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Survey of Household Spending 2002: Data Quality Indicators

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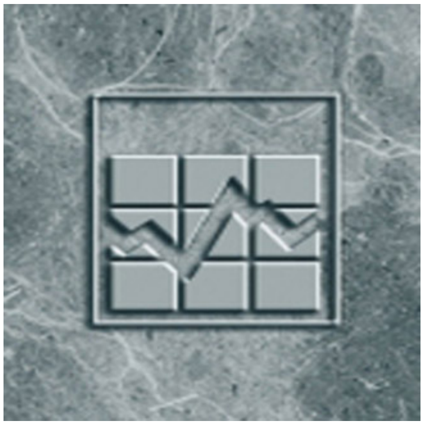

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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

This report was prepared by the members of the Survey of Household Spending unit of the Household Survey Methods Division (HSMD):

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The authors wish to thank the team responsible for the Survey of Household Spending in the Income Statistics Division (ISD) for their co-operation in the preparation of this report.

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Highlights

Sampling errors

- The coefficients of variation (CVs) of the average estimates of total expenditure per household vary between 1.1% and 2.4% for the provinces. The CV at the national level is 0.7%.

- The coefficients of variation (CVs) of the average estimates for the different summary level expenditure categories are less than or equal to 1.8% at the national level, and generally lower than 5% at the provincial level. The results for the characteristics of dwelling and household equipment are similar.

Nonresponse

- The final response rate is 70.5%. Provincial response rates range from 62.9% for Ontario to 79.7% for Prince Edward Island

- The nonresponse rate is 29.5%. It is due to refusals (19.1%), to households that could not be contacted (7.2%), and finally to households with data that were considered unusable (3.2%).

- The final nonresponse rate generally increases with the urbanization level. The nonresponse rate is 24.4% at the rural level, and 34.1% in the urban centres of a million residents or more. This tendency is also observed in the collection nonresponse rates.

- Analysis of final response rates in the strata consisting of high and low-income geographic areas created under the sample design indicates that the nonresponse rates in high-income strata (38.4%) is higher than the rates observed in regular strata (29.4%) and in low-income strata (19.5%). The refusal rate for high-income strata (24.8%) is more than twice the rate of low-income strata (10.1%).

Coverage errors

- There is an undercoverage of 7.2% for households at the national level. Undercoverage of households is also observed for all provinces, with rates varying from 1.8% to 11.3%. Newfoundland and Labrador and British Columbia have the highest undercoverage of households.

- There is an undercoverage of 8.9% for persons at the national level. Undercoverage of persons is also observed for all provinces, with rates varying from 5.4% to 15.7%. Newfoundland and Labrador and British Columbia have the highest undercoverage of persons.

- The national slippage rates for children (0 to 6 and 7 to 17) are quite different from those of other age groups. Overcoverage or a slight undercoverage occurs with respect to children, while there is always undercoverage among adults. The undercoverage rate for all children combined is 0.2%, while it is 11.4% for adults.

Response errors

- Response errors include recall errors, telescopic error and errors due to proxy response. Because the Survey of Household Spending (SHS) interview is lengthy, the response burden can lead to respondent fatigue and have an impact on the data quality. Total interview time varies according to the household characteristics. For some households the interview can take more than five hours. The average length of interview was one hour and fifty minutes.

Processing errors related to imputation

i) Expenditure variables

- 12.7% of respondents required some expenditure imputation (excluding the Clothing section and Personal Taxes, Security and Money Gifts section) with the majority of them having only one or two fields imputed out of the 230 expenditure variables. The regular mortgage payments and mortgage insurance premiums are included under the shelter costs and thus under the total expenditure. Therefore, these two variables were added this year in the calculation of imputation rates. Six per cent of households need an imputation for the mortgage insurance premiums. The overall imputation rate is 7.6% when excluding regular mortgage payments and mortgage insurance premiums, which is similar to rates obtained in previous years.

- About 20% of the individuals required imputation for clothing variables. For the majority of these, the respondents provided the totals and only the components were imputed.

- Less than 3% of the individuals required imputation on at least one variable in the Personal Taxes, Security and Money Gifts section.

ii) Income variables

- About 4% of individuals required imputation for at least one income variable. For about 75% of these, total income was provided by the respondent and imputation was performed to obtain the breakdown by component.

Introduction

The Survey of Household Spending (SHS) is an annual survey that collects data on household income and expenditure using personal interviews. The 2002 SHS sample is made up of 20,861 households[1] distributed throughout the 10 provinces. Collection takes place in January, February and March, and income and spending figures are obtained for the period from January 1 to December 31 of the previous year. Following a redesign that took place in 1997, this survey replaces the periodic Family Expenditure Survey and the Household Facilities and Equipment Survey (with modifications to questionnaires and samples).

Like all surveys, the SHS is subject to errors, despite all the precautions taken at the different stages of the survey to control them. While there is no comprehensive measure of the quality of the data generated by a survey, some quality measures produced at the different stages of the survey can provide users with the information needed in order to interpret the data properly.

This report therefore seeks to describe the quality indicators produced for the 2002 Survey of Household Spending. It covers the usual quality indicators that generally help users interpret data, such as coefficients of variation, response and nonresponse rates, slippage rates and imputation rates.

Quality indicators have been classified according to the main types of error encountered in a survey. Section 1 deals with sampling errors—that is, errors due to the fact that the inferences about the population drawn from the survey are based on information collected from a sample of the population, rather than the entire population. The subsequent sections cover errors not due to sampling. Nonresponse and coverage errors are first discussed in sections 2 and 3. Response errors and processing errors are dealt with in sections 4 and 5 respectively.

This report focuses on data quality. For a detailed description of the methodology of the survey, see reference [1].

[1] The initial sample is made up of 24,177 dwellings. From these dwellings, we have to identify and exclude the ineligible dwellings (see section 2.1) to obtain the 20,861 households from which we collect data on household income and expenditure.

1. Sampling errors

Sampling errors exist when inferences about the population are drawn from the survey using information collected from a sample, rather than the entire population. In addition to the sample design and the estimation method used in the Survey of Household Spending, the sample size and the variability of each characteristic are factors that determine sampling error. Characteristics that are rare or are distributed very unevenly in the population will have greater sampling error than characteristics that are observed more frequently or are more homogeneous in the population.

1.1 Measures of sampling error

The standard error is a commonly used measure of sampling error. The standard error is the degree of variation of the estimate considering that a particular sample was selected, rather than another, among all possible samples of the same size under the same sample design. Since the SHS uses a complex sample design and estimation method, the standard error is estimated using a resampling method known as the Jackknife technique. For more details on this method, see reference [2].

The coefficient of variation (CV) is also a frequently used measure of the reliability of an estimate. It simply expresses the standard error as a percentage of the estimate. Thus, if an estimate Y is obtained for a certain characteristic and SE is the estimated standard error, then the CV will be (SE/Y) x 100.

