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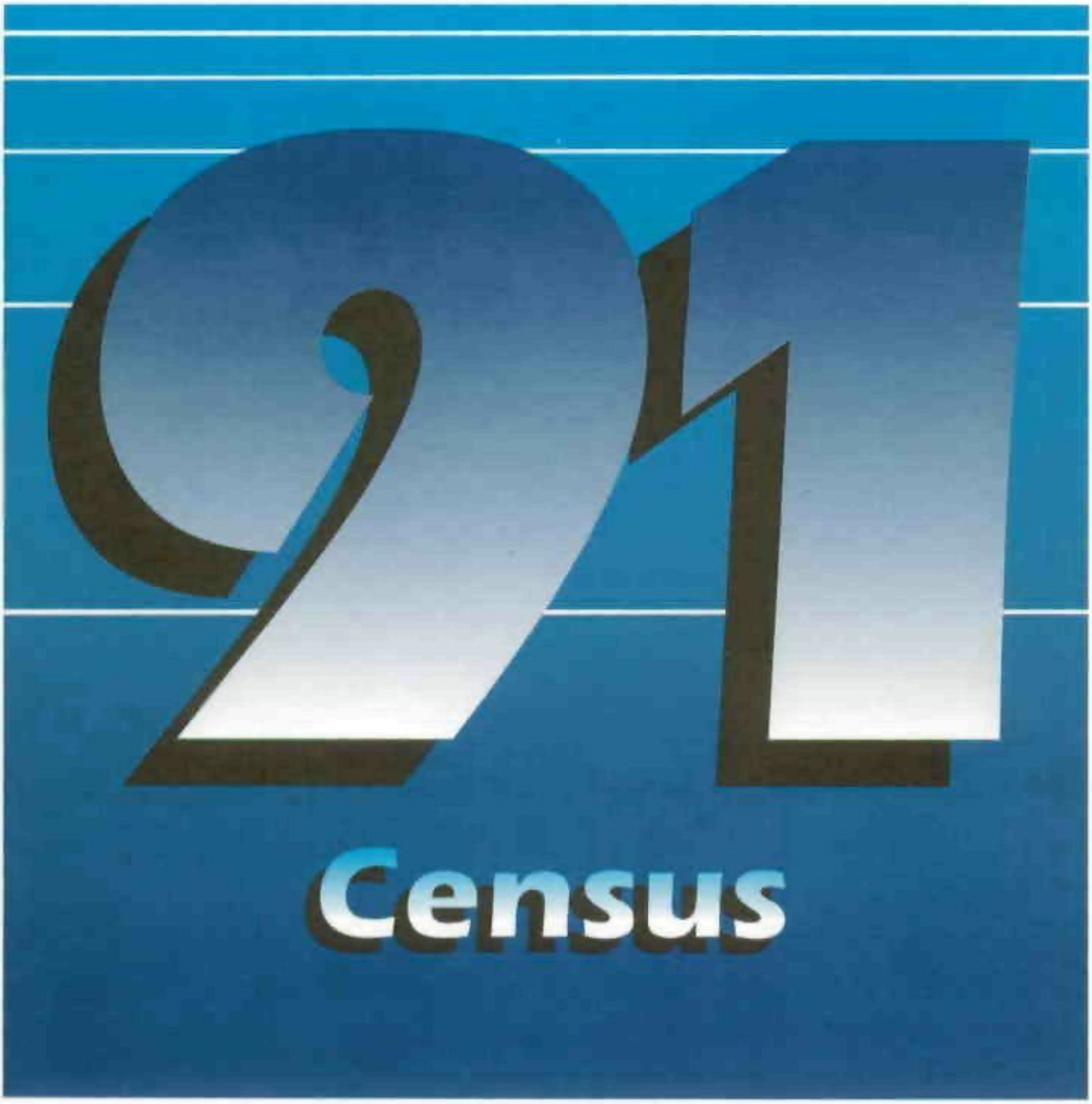
Catalogue 92-343E

Place of Work

1991 Census Technical Reports



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Place of Work

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Preface

Through time, the Census of Canada has become the primary source of information about Canadians and how they live. Decisions based on this information affect the social and economic affairs of all Canadians.

Statistics Canada, as the professional agency in charge of producing this information, has the responsibility for informing users of data quality. The agency must describe the concepts and methodology used in collecting and processing the data, as well as any other features that may affect their use or interpretation.

