



Catalogue no. 62F0026MIE — No. 004

ISSN: 1708-8879

ISBN: 0-662-40938-8

## Research Paper

Household expenditures research paper series

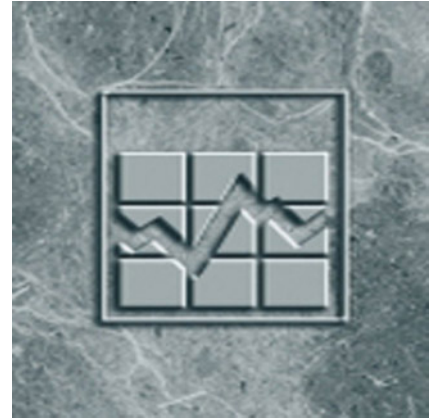
# Methodology of the Food Expenditure Survey

2001

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2001

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July 2005

Catalogue no. 62F0026MIE2005004

ISSN: 1708-8879

ISBN: 0-662-40938-8

Frequency: Occasional

Ottawa

La version française de cette publication est disponible sur demande (n° 62F0026MIF au catalogue).

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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.*

## **Abstract**

The Food Expenditure Survey (FES) is a periodic survey collecting data from households on food spending habits. Data are collected mainly using weekly diaries of purchases that the respondents must fill in daily during two consecutive weeks.

This paper presents a detailed description of the methodology of this survey. First, we briefly described the sample design which is mainly based on the plan of the Labour Force Survey. Then we present the methods of collection, data processing, weighting, and variance estimation, as well as the suppression of unreliable data in the tables of estimates.

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## 1. Introduction

The Food Expenditure Survey (FES) is a periodic survey conducted every four to six years. The survey collects data from Canadian households on food spending habits.

This survey is used to complete the Survey of Household Spending (SHS)<sup>1</sup> by gathering detailed data on food expenditures that cannot be collected using the SHS methodology. The Food Expenditure Survey and the Survey of Household Spending are used to update the weighting used by the Consumer Price Index.

The FES data are gathered through an in-person interview using a paper questionnaire (FE2) and through two weekly diaries of purchases (FE3) that the respondent must fill in daily during two consecutive weeks. The data were gathered from a sample of households covering the 10 provinces as well as the cities of Whitehorse and Yellowknife. In 2001, the city of Iqaluit was added. The survey is conducted every month during a single calendar year. The collected data are then edited and weighted. The survey's products include the publication, tables and microdata files required by various users.

This paper provides a detailed description of the survey's methodology relating to the sample design, data collection and processing, production of estimates and other products, as well as the rules governing their dissemination.

## 2. Target population

The target population of the FES includes individuals residing in private Canadian households, but excludes official representatives of foreign countries living in Canada and their families, and individuals living on Indian reserves and crown lands. The restriction to private households means that people living full-time in institutions such as prisons, chronic care hospitals and residences for senior citizens, as well as members of religious and other communal colonies, members of the Armed Forces living in military camps, and individuals living full-time in hotels or rooming houses are excluded.

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1. The SHS is an annual survey in which a sample of Canadian households is asked to report on all expenditures made during a calendar year. The results of the SHS are published in *Spending Patterns in Canada*, Catalogue No. 62-202.

We did not collect data from persons temporarily living away from their family (for example, students at university) because the data would be gathered from their families if selected in the sample. Therefore, if a household is made up only of persons temporarily living away from their family, it is considered an out of scope household.

Furthermore, in 2001, since the sample size is much smaller than in previous surveys, members of households residing in dwellings located in remote areas are excluded from the survey. These areas, which are sparsely populated in general, are located mainly in the northern parts of certain provinces. These regions are difficult to access and therefore data collection for these households is very costly.

The survey therefore covers about 97% of the population in the 10 provinces. In the Yukon, Northwest Territories and Nunavut, the survey covers only the cities of Whitehorse, Yellowknife and Iqaluit, which represent 62%, 44% and 17% of their respective populations based on the 1996 Census.

### **3. Sample design**

Food expenditure data are collected from households coming from a sample of dwellings selected according to a multi-stage, stratified sampling design. This design varies according to the level of urbanization but generally consists of a two-stage sample for which the first level is an area sample, i.e., a sample of geographic areas called clusters.

The selection of clusters is done for the complete year. This set of selected clusters is divided evenly into 12 subsets for data collection to be done during the 12 months of the year — that is, one subset per month. The collection is done during the whole year so as to take into account the seasonality of food expenditures. The method of dividing the 12 subsets must ensure that the three monthly samples of each quarter cover Canada geographically.

In the second stage, before each month of collection, dwellings are selected from a list of all private dwellings from the subset for that particular month. All the selected dwellings that are inhabited by individuals from the target population constitute the survey sample.