Finally, either the standard error or the coefficient of variation may be used to derive another measure of the accuracy of estimates, namely the confidence interval. This measure indicates the level of confidence that, for a characteristic observed, the true value for the population lies within the interval. An interval with a confidence level of 95% corresponds to the estimate obtained from the sample ± 2 standard errors: (Y ± 2 SE).[2] This means that if the sampling were repeated a large number of times, each sample would provide a different interval and 95% of the intervals would contain the true value of the characteristic. Similarly, if the sampling were repeated, the interval Y ± SE would contain the true value in 68% of cases.

1.2 Coefficients of variation

Estimates of coefficients of variation are calculated for estimates of many characteristics collected in the SHS. The CVs of detailed average household expenditure, as well as the CVs of dwelling characteristics and household facilities and equipment, are available at the national and provincial levels in the publication *User guide—Survey of Household Spending* (see reference [3]).

It should be noted that the estimated CVs do not consider the fact that some of the data were imputed and thus may underestimate the true CVs. For most variables, the imputation rates are low (see section 5) and the provided CVs represent good estimates. To assess the reliability of detailed expenditure with a high imputation rate, the CV and the imputation rate should be considered simultaneously.

[2] The confidence interval is calculated directly from the CV in similar fashion, namely Y ± 2 (CV x Y)/100.

Table 1.1 gives an overview of the CVs of estimates of household averages for a few of the summary level expenditure categories and for income at the provincial level as well as at the national level.

Table 1.1
Coefficients of variation (%) by province and the national level for the estimation of average household expenditures for several summary level expenditure categories and for the estimation of average income

Summary level expenditure categories	Can.	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Total expenditure	0.7	1.4	2.4	1.5	1.4	1.1	1.4	1.4	1.3	1.4	1.4
Total current consumption	0.6	1.3	2.5	1.6	1.4	1.0	1.2	1.3	1.2	1.5	1.2
Food	0.6	1.3	2.1	1.3	1.3	1.1	1.1	1.2	1.3	1.2	1.3
Shelter	0.8	2.1	3.0	1.9	1.8	1.6	1.5	1.8	2.0	1.8	1.6
Household operation	0.9	1.8	3.4	2.6	1.9	1.5	1.8	2.4	1.8	2.0	2.2
Furnishings	1.8	3.6	4.8	5.7	3.9	3.1	3.5	3.9	3.6	3.6	3.7
Clothing	1.1	2.5	3.6	2.4	2.6	2.0	2.2	2.5	2.0	2.8	2.9
Transportation	1.4	3.4	4.6	4.0	3.3	3.0	2.6	3.5	3.7	4.4	2.9
Health care	1.5	2.7	3.9	3.2	2.9	2.1	4.0	3.3	4.4	2.7	2.6
Personal care	1.1	2.3	3.4	2.3	2.3	2.0	2.0	2.4	2.0	2.2	2.9
Recreation	1.5	4.6	5.4	3.4	3.6	2.9	2.9	3.7	2.7	4.2	2.9
Reading & printed materials	1.8	3.9	4.5	3.7	3.5	4.1	3.2	3.5	3.6	3.5	4.7
Education	3.8	7.4	19.7	10.1	8.1	5.9	7.2	7.7	6.5	7.0	6.9
Tobacco, alcoholic beverages	1.6	4.3	6.4	3.9	3.9	3.0	3.2	4.8	4.0	4.2	3.9
Games of chance (net)	8.7	7.1	11.1	7.7	9.6	9.4	18.5	9.0	15.3	15.8	12.0
Miscellaneous expenditures	3.0	7.1	8.4	5.8	9.9	5.3	6.2	5.1	5.1	8.0	5.9
Personal income tax	1.6	3.4	4.5	2.6	3.6	2.5	3.1	3.2	3.9	3.1	3.8
Personal insurance and pension contributions	4.1	2.3	3.6	2.8	3.8	2.2	9.9	3.2	2.8	2.0	2.1
Gifts and contributions	4.6	5.6	14.4	7.4	10.2	8.5	8.4	8.1	8.4	8.3	10.7
Income	0.8	1.5	2.1	1.3	1.2	1.0	1.6	1.3	1.5	1.9	1.4

The coefficients of variation (CVs) of the average estimates of total expenditure per household vary between 1.1% and 2.4% for the provinces. The CV at the national level is 0.7%.

For summary level expenditure categories, the CVs at the national level are less than or equal to 1.8%, except for the following categories: education, games of chance, miscellaneous expenditures, personal insurance and pension contributions, and gifts of money and contributions. These expenditure categories represent respectively 1.5%, 0.5%, 1.5%, 5.7% and 2.4 % of total expenditure (data not presented). Also, with the exception of these categories, the CVs are generally less than or equal to 5% at the provincial level.

Table 1.2 gives an overview of the CVs for some dwelling characteristics and household equipment estimates at the provincial level as well as at the national level.

Table 1.2
Coefficients of variation (%) by province and at the national level for some dwelling characteristics and household equipment

Categories	Can.	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
Owner	0.9	1.7	3.1	2.0	1.8	2.2	1.8	1.9	1.7	2.0	2.0
Renter	1.8	5.6	7.3	4.6	4.6	3.0	3.7	4.5	4.4	5.3	3.7
Washing machine	0.6	1.0	2.1	1.6	1.2	1.1	1.5	1.6	1.1	1.3	1.5
Clothes dryer	0.7	1.1	2.0	1.6	1.3	1.3	1.6	1.5	1.2	1.2	1.5
Dishwasher	1.1	4.4	4.9	3.7	3.0	2.3	2.3	3.0	2.5	2.1	2.0
Freezer	1.0	1.6	2.9	2.0	1.8	2.2	2.2	1.8	1.3	2.0	2.3
Microwave oven	0.4	0.9	1.5	0.7	0.7	0.7	0.8	0.8	0.8	0.6	0.9
Cellular phone	1.1	3.7	4.4	3.3	3.5	2.9	2.0	2.9	2.7	2.3	2.2
CD player	0.7	1.5	3.2	1.7	1.7	1.5	1.4	1.8	1.7	1.4	1.2
Cable TV	1.2	2.2	5.1	2.3	2.7	2.7	2.3	2.4	3.0	2.5	1.6
Satellite dish	2.7	5.6	8.0	5.4	4.8	5.7	5.7	5.7	4.2	6.5	7.0
DVD player	1.5	4.5	8.5	4.6	4.2	4.0	2.8	4.1	3.7	3.0	3.3
Home computer	0.8	2.8	4.3	2.5	2.7	2.0	1.5	2.4	1.9	1.9	1.5
Regular telephone connection to a computer (Modem)	2.3	6.1	8.9	6.0	4.7	4.6	4.1	7.4	6.3	6.4	4.8
High-speed telephone connection to a computer	3.2	13.5	11.5	8.5	8.7	6.4	6.8	6.5	6.1	6.1	6.7
Use of Internet (home)	1.0	3.7	5.5	3.0	3.3	2.5	1.8	3.2	2.3	2.4	1.7
Owned vehicles (one)	1.4	3.4	4.3	3.1	3.7	2.7	2.9	3.7	3.1	3.7	2.9
Owned vehicles (2 or more)	1.5	4.6	4.2	3.1	3.4	4.0	2.9	3.4	2.5	3.0	2.6

The coefficients of variation for the estimates of dwelling characteristics and household equipment are generally below 5% at the provincial level, with some exceptions in the following categories: renter, satellite dish, regular telephone connection to a computer (modem) and high-speed telephone connection to a computer.