In order to describe the quality of the 1991 Census data, Statistics Canada has prepared the following publications: a census **Dictionary**, which provides concise and easy to understand textual and graphical information pertaining to census concepts; a **Handbook**, which provides an overview of how the census is conducted; and a series of **Technical Reports**, which present in greater detail, information on the quality of data for specific characteristics, such as occupation, as covered in this report.

Information on data quality is important for users. It allows them to assess the usefulness of census data for their purposes as well as the risks involved in basing conclusions or decisions on these data. The 1991 Census was a large and complex undertaking and, while considerable effort was taken to ensure high standards throughout all collection and processing operations, the resulting data are inevitably subject to a certain degree of error.

Information on data quality is also important to Statistics Canada. It is an integral part in the development and maintenance of pertinent and reliable statistical programs.

This publication is a major contribution to achieving these goals. It has been prepared by Brad Hawkes, Richard Nadwodny, and Brett Singbeil, from the Place of Work Unit, of the Census Operations Division.

Finally, I would like to express my appreciation to the millions of Canadians who completed their questionnaires on June 4, 1991, as well as to those who assisted Statistics Canada in planning and conducting the census.

Ivan P. Fellegi

Chief Statistician of Canada

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I. Introduction

Every five years a census of population is carried out in Canada. The national Census of Population is a major project conducted by Statistics Canada to collect, verify and publish data. The national Census provides the most comprehensive database on the characteristics of Canadians, their families and their households. The information ranges from age and sex of individuals to their ethnic origin, education, occupation, labour force activity, industry, sources of income, their family and household characteristics. The census is an invaluable source of information that is useful to the various levels of government, to businesses, associations, educational institutions, interest groups, and to the general public. The data can be used in government planning of social and economic programs, assessment of the need for educational and health facilities, and planning by private enterprise.

Information is obtained through a series of questions established after detailed consultation and testing. It is collected by trained enumerators, checked for inconsistencies and errors and forwarded to Revenue Canada Taxation (RCT) regional centres for data entry. The final results are placed on a computer database at Statistics Canada. Data are analyzed, published and disseminated in various forms.

In a massive project such as the census, however, the results are never perfect. Although considerable effort has been made to maintain high standards of quality, errors inevitably occur at various stages of the collection and processing operations. Users must be aware of the nature and scope of any errors that the census data may contain, as well as the risks involved in basing conclusions or decisions on these data.

The 1991 Census Technical Reports have been designed to inform data users of the potential problems or intricacies of the data. The reports inform users of the conceptual framework and definitions used in the data collection, any unusual circumstances which may influence the data, likely principal sources of error and, where possible, the size of the error.

This product is a specialized analytical tool. It complements and co-ordinates other reference products and assists the more sophisticated user to understand variable details and methodological information on coverage, sampling and weighting.

II. Concepts and Definitions

Census data are produced for four distinct "universes", namely the population universe, the family universe, the dwelling universe and the household universe.

The Place of Work variable discussed in this report falls under the population universe. The population universe covers a wide variety of characteristics (demographic, ethno-cultural, income, language, mobility, schooling, labour force, etc.) of individuals. A complete list of population universe variables can be found in the ***1991 Census Dictionary*** (Catalogue No. 92-301E).

1. Concept

In Canada, a large number of the working population commute to places of work located in areas other than their place of residence. To better understand the commuting phenomenon and its impact on the life of urban society, place of work data are used to identify public services requirements such as those for transportation facilities, schools, hospitals, day care and recreation facilities. The data are also used to analyze differential growth rates of industrialization within regions, and the phenomena of dispersion and decentralization of industry from central cores to peripheral zones in major urban areas.

The data represent a unique source of daytime demographic information, as they enable commuting structures to be linked with other census data. Since the data show local and regional commuter flows, they allow municipal and provincial governments to assess public transit needs and modifications to existing transportation systems.

2. 1991 Place of Work Concept

Place of work refers to the usual place of work of non-institutional residents 15 years of age and over who have worked since January 1, 1990. The variable usually relates to the individual's job held in the week prior to enumeration. However, if the person had not worked during that week but had worked since January 1, 1990, the information relates to the job held longest during that period.

Place of work response categories include:

Worked at home:

Includes those persons whose location of employment is in the same building as their place of residence and those persons living and working on the same farm.

Worked outside Canada:

Includes diplomats, Armed Forces personnel and others enumerated abroad; recent immigrants not currently employed whose job of longest duration since January 1, 1990, was outside Canada; and other persons who indicated that they worked outside Canada.