To reduce the collection costs, the FES uses largely the same sample design as the Labour Force Survey (LFS). The dwellings in the FES sample are selected from LFS sample clusters, but the two surveys use different dwelling samples. The main aspects of the LFS cluster sample design are described in Section 3.2. A more detailed description is available in the LFS methodology publication [1]. The approach used in selecting FES dwellings from LFS sample clusters is covered in Section 3.3. The following section explains how the sample is allocated among the five Canadian regions and the three cities of the territories.

### 3.1 Size and allocation of the FES sample

Due to budget constraints, the sample size of the 2001 survey has been reduced considerably compared to the previous survey of 1996. During the 1996 survey, the sample size was 17,000 dwellings resulting in about 15,000 households after excluding vacant dwellings and out of scope households (e.g., the households made up only of individuals having a permanent residence elsewhere). With this sample size, it was expected that the estimates at the national and provincial levels as well those for the cities of the territories<sup>2</sup> would be reliable.

At the planning stage of the FES 2001, it was decided to reduce the sample size from 17,000 dwellings to 14,000 dwellings. Even with this reduction, relatively reliable national estimates, provincial estimates, and estimates for the three cities of the territories were still expected. A few weeks after the start of data collection, in January 2001, the sample size had to be reduced from 14,000 to 9,000 dwellings due to budget constraints. Since collection was already in progress, it was not possible to reduce the January sample. The sample was reduced appropriately starting from the month of February. Reliable estimates were now expected to be produced at the regional level<sup>3</sup> instead of the provincial level.

The total sample, excluding the sample from the three cities of the territories, was allocated among the five Canadian regions so as to obtain a compromise between national and regional reliability of *Total weekly food expenditures*. More specifically, the sample allocation is based on the variability of food expenditure in each region and, to a lesser extent, the household counts at the regional level.

In each region, the sample was distributed to provinces proportionally by their household counts. Each provincial sample was distributed in direct proportion to the size of the population of the census metropolitan areas. The portion of the sample allocated outside the census metropolitan areas matched the LFS allocation [1].

Table 3.1 presents the sample size for each of the provinces and the three cities of the territories for the 1996 and 2001 surveys. The sample size is presented in terms of number of dwellings and number of households (after excluding vacant dwellings and out of scope households).

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2. In the territories, only the cities of Yellowknife, Whitehorse and Iqaluit are covered by the survey.
  3. The five regions are Atlantic, Quebec, Ontario, Prairies and British Columbia.



**Table 3.1**  
**Sample size by province and three cities of the territories**

Geography	Sample size			
	1996		2001	
	Number of Dwellings	Number of Households	Number of Dwellings	Number of Households
<b>Canada</b>	<b>17,000</b>	<b>14,993</b>	<b>9,488</b>	<b>8,414</b>
Newfoundland and Labrador	691	592	233	199
Prince Edward Island	621	516	79	67
Nova Scotia	1,347	1,143	396	329
New Brunswick	1,124	941	304	261
<b>Atlantic Region</b>	<b>3,783</b>	<b>3,192</b>	<b>1,012</b>	<b>856</b>
<b>Quebec Region</b>	<b>2,395</b>	<b>2,139</b>	<b>1,816</b>	<b>1,615</b>
<b>Ontario Region</b>	<b>3,886</b>	<b>3,479</b>	<b>2,632</b>	<b>2,404</b>
Manitoba	1,023	895	451	387
Saskatchewan	1,369	1,211	393	335
Alberta	1,461	1,319	948	868
<b>Prairies Region</b>	<b>3,853</b>	<b>3,425</b>	<b>1,792</b>	<b>1,590</b>
<b>British Columbia Region</b>	<b>2,212</b>	<b>2,038</b>	<b>1,558</b>	<b>1,422</b>
<b>Total regions</b>	<b>16,129</b>	<b>14,273</b>	<b>8,810</b>	<b>7,887</b>
Whitehorse	435	363	250	202
Yellowknife	436	357	252	192
Iqaluit	0	0	176	133
<b>Total 3 cities of the territories</b>	<b>871</b>	<b>720</b>	<b>678</b>	<b>527</b>

### 3.2 LFS sample design (cluster selection)

The LFS sample design is based on data from the Census of Population and is redesigned after each decennial census to take into account the changes in the population. The current design is based on 1991 Census data.

The principles underlying the LFS sample design are the same for every province. First, each province is divided into a number of geographic regions, made up of Economic Regions (ERs), Employment Insurance Economic Regions (EIERs) and of their intersections. In particular, every census metropolitan area forms a geographic region since it is an EIER.

Each geographic region is then divided into types of areas, primarily urban areas, rural areas and remote areas. The sample design varies according to the type of area. Remote areas represent the northern parts of some provinces and are, for the most part, sparsely populated. These areas are excluded from the FES. The sample design of the urban and rural areas is described below.

## Urban areas

In some major cities with large numbers of apartment buildings, both an apartment list frame and an area frame are used. In other urban areas, only an area frame is employed.