The coefficients of variation for the dwelling characteristics and the household equipment at the national level are below or equal to 2.3% with the exception of categories satellite dish and high-speed telephone connection to a computer. There is a smaller proportion of households with such equipment for these two categories. At the national level, this proportion represents 21.3% and 13.6% respectively (data not shown).

1.3 Model for deriving an approximation of the CV

Estimates for different domains of interest (for example, by income quintile) for the summary level expenditure categories are available in the publication *Spending Patterns in Canada* (see reference [4]). Estimates for different domains of interest for detailed expenditure are available upon request from the Income Statistics Division. (For more details on tables available upon request from the Income Statistics Division, see reference [3] or [4].) For operational reasons, it is not possible to produce CVs for all the characteristics collected by the survey at all the different levels of aggregation that may interest users.

1.3.1 Model for deriving an approximation of the CV for domain estimates

It is, however, possible to calculate an approximation of the CV by using a relationship between the number of households in the sample that reported expenditures for a given category and the CV at an aggregated level. This relationship, based on the CV's tendency to increase in proportion to a decrease in the square root of the number of households reporting an expenditure, is illustrated below.

Formula for approximating the CV for a domain (subgroup of the population)

If CV(Y) represents the CV for the estimate of the average per household of a certain characteristic for the entire population, then an approximation of the CV of the estimate of that characteristic can be calculated for a domain (which may be considered as a subgroup of the population, such as a household type, an income quintile, an urbanization level) according to the following equation:

$$CV(Y_d) = CV(Y) \times \sqrt{\frac{nP}{n_d P_d}}$$

where

n: *number of households in the sample*
P: *estimate of the proportion of households reporting a value > 0 for this characteristic in the population*
n_d: *number of households in the sample in domain d*
P_d: *estimate of the proportion of households reporting a value > 0 for this characteristic in domain d*

Generally, approximations for the different domains are calculated using the CV, size *n* and proportion *P* at the national level. If an approximation of a CV is desired for a domain that is entirely contained within a single province (for example, a metropolitan area), then it is preferable to use the values at the provincial level, since provincial CVs are published for the 2002 SHS (reference [3]). It should be noted that a CV obtained using this approach is only an approximation of the real value.

1.3.2 Method of computation of an approximate CV from the microdata file

Microdata file users can obtain an approximation of the CV of the estimates using another method which will generally provide better results than the method described in the previous section for the CVs of detailed expenditure estimates. This approach is described in detail in the documentation provided with the 2002 microdata file. This method of approximation can only be used with the microdata file since it is necessary to have data and weights for each household.

The document on data quality for the 1997 SHS contains the results from the performance evaluation of these two CV approximation methods.

1.4 Suppression of unreliable data in estimation tables

Since the coefficient of variation is an indicator of the reliability of data, we would like to use it to determine whether or not the estimates should be published. Estimates for which the CV is more than 33% are not considered sufficiently reliable to be published. However, CV estimates are not calculated for many of the published estimates. The suppression rule for expenditure estimates is therefore based on the number of households reporting a value greater than zero.[3]

It can be shown that CVs are usually below 33% when the number of households reporting an expenditure is greater than 30. Since this is an approximate rule, some estimates may be published even though the CV is greater than 33%, and some estimates will not be published even though the CV is less than 33%. The document on data quality for the 1997 SHS gives the results from the evaluation of the risk of error in the use of the suppression rule.

2. Nonresponse

Errors due to nonresponse result from the fact that some potential respondents do not provide the necessary information or the provided information proves to be unusable. When the respondent has failed to respond to only some questions, this is referred to as partial nonresponse. In such a case, the missing data are imputed. Errors associated with imputation are described in Section 5, which deals with processing errors.

In this section, nonresponse includes collection nonresponse, which is mainly due to the inability to contact the household or to the refusal of the members of the household to participate partially or completely in the survey, as well as data collected from households that prove to be unusable.

The main impact of nonresponse on data quality is that it can introduce a bias in the estimates if the characteristics of respondents and nonrespondents differ and the difference has an impact on the characteristics studied. Nonresponse rates may easily be calculated, but they have only an indicative value with regard to data quality, since they do not allow estimation of the bias associated with the estimates. The scope of nonresponse may be considered an indicator of the risks of bias in the estimates.

2.1 Response, nonresponse and vacancy rates

Since the units selected in the SHS are dwellings, interviewers must first identify ineligible dwellings, that is, dwellings occupied by persons who are not part of the target population, as well as dwellings that no longer exist (demolished, mobile home moved or dwelling converted to business) and vacant dwellings (unoccupied, seasonal or under construction).

Among eligible dwellings, the proportion of households that did not respond to the survey is evaluated next. This is called the collection nonresponse rate. Included are households that refused to participate in the survey and households where no contact

[3] In practice, we use the estimate of the proportion of households reporting an expenditure, which is multiplied by the sample size.

could be made with the respondents, either because they were absent or because of special circumstances (language problem, illness, death).

Again among eligible dwellings, the rate of unusable data is determined. Unusable data refers to the number of households whose questionnaires were at least partially completed but which were rejected during data processing. There are two main reasons for rejection. First, when many questions on income or expenditures have been left unanswered, the questionnaire is classified as incomplete and is not used. The other source of rejection consists of questionnaires in which the difference between receipts (income and other sources of money received by the household) and disbursements (expenditures and net change in assets and liabilities) is greater than 20%. These questionnaires are also excluded from the estimation and are considered as nonresponse.

For the 2002 Survey of Household Spending, the final response rate is 70.5%. Table 2.1a shows the final response rates as well as the sample size (eligible households) broken down by refusals, no-contacts, usable and unusable data. These rates are provided at the national level as well as at the provincial level.

Table 2.1a
Sample size and response rate (%) by province and at the national level

Province	Eligible households	Non-contacts	Refusals	Unusables	Usables	Final response rate (at estimation stage)[1]
Canada	**20, 861**	**1, 492**	**3, 991**	**674**	**14, 704**	**70.5%**
Newfoundland and Labrador	1, 681	130	224	70	1, 257	**74.8%**
Prince Edward Island	799	36	115	11	637	**79.7%**
Nova Scotia	2, 063	148	429	119	1, 367	**66.3%**
New Brunswick	1, 766	115	349	63	1, 239	**70.2%**
Quebec	2, 760	193	571	7	1, 989	**72.1%**
Ontario	3, 159	307	738	128	1, 986	**62.9%**
Manitoba	1, 858	95	296	24	1, 443	**77.7%**
Saskatchewan	1, 963	105	338	19	1, 501	**76.5%**
Alberta	2, 105	144	417	52	1, 492	**70.9%**
British Columbia	2, 707	219	514	181	1, 793	**66.2%**

1. Usable/eligible x 100

Table 2.1b shows the final nonresponse rates; the collection nonresponse rates, broken down by refusals and no-contacts; and the rate of unusable data broken down into incomplete and out-of-balance questionnaires. The vacancy rates are also included. These rates are provided at the national level as well as at the provincial level.