Worked at the address specified below:

This response category was to be checked off by persons whose place of work did not fall in either the "Worked at home" or "Worked outside Canada" categories. In addition, the full address of the place of work was to be reported. If the full address was not known, the name of the building or street intersection could be substituted. Persons who did not work in one area but who reported regularly to a headquarters were to give the address of the local headquarters or depot. Persons with no fixed or usual place of work were asked to write in **"No usual place of work"**.

1991 Place of Work Question and Instructions

The 1991 Census of Population place of work question appeared (approximately) as follows:

"At what address did this person usually work?"

If street address is unknown, print the name of the building or nearest street intersection. Some large cities are made up of smaller cities or towns called municipalities. Where applicable, distinguish between the municipality and the large city, such as Anjou and Montréal, Scarborough and Toronto, Burnaby and Vancouver, Saanich and Victoria.

01 ○ Worked at home
(including farms)

02 ○ Worked outside Canada

03 ○ Worked at the address specified below

Street address

City, town, village, township, municipality or Indian reserve

County (if known)

Province/territory

Postal code

04

05

1991 Census of Population "Census Guide" Instructions

Instructions included in the 1991 Census of Population Guide which accompanied the census questionnaire appeared (approximately) as follows:

Question 38: PLACE OF WORK

Information on a person's place of work is used to show local and regional commuter patterns and to determine what transportation networks would be needed to service the demand.

Indicate the regular places of work for all household members who are working, **even if they are away from work temporarily** on assignment, training or holidays.

If **Worked at the address specified below** was marked, give as complete an address as possible. For persons who worked in an area where the same name is used for both the city, town or village as for the parish, township or municipality, indicate which is correct by including the type (for example, St. Andrew's town or St. Andrew's **parish**; Granby **city** or Granby **municipality**).

Mark **Worked at home** for persons whose place of work was in the same building or residence as where they lived. Examples might include dressmakers, apartment building superintendents or business owners who live above their store.

For persons who work in a different job site or location every day, or travel as part of their job, enter:

(a) the address or name of their headquarters or depot if they report there before starting work each day;

(b) the address or building name if they work part of the time at a fixed address;

(c) **no usual place** in the space for address if they go directly from their home to various work locations.

3. Census Geography

Statistics Canada uses a very accurate and detailed geographic structure that makes it possible to obtain information for many different geographical units, known as geographic areas. Data from the 1991 Census are available for numerous standard geographic areas, as well as for non-standard or user-defined areas.

Census Boundaries

In order to take a census for a country as large as Canada, smaller geographic boundaries must be established to facilitate enumeration. The basic boundaries are those of the provinces (PROVs) and federal electoral districts (FEDs), as well as those of smaller units called enumeration areas (EAs).

Standard Geographic Areas

Census data are disseminated for a number of standard geographic areas. These areas are of two (2) types: legislative/administrative and statistical.

(a) Legislative/administrative areas are defined, with a few exceptions, by Canadian federal and provincial statutes. These include:

Geographic Area	Total Number
• provinces and territories;	12
• federal electoral districts (FEDs);	295
• census divisions (CDs);	290
• census subdivisions (CSDs);	6,006
• subprovincial regions (SPRs).	68

(b) Statistical areas are defined by Statistics Canada as part of the spatial frame used to collect and disseminate census data. These include:

Geographic Area	Total Number
• agricultural regions;	76
• census consolidated subdivisions (CCSs);	2,630
• census metropolitan areas (CMAs);	25
• census agglomerations (CAs);	115
• primary census metropolitan areas (PCMAs);	12
• primary census agglomerations (PCAs);	21
• census tracts (CTs);	4,068
• provincial census tracts (PCTs);	1,815
• urban areas (UAs)/rural areas;	893
• CMA/CA parts;	N/A
• CMA/CA components;	N/A
• enumeration areas (EAs).	45,995

Other geographical units of a quasi-standard nature are the **unincorporated place (UP), township, range and meridian** and **postal code**.

User-defined Areas

Census data can also be produced for areas other than the standard geographic areas, that is for user-defined areas. These are of two (2) types: aggregations of standard geographic areas and custom **query areas**.

4. Place of Work Geography

"Census agglomeration (CA) of work" refers to the census agglomeration of work of those persons whose census subdivision of work is within a census agglomeration.

"Census division (CD) of work" refers to the census division of work of each respondent whose place of work is not outside Canada, although persons with no usual place of work may or may not have a code for this geographic

area. CD codes are unique only within each province. They should therefore be used in conjunction with the province/territory of work.