An area frame is made up of a list of geographic zones. These zones are combined to form strata. There can be up to three levels of stratification. At the top levels, the aim is generally to form geographically compact and contiguous strata, whereas at the bottom level the requirement is for final strata to be as homogeneous as possible with respect to certain socio-economic characteristics. In a few large cities<sup>4</sup>, separate strata are formed from enumeration areas with high average household income (about \$100,000 or more).

To reduce collection costs, the dwellings that make up the final stratum are not selected directly. The stratum is first divided into clusters. In urban areas, the clusters may be combinations of block-faces, enumeration areas (EAs) or parts of EAs. Then clusters are selected (usually six, sometimes a multiple of six) in each stratum with a probability proportional to cluster size. For example, if the size of one cluster is twice as large as the one of another cluster, the former will be twice as likely to be selected as the latter.

The apartment list frame is a list of apartments prepared using information from the Canada Mortgage and Housing Corporation. This frame provides better representation of apartment residents and minimizes the effect of cluster growth due to construction of new apartment buildings. In some cities<sup>5</sup>, apartment strata are divided into two categories: low-income (where the average household income is under \$20,000) and regular. For each stratum in the frame, apartment buildings are selected for the first-stage sample with a probability proportional to the number of apartments in the building.

In low-density urban areas, which are highly dispersed towns, a different sample design is used. Sampling is done in three stages: first, towns are selected within the strata; next, clusters (block-faces) are chosen within the towns; finally, dwellings are selected within the clusters.

## Rural areas

Only an area frame is used in rural areas. Geographic strata are formed by combining two or three census divisions, which are then subdivided, where numbers permit, to form strata that are homogeneous with respect to certain socio-economic characteristics. In the first stage of sampling, enumeration areas are selected within each final stratum with a probability proportional to the number of dwellings in the EA.

In low-density rural areas, a variation on the sample design is used. Two or three primary sampling units each consisting of a group of six EAs are selected in the

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4. Montreal, Ottawa, Toronto, Hamilton, London, Winnipeg, Calgary and Vancouver.

5. Montreal, Ottawa-Hull, Toronto, Winnipeg, Calgary, Edmonton and Vancouver.

first stage, and then a sample of dwellings is selected within each of the EAs in the selected primary sampling units.

### **3.3 Selection of the FES sample**

Interviewers visit the clusters selected in the LFS sample design and make a list of all private dwellings they contain. From that list, one sample is chosen for the LFS and a different one is selected for the FES. Dwellings are selected by systematic sampling.

Since the FES uses a much smaller sample than the LFS, dwellings are not selected in every LFS cluster. The LFS is a panel survey in which households remain in the sample for six months. The LFS sample was designed so that it could be divided into six representative subsamples to permit rotation of one sixth of the sample each month. That is why six clusters (or a multiple of six) are selected in each final stratum, one per rotation group. This method makes it easy to select a smaller sample for another survey since a subset of the rotation groups can be used. This is generally the approach used for LFS supplementary surveys. For the FES, the number of rotation groups is determined at the stratum level according to the survey's specific needs with regard to provincial and subprovincial allocation of the sample. In some instances, only part of a rotation group is needed. Where this is the case, dwellings are removed from the sample with a systematic drop on a geographically ordered list.

The dwelling sample is obtained following the cluster listing operation. Since the sampling rates are predetermined, there may be a difference between the expected and actual sample sizes if the number of dwellings on the list differs from the number used in developing the survey's sample design. To keep collection costs in check (since cluster sizes tend to increase) and prevent significant disparities in interviewer workloads, two methods are used to control the sample size.

The first method, which is used in general, consists to correct the problem by systematically removing some of the originally selected dwellings. This process of keeping the sample size at the desired level is known as sample stabilization. The second method is used when the number of dwellings increases sharply in certain urban areas. In this case, cluster subsampling is used instead. There are three options, depending on how large the increase is and how similar the new dwellings are to others in the same stratum: form subclusters, create a new stratum, or subsample the dwellings in the cluster.

## **4. Data collection**

The FES gathers information on food expenditure by Canadian households on a voluntary basis.

## 4.1 Data collection method

Data are collected through in-person interviews using a paper questionnaire (FE2) and two weekly diaries of purchases (FE3) that the respondent must fill out daily over two consecutive weeks. The survey is conducted every month during a single calendar year and the data are collected from households coming from a different sample of dwellings each month.

The questionnaire is used primarily to gather data on certain socio-economic characteristics (for example, number of people, household income) and information on household purchasing habits and their food expenditures during the previous month.

The diaries serve to collect daily food expenditures in stores and in restaurants. In the case of spending done in stores, the details include a description of the item purchased, the type of processing (fresh, frozen, canned, dried, other), the type of store (supermarket, specialty store, corner store, other), the number of units purchased, the net weight or volume per unit (in metric or imperial measure) and the total cost of the purchase. In the case of spending done in restaurants, the details include the type of meal (breakfast, lunch, dinner, snack), the number of meals purchased, the type of restaurant (table service, fast food, cafeteria, other), and the total cost of the purchase, excluding the costs, taxes and tips related to alcoholic beverages.