Note that the vacancy rates shown in tables in section 2 include vacant dwellings (unoccupied, seasonal or under construction) as well as dwellings that no longer exist (demolished, mobile home moved or dwelling converted to business).

Table 2.1b
Nonresponse and vacancy rates (%) by province and at the national level

Province	Vacancy rate	Collection nonresponse rate			Unusable data rate			Final nonresponse rate (at estimation stage)
		TOTAL	No contact	Refusal	TOTAL	Incom-plete	Out-of balance	
Canada	**11.4**	**26.3**	**7.2**	**19.1**	**3.2**	**1.9**	**1.4**	**29.5**
N.L.	21.0	21.1	7.7	13.3	4.2	1.9	2.3	25.2
P.E.I.	17.3	18.9	4.5	14.4	1.4	0.3	1.1	20.3
N. S.	13.9	28.0	7.2	20.8	5.8	4.3	1.5	33.7
N. B.	15.1	26.3	6.5	19.8	3.6	2.4	1.2	29.8
Quebec	7.9	27.7	7.0	20.7	0.3	0.1	0.1	27.9
Ontario	7.7	33.1	9.7	23.4	4.1	1.2	2.9	37.1
Man.	11.7	21.0	5.1	15.9	1.3	0.2	1.1	22.3
Sask.	11.9	22.6	5.3	17.2	1.0	0.2	0.8	23.5
Alta	7.3	26.7	6.8	19.8	2.5	0.9	1.6	29.1
B.C.	8.5	27.1	8.1	19.0	6.7	5.8	0.9	33.8

The final nonresponse rate at the national level is 29.5%. It is due to refusals (19.1%), to households that could not be contacted (7.2%), and finally to households for which the data were unusable (3.2%). In all provinces, refusals are the main cause of nonresponse, followed by the households that could not be contacted, and by the households for which the data were unusable.

The final nonresponse rate varies from one province to another. Prince Edward Island has the lowest nonresponse rate at 20.3%, as well as the second lowest refusal rate (14.4%). Nonresponse rates in Prince Edward Island, Manitoba and Saskatchewan are smaller than 25%, while rates over 30% are observed in Nova Scotia, Ontario and British Columbia. Ontario has the highest nonresponse rate at 37.1%. The highest rates of no contact (9.7%) and refusal (23.4%) are also observed in Ontario.

The vacancy rates are shown in Table 2.1, but it should be kept in mind that vacant dwellings do not contribute to the bias of the sample if they are correctly identified. By analysing vacancy rates, we can detect dwelling identification problems associated with the collection process. The national vacancy rate for the 2002 SHS is 11.4%.

2.2 Nonresponse according to urbanization level

Nonresponse varies according to urbanization level. The various rates at the national level are shown by urbanization level in Table 2.2.[4]

Table 2.2
Nonresponse and vacancy rates (%) by urbanization level

Urbanization category	Vacancy rate	Collection nonresponse rate			Unusable data rate			Final nonresponse rate (at estimation stage)
		TOTAL	No contact	Refusal	TOTAL	Incom-plete	Out-of-balance	
Urban								
1,000,000 or more	5.0	30.8	9.2	21.6	3.3	2.1	1.2	34.1
500,000 to 999,999	4.3	27.1	7.4	19.7	2.0	0.5	1.5	29.1
250,000 to 499,999	4.6	32.1	10.4	21.7	6.4	4.7	1.6	38.4
100,000 to 249,999	7.8	27.6	7.1	20.4	3.8	2.3	1.5	31.4
30,000 to 99,999	6.1	25.3	6.0	19.3	2.8	1.9	0.9	28.1
Less than 30,000	8.9	23.2	5.6	17.6	3.3	1.6	1.6	26.5
Rural	24.6	21.6	5.5	16.1	2.8	1.4	1.4	24.4
Total	**11.4**	**26.3**	**7.2**	**19.1**	**3.2**	**1.9**	**1.4**	**29.5**

The final nonresponse rate generally increases with urbanization level. According to Table 2.2, the “500,000 to 999,999” group and, to a lesser extent, the “1,000,000 or more” group, go against this rule. For the “500,000 to 999,999” group, this can be explained in part by the fact that this group has the lowest rate of unusable data (2.0%).

The collection nonresponse rate also increases with urbanization level. There is a difference of nearly 8% between the urbanization categories “less than 30,000” and “1,000,000 or more”. Refusals account for more than 60% of the total nonresponse at each level of urbanization except for the urbanization category “250,000 to 499,999”. The highest rates of no contact (10.4%), refusal (21.7%) and unusable data (6.4%) are also observed for the urbanization category “250,000 to 499,999”.

From an examination of the vacancy rate by urbanization level, it appears that the vacancy rate at the rural level (24.6%) is nearly three times higher than for low-population urban areas (8.9%). The latter also shows a rate that is higher than for the high-population urban areas. This phenomenon is also observed in the Labour Force Survey (LFS) and may be explained by a greater number of seasonal dwellings in rural areas. The same factor also explains the higher vacancy rates in the Atlantic provinces, as illustrated in Table 2.1b, and especially in Prince Edward Island, which has a high proportion of rural dwellings. Since the SHS sample is more concentrated in high-population urban areas than the LFS, the national vacancy rate for the SHS can be expected to be slightly lower than that for the LFS.

[4] Tables on nonresponse rates by urbanization level and province are available on request from the Household Survey Methods Division.

2.3 Nonresponse according to income strata

Since income information is not available for nonrespondents, it is not possible to compare nonresponse rates according to income. However, the LFS sample design, used for the SHS, was designed in such a way that in nine large cities there are strata consisting of geographic areas where the average household income exceeds $100,000, and in seven large cities there are strata consisting of apartments inhabited by households with an average income of less than $20,000. Even though the number of such strata is small and accounts for only a small number of dwellings in the SHS sample (approximately 570 for high income and 160 for low income strata, or 3% of the sample), the comparison of nonresponse rates for these two groups in relation to the other strata is revealing. Table 2.3 shows these results.

Table 2.3
Comparison of nonresponse and vacancy rates (%) in high-income and low-income strata in relation to other strata

Stratum type based on income	Vacancy rate	Collection nonresponse rate			Unusable data rate			Final nonresponse rate (at estimation stage)
		TOTAL	No contact	Refusal	TOTAL	Incom-plete	Out-of-balance	
High-income	5.1	33.6	8.8	24.8	4.8	1.1	3.6	38.4
Regular	11.7	26.1	7.1	19.1	3.2	1.9	1.3	29.4
Low-income	1.8	18.8	8.7	10.1	0.7	0.7	0.0	19.5
Total	**11.4**	**26.3**	**7.2**	**19.1**	**3.2**	**1.9**	**1.4**	**29.5**

The final nonresponse rate (38.4%) in high-income strata is nearly twice the rate of low-income strata and about 30% higher than that for regular strata. The refusal rate for high-income strata is at 24.8%, which is more than twice the rate of low-income strata.

Households in regular strata have a final nonresponse rate approximately 50% higher than that of the low-income strata. Different behaviour is observed for these two types of strata. The refusal rate in the regular strata is twice the rate of the low-income strata. Moreover, there are almost no unusable data in the low-income strata.