"Census metropolitan area (CMA) of work" refers to the census metropolitan area of work of those persons whose census subdivision of work is within a census metropolitan area.

"Census subdivision (CSD) of work" refers to the census subdivision (municipality) of work of each respondent whose place of work is not outside Canada, although persons with no usual place of work may or may not have a code for this geographic area. CSD codes are uniquely defined within each census division. They should therefore be used in conjunction with the census division of work and the province/territory of work.

"Province/territory of work" refers to the province or territory of work of each respondent whose place of work is not outside Canada, although persons with no usual place of work may or may not have a code for this geographic area.

See the Appendix section for a more detailed description of geographic concepts and geographical units. An in-depth look at terms related to the geography of the 1991 Census is to be found in the "Geography" section of the ***1991 Census Dictionary***. This section describes, more extensively, concepts related to geographic areas and census cartography.

III. Data Collection and Coverage

For the 1991 Census, information was collected from more than 11 million dwellings both in Canada and abroad. The data collection process consists of the drop-off and retrieval of approximately 11,500,000 questionnaires. These questionnaires are then edited to ensure they have been properly completed by all Canadians across the country. This phase employed approximately forty thousand (40,000) people in a variety of tasks from mapping to post-censal activities.

1. Data Collection Methods

Two **collection methods** were used for the 1991 Census: **self-enumeration** and **canvasser enumeration**. In self-enumeration areas, a questionnaire (Form 2A or Form 2B) was dropped off at each household before Census Day (June 4th). A member of the household was to complete the questionnaire on Census Day. Questionnaires were mailed back in pre-addressed envelopes. In 1991, less than 2% of households were enumerated by canvassers: Census Representatives completed a long form questionnaire (Form 2D) for these households by interview. This method was used to enumerate each household in remote or northern areas and on Indian reserves where irregular mail service makes mail-back impractical. Some of the remote areas were enumerated as early as March 1991. Data was collected on ***every Canadian citizen, landed immigrant and non-permanent resident alive at midnight between June 3rd and June 4th 1991.***

The two main types of accepted **enumeration approaches** used by census takers are the **"de jure"** approach and **"de facto"** approach. The "de jure" approach assigns the person to the dwelling in which he/she usually resides. The "de facto" approach assigns the person to the dwelling in which he/she is staying at the time of enumeration. In Canada the **"modified de jure"** approach is used. It allows a subsequent matching process to determine whether or not a person enumerated in one dwelling as temporary was also identified as a usual resident in his/her stated usual place of residence. This approach recognizes, and compensates for the potential failure of a straight "de jure" approach to enumerate persons away from their usual place of residence on census night.

In 1991, a number of initiatives were taken to improve coverage. These included:

- using paid advertising to inform Canadians on when and how "to count themselves in";
- creating an address register from other sources of information and using this list to check if any dwellings were missed;
- establishing special procedures to count homeless people through soup kitchens;
- establishing special procedures to count the population on Indian reserves;
- respondent-friendly questionnaire;
- public Communications Program and a multilingual Telephone Assistance Service;
- edit and follow-up by Census Representative for non-response and missing information;
- quality checks of the Census Representative's work by the Census Commissioner and the Quality Control Technician.

The primary components, documents and geographical unit used for data collection and coverage are:

- **Visitation Record (VR) (Form 1)**
  A document used by Census Representatives to list the household numbers and the number of persons per household including temporary residents in all enumeration areas. The VR lists every private and collective dwelling (occupied and unoccupied), as well as every agricultural holding in an enumeration area. The VR also provides control totals to help ensure that all dwellings and persons were enumerated.

- **Census of Population Questionnaires**
  Seven questionnaires have been designed for the collection of data. The 1991 Census Questionnaires include:

Collective Dwelling Record	(Form 1A);
Short Questionnaire	(Form 2A);
Long Questionnaire	(Form 2B);
Overseas Population Form	(Form 2C);
Long Canvasser Questionnaire	(Form 2D);
Individual Census Questionnaire	(Form 3);
Soup Kitchen Questionnaire	(Form 3B).

- **Enumeration Area (EA)**
  An EA is an area canvassed by a Census Representative. It is the smallest geographical unit for which census data are available. The number of dwellings vary from 375 (maximum) in large urban areas to 125 (minimum) in rural areas.

Please refer to the **Long Questionnaire (Form 2B)** for questions asked in the 1991 Census of Canada.