In addition, for 2001, respondents were strongly encouraged to attach their receipts to the page in the diary corresponding to the date of the purchase. There was another new element in 2001, namely the notebook. All members of the household aged 10 years and older were given a small notebook to carry around at all times in which to record products at the time of purchase.

### Members of the household

To obtain the expenditures of a household, it is essential to properly identify the members that make up that household. The person or group of people who occupy a dwelling constitute a household. For the FES, the members of that household are the persons living in the dwelling at the time of the interview who do not have a permanent residence elsewhere and who are not members of another household.

## 4.2 Interview and follow-up procedures

The interviews are conducted by Statistics Canada interviewers, some of whom also collect LFS data. These interviewers receive training specific to the FES.

One or two weeks before the month of the interview, the regional office mails an introductory letter to the occupants of the selected dwellings stressing the importance of the survey and the confidentiality of the information gathered, along with a brochure providing additional information on the survey. The interviewer then goes to the dwelling. If no one is home, further attempts are made to contact the household: for example, by visiting at different times of the day or by telephoning. The telephone number, if available, is part of the

information on the dwelling which is given to the interviewer. If the telephone number is missing, the interviewer tries to track it down.

During the initial meeting, the interviewer himself fills out the questionnaire (FE2) by recording the answers obtained from the respondent. He then gives the diaries (FE3) to the respondent providing explanations on how to complete them properly and setting a time to come back eight days later to collect the completed diary. At the time of the second visit, the interviewer collects the first diary, reminds the respondent to complete the second one and sets a final meeting date to collect that diary.

If a person refuses to participate in the FES, the interviewer completes a non-interview report and informs the senior interviewer as soon as possible. Depending on the comments received, the senior interviewer will decide whether or not to start refusal conversion attempts. Note that sending a letter for refusals mentioning the importance of obtaining the data may be useful, but has its limits due to time constraints as the data must be gathered over a two week period in the interview month.

### **4.3 Monitoring and controls**

All of the FES interviewers work under the supervision of a senior interviewer responsible for ensuring that the interviewers are very familiar with the survey's concepts and methods and for periodically overseeing the work and reviewing the documents completed. The senior interviewers work in turn under the supervision of program managers posted to each of Statistics Canada's regional offices.

At the end of each weekly reporting period, the interviewer returns to the respondent's residence to collect and review the diary from the previous week to ensure that it is complete and accurate. If the diary was not completed, the interviewer tries to complete it by asking the respondent to recall what his expenditures were. He also uses this opportunity to gather information on what factors may have influenced the respondent's habits and expenditures. Some of the factors might be the absence of members of the household during the week, the number of meals served to guests or other people not part of the household, the number of meals received free, donations of food, or food from the respondent's farm business or garden, or from hunting or fishing.

### **4.4 Non-response to the FES**

Despite the interviewers' best efforts to gather the information, there are always a certain number of non-respondent households. It may not have been possible to contact them, an interview may not have been conducted for reasons beyond anyone's control, or the members of the household may have refused to participate in the survey. Collection non-response rates for the past two surveys are shown in Table 4.1.

**Table 4.1**  
**FES non-response rates**

Reference year	Non-response rates			
	At collection time			Final total
	Total	No contact	Refusal	
1996	21.8	4.6	17.2	23.7
2001	28.5	11.4	17.0	28.5

In 2001, the final non-response rate is equal to that of the collection non-response rate. In 1996, the final non-response rate was 23.7% as a result of 280 questionnaires that were answered but could not be used. This difference is explained by a change in data processing between 1996 and 2001.

There are also respondents who report only one week of data. In 2001, for the 10 provinces, this situation occurred in slightly less than 5% of cases. In 1996, it was slightly less than 2%.

## 5. Data processing

The main steps in the processing of FES data are response coding, data capture, editing, imputation of partial non-response, and weighting. The latter will be covered in Section 6.

### 5.1 Coding, data capture and editing

Coding is an important step in the FES. Basic coding is done on the questionnaire and a lot of coding is done on the diaries: all the descriptions of the bought items declared in the diaries must be coded. Note that in 2001, the coding was done by specialized personnel from this survey, which was not the case in 1996.

The coding is done at the Head Office of Statistics Canada (SC). In the case of the diaries, the coders use software developed in the Income Statistics Division of STC to help choose the appropriate food codes and write the codes in red directly on the diaries. When the description of the item purchased is missing or not detailed enough, the most appropriate unspecified food code is given and will be handled in the automated imputation process mentioned in the next section.