As for the 1997 to 2001 SHS, the vacancy rate is higher for regular strata than for each of the other two strata. The vacancy rate in low-income strata is at 1.8%, down from a rate of 5.1% in 2001.

2.4 Adjustment for nonresponse

To compensate for nonresponse, the weights in the SHS are inflated by the inverse of the weighted response rate within certain groups defined on the basis of the different urbanization levels in each province. The weighted rates differ from the rates presented in this section since the former takes into account the sampling weight of each household. An algebraic description of the nonresponse adjustment is provided in Appendix A.

The weights adjustment for nonresponse takes into account the differences in nonresponse by urbanization level as described in Section 2.2. It will reduce the bias to the extent that the characteristics of respondents and nonrespondents are similar for a given urbanization level.

3. Coverage errors

In the design of the survey, the target population was defined. It is useful to go over this definition, since a good understanding of the target population is necessary in order to properly interpret the survey data. One should note that SHS uses the LFS sampling frame.

Target population

> The target population consists of individuals living in private households. It therefore excludes residents of institutions such as prisons, chronic care hospitals or senior citizens' homes, as well as members of religious orders and other groups living communally, members of the Armed Forces living in military compounds, and individuals residing permanently in hotels or rooming houses. Also excluded are foreign countries' official representatives residing in Canada and their families as well as individuals residing on Indian reserves or public lands (with exception for the Territories). With these exclusions, the survey covers nearly 98% of the population in the 10 provinces. Territories are excluded from the target population for the 2002 SHS, as the survey covers this region only every other year.

Coverage errors result from inadequate representation of the target population based on the units of the sampling frame. Some units of the target population may be omitted from the sampling frame, in which case there is undercoverage. Other units that are not in the target population may be included by error, or some units may be included more than once. These units are responsible for overcoverage.

3.1 Undercoverage and overcoverage: slippage rates

In the SHS, the sample is selected using a list of dwellings in each selected cluster. Factors contributing to undercoverage are: the omission of dwellings in the creation of the list, new dwellings that are added between the creation of the list and the interviewer's visit (mainly in developing areas), and the erroneous classification of vacant dwellings. The inclusion of dwellings that are not within the boundaries of the cluster is a source of overcoverage. Similarly, errors can take place during data collection due to improper identification of persons as members of the selected household. These errors also contribute to undercoverage or overcoverage.

A good representation of the target population is essential to the production of realistic expenditure estimates. The number of people per household is also an important characteristic in the estimation of average household expenditures. Therefore, it is necessary that the sample not only adequately represent the individuals in the target population, but also the distribution of households according to their size.

In 1999, a weighting strategy that uses new controls was introduced. This method results in a better correction of the representation of the target population by using a more detailed age-sex grouping than was used previously and for which the coverage varies from one group to the other.

There is generally a net undercoverage of the number of persons in the SHS. This undercoverage is corrected by an adjustment of weights using auxiliary data based on post-censal demographic estimates. The slippage rate (see Appendix A) is a measure of the percentage of difference between the auxiliary data and the survey estimates calculated using weights not adjusted with these data.[5] Tables 3.1 and 3.2 respectively show slippage rates by age-sex group at the national level and at the provincial level. Table 3.3 presents these rates for the household size categories used for the weight adjustment. A positive rate indicates overcoverage of the number of persons in the survey.

Table 3.1
National slippage rates by age-sex group

	Age	Sex		Total
		Male	Female	
Canada	0-6 years	9.1	-7.5	1.0
	7-17 years	-2.3	0.9	-0.8
	18-24 years	-16.2	-14.8	-15.5
	25-34 years	-20.1	-13.0	-16.6
	35-54 years	-13.8	-8.8	-11.3
	55-59 years	-9.9	-11.1	-10.5
	60-64 years	-13.0	-1.4	-7.1
	65-69 years	-2.2	-3.3	-2.7
	70 years and +	-5.5	-5.7	-5.6
	Total	**-10.1**	**-7.8**	**-8.9**

For the 2002 SHS, the national undercoverage rate was 8.9%. If we analyze Table 3.1 with respect to age group, we can see that national slippage rates for children (0 to 6 and 7 to 17) are quite different from those of other age groups. Overcoverage or a slight undercoverage occurs with respect to children, while there is always undercoverage among adults. Only the 0 to 6 year-old female group does not follow this pattern. The undercoverage rate for all children combined is 0.2%, while it is 11.4% for adults (data not shown).

The highest national rates occurred among 18 to 24 year-old men, 25 to 34 year-old men and 18 to 24 year old women. Except for the category 55 to 59 years old, the undercoverage rate for women is either smaller or in the same range as the undercoverage rate for men.

[5] The subweight which is the survey weight adjusted for nonresponse is used (see Appendix A).

As mentioned previously, the SHS uses the LFS sampling frame. Over the same period, the national LFS undercoverage rate was 9.6% (reference [5]). This is slightly lower than the 10.9% SHS rate for those 15 years or older (data not shown).

Table 3.2
Slippage rates for provinces by age-sex group

Sex	Age	N.L.	P.E.I.	N.S.	N.B.	Quebec	Ontario	Man.	Sask.	Alta	B. C
Male	0-6	-3.3	13.5	8.5	25.8	8.1	15.9	6.5	-3.5	1.3	-1.8
	7-17	-21.0	1.7	-1.6	-3.1	1.7	-4.2	-0.3	-11.8	4.7	-5.4
	18-24	-37.8	-34.3	-15.4	-24.5	-0.8	-25.3	-10.1	-24.6	-13.7	-14.1
	25-34	-33.8	-18.0	-18.1	-10.6	-17.2	-22.2	-12.3	-21.3	-14.1	-26.1
	35-54	-21.2	-19.4	-12.7	-13.1	-12.4	-12.4	-9.1	-12.9	-13.5	-21.1
	55-59	5.3	-17.9	-8.2	-13.3	-25.5	7.3	-11.6	-30.7	-18.6	-18.2
	60-64	-7.5	2.9	-17.0	0.7	-11.0	-11.9	-33.6	0.8	-23.8	-13.7
	65-69	-15.2	0.4	-19.4	-2.8	-1.1	6.1	-2.3	-31.0	-1.7	-15.6
	70 +	-3.6	-5.6	1.8	-1.3	-12.1	-5.2	-6.1	-4.9	-6.6	2.4
	Total	**-19.6**	**-11.8**	**-9.5**	**-7.5**	**-8.8**	**-9.2**	**-7.5**	**-14.5**	**-9.3**	**-14.8**
Female	0-6	-11.7	-17.3	-30.1	-1.2	11.6	-14.7	-4.5	-8.5	-6.9	-14.8
	7-17	-3.9	5.9	9.3	-8.8	-0.1	6.2	5.4	-6.9	-1.4	-11.2
	18-24	-18.2	-23.7	-10.9	-16.2	4.0	-25.4	-4.3	-11.4	-10.0	-25.5
	25-34	-16.4	-15.9	-16.4	-10.1	-9.2	-11.8	-13.9	-15.9	-8.4	-25.2
	35-54	-16.6	-12.9	-8.8	-10.4	-10.1	-5.8	-0.4	-8.8	-7.7	-16.7
	55-59	3.0	-8.6	-13.1	-14.3	-9.3	-6.4	-23.2	-21.2	-15.4	-21.0
	60-64	-13.7	-6.6	-3.5	14.4	9.3	0.7	-19.5	-23.0	-24.2	-6.0
	65-69	-22.8	16.5	-0.4	-0.2	-10.4	5.5	-7.0	-11.0	-12.0	-6.5
	70 +	1.2	-10.1	1.1	-2.8	-8.7	-7.2	9.6	0.7	-15.9	0.6
	Total	**-12.0**	**-9.9**	**-7.6**	**-8.0**	**-4.7**	**-6.8**	**-3.2**	**-9.8**	**-8.8**	**-15.4**
Total		**-15.7**	**-10.8**	**-8.5**	**-7.7**	**-6.7**	**-8.0**	**-5.4**	**-12.1**	**-9.0**	**-15.1**

