresponding estimates (although in theory there could be a significant difference in that case). It should be noted that this method is fairly approximate as it corresponds to approximating the confidence interval for the difference of the two estimates. The resulting approximated confidence interval will be slightly larger than the one derived in Section 13.3. As a result, by using this conservative convention, there is a small risk that, according to the level of confidence used cases where the difference is significant (but very small) will not be identified.

13.5 Coefficients of variations for quantitative estimates

Only a few quantitative variables could be estimated from this survey (see Section 12.3.2 for the definition of a quantitative estimate). Only Questions 8 to 15 in Section 1 could be potentially used to compute quantitative estimates. However, no analyses should be done using Questions 9 and 14 (see Section 10.6 for more details).

As a general rule the coefficient of variation of a quantitative total will be larger than the coefficient of variation of the corresponding category estimate. If the corresponding category estimate is not releasable, the quantitative estimate will not be either. For example, when considering only the principals in elementary schools, the CV for the average number of years of experience as an elementary teacher likely would be greater than the CV of the proportion of principals that have teaching experience in elementary schools. Hence if the coefficient of variation of the proportion is not releasable, then the coefficient of variation of the corresponding quantitative estimate probably will not be releasable.

Appendix A: Questionnaire

This appendix contains a copy of the SOP questionnaire, which was intended for the principals of the schools.

The questionnaire reproduced in the appendix is in English. Please refer to the French version of the User's Guide to obtain a French copy of the questionnaire.

Appendix B: School characteristics

This appendix gives an overview of the definitions used to derive the school characteristics variables.

Instructional level of the school – Elementary, secondary and mixed elementary and secondary schools

Elementary and secondary schools in Canada have been classed as **elementary** if they provide Grade 6 and under or a majority of elementary grades; **secondary**, if they offer Grade 7 and over or a majority of secondary grades. **Mixed elementary and secondary** schools are schools offering a combination of elementary and secondary grades.

School location – Urban and rural

Rural schools are those located in rural areas and small towns (RST) as well as those within the rural fringes of a larger centre (census metropolitan areas (CMAs) or census agglomerations (CAs)). **Urban** schools are those located in a CMA or CA, but not in the rural fringe.

Funding of school – Public and private

A school was classified as either public or private according to whether a public agency or a private entity had the ultimate power to make decisions concerning its affairs. A school was classified as **public** if the school principal reported that it was: controlled and managed directly by a public education authority or agency; or controlled and managed either by a government agency directly or by a governing body (council, committee, etc.), most of whose members were either appointed by a public authority or elected by public franchise. A school was classified as **private** if the school principal reported that it was controlled and managed by a non-governmental organisation (e.g., a church, a trade union or a business enterprise) or if its governing board consisted mostly of members not selected by a public agency.

School size – Small, medium and large

Size of school is established based on the distribution of the number of students enrolled in Elementary, Secondary and Mixed elementary and secondary schools. Schools for which their number of students fall in the bottom third (<33.3%) of the distribution are defined as “**small-size schools**”. “**Medium-size schools**” are defined as those for which their number of students is falling between the bottom third ($\geq 33.3\%$) and the top third ($\leq 66.6\%$) of the distribution, while “**large-size schools**” represent those for which their number of students is falling at the top of the distribution ($> 66.6\%$). Size of school is given as follows:

	Elementary	Secondary	Mixed elementary and secondary
Small	Less than 200 students	Less than 300 students	Less than 60 students
Medium	200 to 350 students	300 to 700 students	60 to 200 students
Large	More than 350 students	More than 700 students	More than 200 students