In the case of food purchased from stores, each entry of a diary consists of the following fields: the description of the item purchased, the type of processing, the type of store, the number of units purchased, the net weight or volume per unit and the total cost of the purchase. All fields that are missing, other than the description of the item, are imputed by the coder using the other information present in the diary. For quality control, some respondents' questionnaires and diaries are selected randomly and checked by the senior coders.

After the coding is done, the questionnaires and diaries are captured. The main automated edit during capture is the one checking the validity of the food codes. If a food code is not valid, the keyer checks if it is a keying error. If this is not the case, the keyer enters a specific code so that when it goes through a series of automated edits after data capture, this food code will be flagged as needing correction.

In terms of data capture, a workload for a keyer is 20 respondents' questionnaires and diaries split into 4 batches of 5. As a quality check of data capture, a batch is selected randomly. If the data quality of the batch is acceptable, then the workload is accepted, if not then the 3 other batches are checked.

Finally, captured data pass through a series of automated edits. When there are errors, some of them are imputed automatically while the others, after a final look at the questionnaires and/or diaries, are imputed or flagged manually as needing to undergo the automated imputation process.

## 5.2 Imputation

As already mentioned in the previous section, during coding and data capture the questionnaires and diaries are submitted to some manual and automated edits, as well as to some manual or automated imputations including fields flagged as needing to go into the automated imputation process.

The fields that are flagged to be imputed are mostly missing fields. An example of a missing field on the questionnaire (FE2) is having an expenditure for restaurants but the number of meals purchased in them missing. An example of a missing field on the diary (FE3) is having beef as a purchased item, but the type of beef (ground, stewing, etc.) missing. More than one automated method of imputation is used, but the basic one in 2001 is the nearest-neighbour method.

This technique involves forming groups of similar households based on certain classifications (e.g., province of residence, quarter of data collection). Within those groups, each household requiring imputation (recipient) is matched to a household that has a complete questionnaire (donor) and resembles the other most closely with respect to certain characteristics (e.g. income, household size, etc.). The donor's data are imputed to the recipient as long as they satisfy the edit requirement for consistency with the data reported by the recipient. For example, if the recipient has indicated the purchase of prepared food then the imputed expenditures must be greater than zero.

If a donor cannot be found for some recipients during this first step, the donor imputation method is used again, dropping the household income resemblance, which is considered less significant than others. Many donor imputation steps are required in order to impute all recipients. For a few cases the most significant condition, which is the quarter, is also dropped to find a donor. For more details on the different donor imputation steps, see Reference [2].

In the case of the questionnaire (FE2), two sections are imputed: *Spending habits* (Section B) and *Food and beverages while away from home overnight or*

*longer during the previous month* (Section C). These sections are imputed independently since they are considered fairly independent from each other. Section B uses the nearest neighbour approach, but Section C in some cases uses other methods due to the difficulty of finding an appropriate donor. For example, some respondents have reported expenditures in restaurants but not the number of meals purchased or vice versa. These cases are imputed using the mean imputation method. The imputed mean used is the one at the national level.

In the case of the diary (FE3), for each day only the section *Food and beverages purchased from stores* is imputed. To impute this section, independent imputation runs are carried out based on the grouping of missing information needing imputation. Generally the imputation is done at the entry level but in some cases it is done at the day level. These cases occur when the respondent has only listed the total expenditures on food purchased from stores on a given day.

For imputation at the entry level, the respondent must have provided some additional information. For example, the respondent has purchased beef without specifying which kind of beef: ground, stewing, etc. In this case, the unit price is considered the most important matching criteria in finding a donor. If the unit price is missing then total expenditure is used for matching, along with other variables.

Some descriptions of items are broad, such as Vegetables for example. For the first time, in 2001, these descriptions are coded and imputed. Sometimes a donor cannot be found for some recipients because of a high expenditure reported with the description. To impute them, we sum for each potential donor all the expenditures in a day with the appropriate food entries (all vegetables for example). When a donor is found with a sum of expenditures matching the recipient's high expenditure, then all the appropriate food entries of the donor are assigned to the recipient.

Day level information will be imputed if the respondent has just listed the total expenditures on food in any day. The recipient day's expenditure is matched to the donor total day's expenditure. Days are considered as donors only if they do not have any imputation at the entry level. All entries of a selected donor's day are assigned to the recipient record. The recipient total expenditures will be overwritten with the donor total expenditures when the two numbers do not match exactly.

Finally, note that households providing data for only one week, out of two, are not imputed for the week they did not report.

## **6. Weighting and estimation**

Estimates are based on the principle that each household in the sample represents a certain number of households in the target population, as defined in Section 2. Therefore each respondent household is assigned a survey weight,



which indicates how many households in the population it represents. This survey weight is generally the product of three factors: a design weight that incorporates data from the sample design, an adjustment factor for non-response that offsets non-respondent households, and finally an adjustment factor to re-adjust the estimates of some characteristics of the sample based on estimates coming from external sources considered more reliable.