We observe a net undercoverage for all provinces, with the rates varying from 5.4% to 15.7%. However, a low overall rate of undercoverage is not a guarantee of better coverage. For example, the New Brunswick overall slippage rate (-7.7%) concealed the worst case of overcoverage for a provincial age-sex group (25.8% among 0 to 6 year-old females). On the other hand, despite an overall slippage rate of -15.1%, British Columbia has only the eighth worst case of undercoverage (26.1% among 25 to 34 year-old men).

Among the provinces, the highest undercoverage rate occurred among 18 to 24 year old men in Newfoundland and Labrador. Moreover, this province has higher undercoverage rates among men aged 7 to 17, 18 to 24, 25 to 34 and 35 to 54 than those for the same age-sex groups in other provinces. We can also see that the pattern of slippage rates differs substantially for age-sex groups from one province to the next.

Table 3.3
Slippage rates for provinces by household size

Province	Slippage rate			
	Households	One-person households	Two-person households	Three-person and more households
Canada	**-7.2**	**-8.3**	**-3.2**	**-9.7**
Newfoundland and Labrador	-11.0	1.1	-5.9	-18.9
Prince Edward Island	-8.8	-6.9	0.3	-16.7
Nova Scotia	-5.5	2.5	-1.3	-14.0
New Brunswick	-4.5	9.0	-3.4	-12.4
Quebec	-5.8	-8.7	1.7	-10.1
Ontario	-7.2	-12.4	-3.6	-6.9
Manitoba	-1.8	7.1	-2.9	-7.2
Saskatchewan	-8.1	-3.1	-1.8	-17.2
Alberta	-7.9	-14.1	-6.4	-5.7
British Columbia	-11.3	-4.8	-9.6	-17.1

Nationally, the number of households was underestimated by 7.2%. This slippage rate is comparable to the -8.9% slippage rate for individuals.

Among the provinces, there is a substantial variation in the slippage rate for one-person households. This rate ranges from -14.1% for Alberta to 9% for New Brunswick. The same phenomenon occurs with respect to two-person and three-person and more households but with less variation. For two-person households, the slippage rate ranges from -9.6% in British Columbia to 1.7% in Quebec. The slippage rate for households of three or more persons is less variable, with values ranging from -5.7% for Alberta to -18.9% for Newfoundland and Labrador. For households of three or more persons, there is always undercoverage. Except for Ontario and Alberta, the greatest undercoverage is observed for households of three or more persons.

3.2 Adjustment for coverage error at the population and household levels

To correct the coverage problem illustrated in tables 3.1 and 3.2 and to reduce the resulting bias, the survey data are adjusted during weighting using demographic estimates for the age groups defined in these tables, for each province. For more information on the methodology adjustment see reference [1]. This adjustment greatly reduces the bias caused by coverage errors but does not completely eliminate bias if the characteristics of the individuals omitted from the survey differ from those of individuals included for a given age group in a province.

Furthermore, the effectiveness of the coverage adjustment based on demographic estimates depends mostly on the quality of those estimates and their accuracy in representing the survey's target population. The demographic estimates are not error-free. They are post-censal estimates based on the population counts from the 1996 Census adjusted for net undercoverage, and they take into account recent statistics on migration, births, deaths, etc. These demographic estimates are adjusted to account for certain exclusions specific to household surveys, such as persons living in institutions. Conceptually, they differ slightly from the SHS target population in that they include persons living in non-institutional collective dwellings, such as members of groups living communally and individuals permanently residing in hotels or rooming houses. However, this difference is considered negligible, since such individuals represent less than 0.4% of the Canadian population.

To remedy the issue of the sample's representativity with respect to the number of households based on their respective sizes as illustrated in Table 3.3, we use supplementary data to adjust the data appearing in the survey. By adjusting the weights of the SHS to reflect post-censal estimates of the number of households by size, we hope to compensate for the bias produced by inadequate representation of households. However, we will not necessarily succeed in eliminating such bias if features of uninterviewed (omitted or non-respondent) households differ from those of responding households for the same size or group. As in the case of demographic estimates of population, the success of such an adjustment depends on the quality of the supplemental data on the number of households.

In addition to demographic estimates of age-sex groups by province, three other groups of supplementary data are used during weighting to adjust survey data and thereby improve their representativity. The first set of data is used to control the number of children and adults in certain major cities. The second is designed to control the number of single-parent households and couples with children by province. Finally, counts for major categories of income from wages and salaries are used when adjusting weights to ensure a certain degree of consistency between the income distributions from the SHS and from outside sources.

4. Response errors

Response errors represent a lack of accuracy in responses to questions. They can be attributed to different factors, including a questionnaire that requires improvements, misinterpretation of questions by interviewers or respondents, and errors in respondents' statements.

In the SHS, there can be various reasons for errors in respondents' statements. First, there are recall errors that occur when a respondent forgets expenditures made during the period covered by the survey (which corresponds to the calendar year), or when a respondent provides an erroneous value because of the time interval that has elapsed between the time of purchase and the date of the interview. Recall errors are probably the survey's largest source of response error, since the reference period is long (12 months) and a great variety of information is requested.

One of the main measures taken to minimize recall error in the SHS is to calculate the difference between receipts (income and other amounts received by the household) and disbursements (expenditures plus net change in assets and liabilities) for each household. When the difference exceeds 10% of receipts or disbursements, with the higher amount being retained, respondents are contacted again in order to obtain additional information and to try to identify errors or omissions. The respondent is also encouraged to consult various documents (invoices, bank statements, etc.) in order to provide more accurate data. To determine expenditures for small items purchased at regular intervals, interviewers generally suggest that respondents estimate the frequency of the purchases and the price generally paid in order to derive expenditures for a 12-month period.

A second source of error in respondents' reporting is telescopic error, which consists of including in the reference period events that occurred before or after it. In the SHS, the use of the calendar year is considered to provide a good marker for the start of the reference period. Furthermore, since the reference period is a long one, telescopic error has less impact.