## **6.1 Design weight**

A household's design weight corresponds to the inverse of the probability that it is included in the sample. Since the FES is a probability survey, each household of the target population has a known probability of being selected in the sample. If, for example, a household's probability of being selected is 1 in 200, then this household will have a weight of 200.

The sample design, defining among other things the sample allocation method, determines the design weight. The FES uses the sample design of the LFS, which is a sample design self-weighted in each stratum. This means that the design weights established when the design is developed are equal in each of the stratum. To the extent that the sample design and sample allocation are not modified, the initial weights could be used. However, the stabilization steps and sub-sampling described in Section 3.3 alter the initial selection probabilities. Consequently, the LFS design weights are adjusted to take these changes into account.

Since the FES sample is a sub-group of the six LFS rotation groups, the survey's design weights are obtained by adjusting the LFS design weights based on the number of rotation groups used. This latter factor can vary from one stratum to another since the number of rotation groups used in each stratum is set so as to meet the specific needs of the FES for sample allocation. In most cases, because of the very small size of the FES, it was necessary to sub-sample within an LFS rotation group. The weights are therefore also adjusted to take this step into account.

## **6.2 Adjustment for total non-response**

When a respondent fails to respond to certain questions on the FE2 questionnaire or leaves out certain information on the expenditures reported in the diary, the missing data are imputed using the methods described in Section 5.2. The weights are adjusted to compensate for total non-response (when the household cannot be contacted or refuses to respond).

The adjustment of the weights for total non-response is based on the hypothesis that the characteristics of the non-respondent households are similar to those of the respondent households and, therefore, the latter can be used to represent all households: respondents and non-respondents. To make the adjustment, the sample is first subdivided into non-response classes defined in such a way as to increase the chances that respondents and non-respondents have similar characteristics. These characteristics are chosen based on what the survey is looking to measure.

Non-response classes were defined quarterly since the size of the sample did not allow definition of classes for each month.

Non-response classes by quarter correspond to the different levels of urbanization in each region. The levels of urbanization are generally as follows: main metropolitan areas, urban areas of over one million inhabitants, other smaller urban areas and finally, rural areas. In some regions, it may be necessary to combine some levels because the sample is too small. In each of the three cities of the territories, there are only four non-response classes, each representing one quarter.

High-income household strata also constitute specific non-response classes in each of the regions in which they exist. Non-response classes do not overlap and when combined, they cover all of the target population.

For each non-response class, a non-response compensation factor is calculated and defined as the inverse of the weighted response rate of the class. This factor, in other words, is the ratio of the number of weighted sampled households, so that they represent all the households in the class, over the number of weighted respondent households. To avoid adjustment factors for non-response that are too high, as many non-response classes as possible are combined when the adjustment factor is higher than 2.

### **6.3 Adjustment to auxiliary data**

In principle, by multiplying the design weight by the adjustment factor for non-response, it is possible to produce estimates at the population level. However, auxiliary data on the target population can be used to improve the survey's estimates. More reliable estimates can be produced if these auxiliary data are correlated to the main characteristics measured by the survey. For example, food expenditure is correlated to the size of the household. An incorrect distribution of the sample in terms of the size of the household would impact expenditure estimates. Using auxiliary data on the number of households by size, the weights can be adjusted to obtain a better distribution of the number of households.

In the FES, several sources of auxiliary data are used to adjust weights. First of all, post-censal estimates of population, produced by Statistics Canada's Demography Division, provide counts of the number of people by various age groups and by gender per province or territory. These counts correspond to population estimates at a given time based on census data and on information from administrative files, such as births, deaths, immigration, emigration, etc.

These demographic estimates are adjusted to take into account certain specific exclusions to household surveys, such as people living in institutions. From a design standpoint, they differ slightly from the FES target population by including people residing in collective households that are not institutions, for example, members of groups living in communal colonies and individuals residing full-time in hotels or rooming houses. However, this difference is considered negligible because these individuals represent less than 0.4% of the Canadian population.

These counts are then adjusted to reflect the FES target population at the end of the survey's reference year. This adjustment includes the exclusion of remote areas because they are not covered by the survey. Counts for six age groups for each region<sup>6</sup> are used to adjust the weights. The demographic counts of the number of people aged 18 or older and the number of people under 18 years of age in certain metropolitan areas<sup>7</sup> are also used.

The estimates of the number of households by size (one, two, or three or more persons) for each region and the number of households by certain types of household are also used to adjust the representativeness of the sample in these groups. For types of household, we use more specifically the number of households consisting of a lone-parent family and the number of households composed of parents with children who have never married.

For the city of Whitehorse, we use estimates, derived<sup>8</sup> from those of the Yukon, of the number of households by size (one, two, or three or more people). For the cities of Yellowknife and Iqaluit, we use only the estimate of the number of households. In the case of Yellowknife, the estimate was derived from that of the Northwest Territories. For Iqaluit, we used the preliminary estimate of the number of households following the 2001 Census given the unusual growth of this city as a result of the creation of the territory of Nunavut in 1999.