Responses by proxy can also contribute to response error. The household member who made an expenditure is generally best able to report it accurately. This is definitely the case with, say, personal purchases. Expenditures reported by an intermediary are more likely to be tainted by response error, and this type of error tends to have a greater effect on certain types of expenditures.

Among other sources of response error, the extent of the respondent's co-operation should not be overlooked. For personal reasons, the respondent may decide not to mention particular expenditures or decide to twist the facts.

In the SHS, another factor is response burden, owing to the length of the interview and the great variety of items to be reported, as well as the pace of the interview. This can lead to respondent fatigue and affect the quality of the responses obtained. The interview time varies greatly from one household to another, depending on household size, income and various other characteristics. For some households, the interview can take more than five hours.

It should be stressed that questions were added to the 2001 SHS. Among other things, for 2001 only, extra questions were included in the survey so that data from the SHS could be used in the weighting of the Consumer Price Index. This change may affect historical comparisons for a few variables. For example, questions were added under "Personal care preparations" to collect specific information about hair care products, makeup, fragrances, deodorants and oral hygiene products. As a result of these extra questions, respondents may have given more precise information and the increase in the estimate for "Personal care preparations" may have been at least partly caused by an improvement in respondent recall. The effect of additional questions on estimates is difficult to quantify. However, in 2002 when the extra questions were removed, the estimate for personal care spending decreased again.

While response errors are a major source of error in a historical interview, they are the aspects of data quality that are the hardest to measure. Generally, it is necessary to conduct quite costly special studies in an attempt to measure them. Efforts are made to combat response errors by using survey techniques designed to reduce them.

5. Processing errors

Processing errors can arise in all types of data handling. The main stages of data processing are coding, data entry, editing, imputation of partial nonresponse and weighting. In the SHS, different procedures are applied at each stage in order to minimize processing errors and the survey estimates are compared with other data sources prior to release. Errors related to the adjustments made at the weighting stage have been described in sections 2 and 3. The other types of processing errors are covered in this section.

Coding is necessary for only a few questions. This is done by the interviewer and subsequently verified by a senior interviewer. Before 2001, data entry was done with the help of an automated verification system that grouped the questionnaires into batches and chose some questionnaires from each batch to be entered a second time. Any errors found were to be corrected. If the number of errors in a batch was greater than a certain threshold, then the entire batch was submitted for re-entry. Due to the introduction of a new data capture system (BLAISE), there was no questionnaire batch verification procedure in 2002. However, some edits were implemented in the new data capture system to ensure consistency of data captured. The results of a preliminary data capture study seem to show that data capture error rates of the new system are similar to the ones of the old system.

The first stage of automated verification is done after each questionnaire has been verified manually by both the interviewer and the senior interviewer. It is ensured that the respondent's answers follow some essential consistency rules. Unusual situations that may justify corrections are also identified. This stage of verification is done in Statistics Canada's regional offices in case it is necessary to recontact respondents if some supplementary information is required to resolve inconsistencies in the answers provided. Specially-trained members of the verification teams solve any problems identified. Thereafter, other verification checks are done at head office and invalid responses are corrected.

The processing of SHS data also involves imputation for partial nonresponse. Partial nonresponse occurs when the respondent refuses to answer or does not know the answer to certain questions. The imputation approach differs depending on whether the data is categorical or continuous. Categorical data takes on only specific values (as in yes/no questions or type of dwelling questions), while continuous data can take any numerical value (as for income and expenditure data).

Categorical data, which are obtained mainly in the facilities and equipment section of the questionnaire, are imputed with the help of a "hot deck" imputation technique that randomly chooses a donor from a group of answering households with similar characteristics.

Income and expenditure data are imputed using the nearest neighbour technique. The imputation is done on one group of variables at a time, with the groups chosen by taking the relationships among the variables into account. A group generally corresponds to a section of the questionnaire. For every group, the missing values of a recipient (a household that has some missing data for at least one of these variables) are imputed from data from the most similar record among all donors (households that have no missing values for these variables). For each recipient the closest donor is chosen as the one that minimizes a particular distance function. This function is based on matching variables that are chosen because they are correlated with the variables to be imputed. For example, the total income of a household is chosen as a matching variable for all sections pertaining to expenditures. It must also be ensured that, after receiving the donor values, the recipient household satisfies some consistency rules. In general, the imputation is done at the household level, but in some groups (e.g., income and clothing expenditures), the imputation is done at the person level since the original data is collected at that level.

Note that since 2001, the imputation of all expenditure and income data is done using a new system based on slightly different methodology from the one used by the previous system. The new system allows a better use of categorical variables as matching fields when selecting a donor. The new system was tested prior to its implementation and the results it gave were similar to those with the old system. Also, results with the new system are similar to those of previous years.

The bias caused by imputation of partial nonresponse is difficult to evaluate. It depends on the differences between respondents and nonrespondents as well as the ability of the imputation method to produce unbiased estimates. However, the imputation rates indicate the importance of partial nonresponse. They are presented in the following section.[6]

5.1 Proportion of households or persons requiring imputation at national and provincial levels

A preliminary indication of the magnitude of partial nonresponse is the proportion of households requiring imputation and the number of variables imputed by household. The questionnaire can be divided into two major groups of variables: those collected at the household level and those collected at the individual level (such as income and clothing expenditure). For the latter, the respondent may provide only the total income or total clothing expenditures if he/she is unable to provide the breakdowns by source of income or type of expenditure. The level of imputation for the components of income and clothing expenditure is then larger, but this does not affect the total income, total clothing expenditure or total expenditure.

The percentage of households requiring imputation for household expenditure (excluding clothing expenditures and expenditures in the section on Personal Taxes, Security and Money Gifts) is presented in the next sub-section. The subsequent sub-section presents the percentage of persons requiring imputation for a clothing expenditure variable, the percentage of persons requiring imputation for an income variable and the percentage of persons requiring imputation for a variable in the section on Personal Taxes, Security and Money Gifts. After data imputation by the system, some corrections might have been needed on both imputed and non-imputed variables aiming to ensure data consistency. The results are provided at the national, and provincial levels. This gives an indication of which provinces are more affected by imputation.

5.1.1 Household expenditure imputation by province

The percentage of usable households that required imputation for an expenditure variable (excluding clothing expenditures and expenditures in the section on Personal Taxes, Security and Money Gifts) is presented in Table 5.1. Usable households correspond to all households living in eligible dwellings, excluding households who could not be contacted, who refused to participate in the survey, or who provided unusable

[6] For operational reasons, these data quality indicators are not available for categorical data such as household facilities and equipment.

data (see section 2.1). The table is broken down by the number of imputed variables (out of 230) for a household.

Note that regular mortgage payments and mortgage insurance premiums are included under the shelter costs and thus under the total expenditure. In 2002, year, these two variables were added in the calculation of imputation rates shown in Table 5.1. The impact of this modification is a higher overall imputation rate.