The adjustment of the weights to take into account all of the above counts is done simultaneously using a variant of the generalized regression estimator (GREG), which is based on the weighting method proposed by Lemaître and Dufour [3]. With this method, it is possible to match the survey's estimates with estimates from auxiliary sources and ensure, at the same time, that all members of the household will still have the same weight after adjustment. The adjustment factor calculated by the GREG is then applied to the design weight and to the non-response adjustment factor to produce the household's final weight.

A slight variation on this method had to be used for Yellowknife and Iqaluit. Although only the number of households was controlled, estimates of the number of households by size were unacceptable after application of the method as such. For further details, see Reference [4].

## 6.4 Other adjustments

During the in-person interviews with the questionnaire (FE2), respondents were asked to indicate the household expenditure for food purchased at stores over a four-week period. The expenditure estimate obtained from the questionnaire (FE2) was 8.3% higher than that obtained from the diary data (FE3). It is felt that the burden imposed by requiring the respondent to fill out the two diaries (FE3), which consists mainly of reporting a wide variety of items over a two-week

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6. In Whitehorse, only two groups are used: under 18 and 18 or over. In Yellowknife and Iqaluit, there is no adjustment done in terms of number of people.
  7. The metropolitan areas are as follows: St. John's, Halifax, Saint John, Québec, Montréal, Ottawa, Toronto, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver and Victoria.
  8. Estimates for a city in one of the territories are obtained from equivalent estimates of its territory multiplied by the proportion of the territory that this city represents based on the 1996 Census.

period, may lead to respondent fatigue and may affect the quality of the responses obtained. Based on the assumption that the estimate of food purchased in stores from the questionnaire is more reliable than the corresponding diary estimate<sup>9</sup> due to the burden related to the diary, the values for each household of food purchased in stores locally and while on one-day trips were multiplied by 1.083.

To take into account the seasonality of food expenditures, the data collection is done during all 12 months of the year. The strategy chosen to realize this is to divide the sample evenly into 12 subsets – that is, one subset per month. Another potential adjustment to this type of survey would be a temporal adjustment. Data collection problems encountered in a specific month, for example, might justify this type of adjustment. To date, with the current adjustments, a temporal adjustment has not been considered necessary.

## 6.5 Estimates

The FES gathers food expenditure data from respondents over a two-week period. Some respondents only provide expenditures for one week. In order to calculate the estimate of average weekly expenditure per household for an item, we calculate the estimate of its total expenditure divided by the estimate of the number of diaries. As well, to calculate the percentage reporting for an item, we calculate the estimate of the number of diaries reporting an expenditure for that item divided by the estimate of the number of diaries.

## 7. Estimation of the sampling error

After the estimates have been calculated, it is necessary to determine the reliability of those estimates, or in other words, to estimate the sampling error associated with each estimate. The standard error or coefficient of variation (CV), which is simply the standard error expressed as a percentage of the estimate, is the common measure of the sampling error. It corresponds to the degree of variation observed in estimates after selecting a particular sample rather than another. Since the FES is a probability survey, it is possible to estimate the standard error of the estimates.

In the FES, the jackknife method is used to estimate the standard error. This method involves creating replicates of the sample based on FES data. As many replicates are created as there are first-stage sampling units (primary sampling unit or PSU)<sup>10</sup> by removing one PSU from the sample for each successive replicate. Each PSU is part of a stratum and when one PSU is removed, the design weights of the other PSUs in the stratum are adjusted to compensate for the removal. The final estimates are then recalculated using the adjustments to the auxiliary data described in Section 6.3 applied to the replicates. By repeating this operation for each PSU in the sample, we get the same number of estimates as there are PSUs. The variability between these estimates is used to estimate

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9. Other analysis supports this assumption. For further details, see Reference [5].

10. The PSUs, in the case of the FES, are the clusters. For further details, see Section 3.

the standard error of the estimate from the whole sample. The detailed formula is found in Appendix A

### **7.1 Model for deriving an approximation of the CV for domain estimates**

For operational reasons, it is not possible to produce CVs for all the various levels of aggregation that may be of interest to users, for example, by type of household, by level of urbanization or for certain metropolitan areas. The approach suggested to FES users is to calculate an approximation of the CV using a relationship of the number of diaries in which expenditures for an item were reported to the CV at an aggregate level (generally at the national level). This relationship, based on the CV's tendency to grow inversely proportional to the square root of the number of diaries with a non-zero amount, is shown in Appendix B.

### **7.2 Model for deriving an approximation of the CV from microdata files**

Users of microdata files can use another approach to derive an approximation of the CV of an estimate, which will generally be more accurate than the one described above. This approach, which is relatively simply to apply, is described in greater detail in Reference [6]. It can only be used with the microdata files because both the data and the weights for each household are needed to calculate this approximation.

## **8. Suppression of data and confidentiality**

A number of measures are taken to ensure that the estimates produced from the FES are sufficiently reliable to be published and that the anonymity of the households is respected.

### **8.1 Suppression of unreliable data in the tables of estimates**

Since the coefficient of variation is an indicator of the reliability of the data, ideally we would use it to determine whether the estimates should be published or not. Estimates with a CV estimated at more than 33% are not reliable enough to be published.

However, the large number of estimates produced from the FES means that it is not possible to calculate the CVs for each of these estimates. A study conducted using the data of the 1996 and 2001 surveys revealed that the CVs are generally 33% when the number of diaries with a non-zero amount is around 40. This rule is therefore applied to determine whether the FES estimates can be published. Since this is an approximate rule, some estimates will be published even when the CV is higher than 33%, while some will not be published even though the CV is less than 33%. The report on the quality of the 2001 data [7] contains an evaluation of the performance of this rule.

It is important to note that even though estimates for a certain category of food are not released because fewer than 40 diaries contained a non-zero amount for that category, the data are retained in the estimates of the aggregate components.

## **8.2 Confidentiality of the microdata files**

Although public use microdata files are developed from the data gathered by the FES, they are different from the files used by Statistics Canada for the dissemination of estimates. These differences are due mainly to a series of measures taken to protect the anonymity of the households responding to the survey.

## **9. Changes in the survey methodology**

The survey's methodology remained similar to that of 1996 except for the strategies for imputation and for adjustment of the auxiliary data in the weighting. The sample design was also modified as a result of the reduction in the size of the sample for budget reasons. The goal at this time is to obtain estimates with reasonable variances at the level of the five Canadian regions rather than the ten provinces.

The weighting strategy was modified as part of a project to harmonize the auxiliary data adjustments in Statistics Canada surveys related to income statistics. For the FES, the principal changes were the use of more age groups for demographic counts and the addition of counts at the household type level. To ensure comparability of trend analyses, the 1996 FES was re-weighted using this new strategy and demographic estimates based on the 1996 Census rather than those based on the 1991 Census that were used in the original weighting.

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## APPENDIX A

### Formula for calculating the variance of estimates using the jackknife method

In the jackknife procedure for estimating the variance of estimates, the variability between the estimates is measured using the following formula:

$$Var(\hat{Y}) = \sum_{h=1}^H \frac{n(h) - 1}{n(h)} \sum_{i=1}^{n(h)} (\hat{Y} - \hat{Y}_{(hi)})^2$$

where

$n(h)$  is the number of PSUs in stratum  $h$

$\hat{Y}_{(hi)}$  is the estimate of  $Y$  when the PSU  $i$  of stratum  $h$  is removed.

The standard error is the square root of the variance.



## APPENDIX B

### Formula for approximating the CV for a domain (a sub-group of the population)

If  $CV(Y)$  represents the CV for the estimate of the average weekly expenditure per household of a certain characteristic for the whole of the population, then it is possible to calculate an approximation of the CV of the estimate of that characteristic for a domain (which can be considered a sub-group of the population, such as type of household, level of urbanization, ...) using the following equation:

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

where

$n$  = the number of diaries with a non-zero amount for the characteristic

=  $\frac{\text{the number of diaries} * \text{the estimate of the percentage reporting}^{11}}{100}$

-----  
100

$n_d$  = the number of diaries with a non-zero amount for the characteristic in domain  $d$

=  $\frac{\text{the number of diaries in domain } d * \text{the estimate of the percentage reporting in domain } d}{100}$

-----  
100

In general, the CV, the number of diaries and the percentage reporting at the national level are used to calculate approximations for various domains. In a case where we want to calculate an approximation of the CV of a domain wholly contained in a single region (e.g. metropolitan area), it is preferable to use these values at the regional level since the regional CVs are published for the FES.

You will find an example of the calculation on the next page.

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11. Percentage of diaries with a non-zero amount for the characteristic.

### Calculation example

In Table 2b of the publication of the 2001 FES [8], there are different estimates by income group, but the CVs associated with these estimates are not found in the publication.

The CV of average weekly expenditure per household for food purchased in stores in the case of all households in the lowest income group, based on the formula provided above and using Tables 2a, 2c and the technical table 2b, is

$$= 1.04\% \times \sqrt{10140/1756}$$

$$= 1.04\% \times 2.40$$

$$= 2.50\%$$

where  $n$  is the number of diaries with a non-zero amount

$$= (\text{number of diaries} \times \text{percentage reporting}) / 100$$

$$= (11,034 \times 91.9) / 100$$

$$= 10,140$$

and  $n_d$  is the number of diaries from households in the lowest income group with a non-zero amount

$$= (\text{number of diaries from households in the lowest income group} \times \text{percentage reporting for households in the lowest income group}) / 100$$

$$= (2,011 \times 87.3) / 100$$

$$= 1,756.$$