Table 5.1
Households requiring expenditure imputation by province

Province	Households (%) requiring imputation for **EXPENDITURE VARIABLES**[1] (excluding clothing expenditures and expenditures in the section on Personal Taxes, Security and Money Gifts)			
	Number of variables imputed (out of 230)			**TOTAL**
	1	**2**	**3 or more**	
Canada	**9.9**	**1.7**	**1.1**	**12.7**
Newfoundland and Labrador	16.1	1.5	0.3	18.0
Prince Edward Island	12.6	1.9	0.3	14.8
Nova Scotia	13.8	3.1	2.5	19.4
New Brunswick	9.9	1.0	0.6	11.5
Quebec	8.4	0.7	0.5	9.6
Ontario	10.2	3.0	2.2	15.4
Manitoba	7.6	1.7	0.7	10.0
Saskatchewan	8.5	1.5	0.6	10.6
Alberta	8.4	1.3	0.6	10.4
British Columbia	7.2	1.6	1.5	10.3

[1] Includes regular mortgage payments and mortgage insurance premiums

Table 5.1 indicates that 12.7% of households required some expenditure imputation (excluding the clothing section and the Personal Taxes, Security and Money Gifts section) at the national level, but nearly 78% of them had only one variable imputed. Note that the higher overall imputation rate is attributed to the inclusion in 2002 of regular mortgage payments and mortgage insurance premiums. Six per cent of households need an imputation for the mortgage insurance premiums. The overall imputation rate is 7.6% (data not shown) when excluding regular mortgage payments and mortgage insurance premiums, which is similar to rates obtained in previous years.

There are very few households that had more than one variable imputed (2.8%). At the provincial level, Quebec (9.6%), Manitoba (10%), British Columbia (10.3%), Alberta (10.4%) and Saskatchewan (10.6%) have the lowest imputation rates. The highest rates are observed in Nova Scotia (19.4%), Newfoundland and Labrador (18%) and in Ontario (15.4%). The low percentage of households (particularly when excluding regular mortgage payments and mortgage insurance premiums) for which some variables had to be imputed, combined with the low number of variables that had to be imputed when imputation was necessary, suggests that the imputed values should not have a strong impact on the estimates.

5.1.2 Person expenditure and income imputation by province

Since some respondents provide only totals for clothing expenditure and income variables, a two-step procedure is used to impute these variables (at the individual level). Individuals who require imputation of only certain components are imputed first. Then, they are followed by those for which totals are available but imputation on all components is required. (See reference [1] for a more detailed description of this process.)

The percentage of usable individuals (persons who are members of usable households) requiring imputation for an income variable are presented by province in Table 5.2. The percentage of persons who had one variable imputed, those who had two or more variables (but not all) imputed and the percentage of persons for which only total income was available (and hence required having all their components imputed) are shown. The total percentage of persons requiring some form of income imputation is also provided. The second to last column of Table 5.2 indicates the total percentage of persons requiring some form of imputation, for the clothing expenditure variables. The last column of Table 5.2 indicates the total percentage of persons requiring some form of imputation for the Personal Taxes, Security and Money Gifts section.

Table 5.2
Persons requiring income imputation, persons requiring clothing expenditure imputation and persons requiring imputation for variables in personal taxes, security and money gifts section by province

Province	Percentage of persons requiring imputation for **INCOME VARIABLES**				Percentage of persons requiring imputation for at least one of the 11 clothing expenditure variables	Percentage of persons requiring imputation for at least one of the 15 variables in the section on personal taxes, security and money gifts
	1 income variable imputed	2 or more income variables imputed (not all)	All income variables imputed (total income known)	**TOTAL** (any form of income imputation)		
Canada	**0.7**	**0.2**	**3.1**	**4.1**	**19.5**	**2.6**
N.L.	0.2	0.1	3.2	3.5	6.1	1.4
P.E.I.	0.1	0.2	6.4	6.9	15.2	1.2
N.S.	1.2	0.3	3.0	4.5	13.9	4.6
N.B.	0.2	0.1	3.5	3.9	14.3	1.5
Que.	0.5	0.1	1.8	2.5	26.2	1.3
Ont.	2.0	0.2	3.0	5.2	17.3	5.4
Man.	0.4	0.2	2.3	2.9	24.4	1.7
Sask.	0.3	0.2	3.5	4.0	22.4	2.7
Alta.	0.1	0.1	3.1	3.3	24.3	1.5
B.C.	1.3	0.3	3.7	5.5	23.9	3.1

These results show that nearly 4% of persons from usable households had some imputation performed on at least one income variable. For about 75% of them, the respondent gave the total income but all their components had to be imputed. For many of the remaining persons requiring imputation, only one component of income (one variable) had to be imputed. Provincially, the percentages of persons requiring some imputation on at least one income variable are also low, ranging from a low of 2.5% for Quebec to a high of 6.9% for Prince Edward Island.

From the second to last column of the table, it can be seen that about 20% of persons required imputation for at least one of the clothing expenditure variables. The rates at the provincial level range from 6.1% for Newfoundland and Labrador to 26.2% for Quebec. Almost all these people provided their total expenditure on clothing but required imputation of the components. The higher level of imputation required on clothing expenditure components implies that the estimates for these components could be greatly affected by imputation, while the effect on the estimates for total clothing expenditures will be negligible.

From the last column of the table, results show that less than 3% of persons had some imputation performed on at least one variable in the Personal Taxes, Security and Money Gifts section. Provincially, these percentages are also low, ranging from a low of 1.2% for Prince Edward Island to a high of 5.4% for Ontario.

References

[1] Tremblay, J. and Arsenault, S. 2001. *Methodology of the Survey of Household Spending.* Catalogue no. 62F0026MIE2001003.Ottawa. Household Survey Methods Division, Statistics Canada.

[2] Wolter, K.M. 1985. *Introduction to Variance Estimation.* New York. Springer-Verlag.

[3] Statistics Canada, Income Statistics Division. 2002. *User guide—Survey of Household Spending.* Catalogue no. 62F0026MIE2003002. Ottawa.

[4] Statistics Canada, Income Statistics Division. 2002. *Spending Patterns in Canada*. Catalogue no. 62-202. Ottawa.

[5] Statistics Canada, Household Survey Methods Division. 2002. *Labour Force Survey, Operations Report.* Survey 200212. Ottawa.

Appendix A

Algebraic notation

1. Nonresponse Adjustment

The subweight (i.e., the design weight adjusted for nonresponse) for a household k, denoted as w_k^{NR}, is

$$w_k^{NR} = \pi_k^{-1} * \frac{1}{rate_g} \qquad with \qquad rate_g = \frac{\sum_{k \in s_{g,r}} \pi_k^{-1}}{\sum_{k \in s_{g,r}} \pi_k^{-1} + \sum_{k \in s_{g,nr}} \pi_k^{-1}}$$

where

$s_{g,r}$ is the set of respondents in nonresponse group g,

$s_{g,nr}$ is the set of nonrespondents (refusals, no contacts, unusable data) in nonresponse group g, and

π_k^{-1} is the design weight assigned to household k.

2. Calculation of the slippage rate

The slippage rate for a control group c, denoted as $rate_c$, is

$$rate_c = 100 * \frac{\left(\sum_{k \in s_{c,r}} w_k^{NR} \right) - t_c}{t_c}$$

where

$s_{c,r}$ is the set of respondents in control group c,

w_k^{NR} is the subweight of household k, and

t_c is the total of the auxiliary data for the control group c.