2. Address Register (AR)

In 1991, to help increase coverage, an Address Register (AR) was implemented in urban areas with populations of fifty thousand (50,000) and over. The Address Register is a list compiled by merging several administrative data files from a variety of sources. The Census Representative was to compare the addresses in the Visitation record when the questionnaires were delivered with the addresses in the list taken from the Address Register. If an address appearing in the AR did not match any address in the Visitation Record, the Census Representative returned to the sector again to locate the dwelling at the missed address. Conversely, any address entered by the Census Representative that was not in the AR was added to the AR after the census.

3. Special Coverage Studies

Since one hundred percent (100%) coverage is virtually impossible in such a large survey, a number of checks are performed on the collection of data. These studies measure the extent of coverage errors that occur when dwellings or individuals are missed, incorrectly included, or double-counted. Some examples of these checks are the **Vacancy Check, Temporary Residents Study, Reverse Record Check**, and the **Overcoverage Study**. These studies will be discussed in more detail in the following chapters on Data Assimilation (Chapter IV) and Data Evaluation (Chapter VI), and in the 1991 Technical Report on coverage (Catalogue No. 92-341).

4. Sampling and Weighting

The 1991 Census data were collected either on a 100% basis (i.e., for all households) or on a sample basis (i.e., from only a systematic sample of households) with data weighted to provide estimates of the entire population. The place of work data to which this report refers was collected on a 20% sample basis and weighted up to compensate for sampling. All table headings are noted accordingly. Note that, on most Indian reserves, collective dwellings and remote areas, data were collected on a 100% basis.

For the 20% data, a weighting algorithm was developed so that these data could be used to estimate responses from 100% of the population. The procedure to weight sample data in 1991 has been revised from 1986 and is known as the "Generalized Least Squares Estimation Procedure (GLSEP)". In order to produce these weights, the GLSEP begins with initial weights of approximately 5 and then, using basic census information known for every person, i.e., age, sex, marital status, adjusts them to obtain the desired agreement between the sample estimates and the population counts.

Once data are finalized and weights are calculated, final data are transferred to the Canada Retrieval Databases and these bases are used to produce the published and custom products.

5. Edit and Follow-up

Data collection staff, or Census Representatives, across the country were responsible for a preliminary data quality check. The first quality control operation was to verify that a response was given to each question by every enumerated person receiving the 2A and 2B Census forms. In the case of non-response, the census representative was required to follow up, that is, contact the respondent in question and attempt to obtain the missing information.

6. Coverage

Respondents were required to meet the following eligibility criteria:

- Canadian citizen or landed immigrant on Census Day;
- Canadian citizen or landed immigrant who was outside Canada on Census Day, but who had a usual place of residence in Canada (Canadian government representatives, members of the Canadian Armed Forces, and persons on merchant vessels or ocean liners, and their families);
- Canadian citizen residing abroad, attached to a diplomatic mission or in a military corps.

For the first time in 1991, the census of population also included non-permanent residents. They include:

- persons holding student authorizations;
- persons holding employment authorizations;
- persons holding Minister's permits;
- refugee claimants.

Foreign residents are not enumerated and so are excluded from the census. They include:

- representatives of governments of other countries and their families;
- members of the Armed Forces of other countries and their families;
- residents of other countries visiting in Canada temporarily.

Comparison of the 1991 Census data with data from earlier censuses is affected by a change in the definition of the 1991 Census population. Persons in Canada on student authorizations, employment authorizations, Minister's permits, and as refugee claimants were enumerated in the 1991 Census but not in previous censuses. These persons are referred to as non-permanent residents.

7. Content Considerations

(1) The exclusion of institutional residents: Institutional residents are defined as those individuals other than staff members and their families who live in institutional collective dwellings such as residences for senior citizens, hospitals, correctional and penal institutions. Detailed sample data were not collected from this sector of the population.

(2) Data collected on a sample basis were weighted up to provide estimates of the entire population excluding institutional residents. However, weighted counts are subject to sampling variability. This means, for any given area, the weighted count may differ from that shown in tabulations containing data collected on a 100%

basis. While the differences are relatively small for geographic areas with large populations, they can be greater for areas with small populations.

Users should also be aware that differences in counts may be due to the different subpopulations or universes for which the data are reported. For example, mobility data are reported for persons 5 years and over for the 5 year interval data and 1 year and over for the 1 year interval data, excluding those temporarily residing overseas; education and labour force data (which includes **place of work** data) are reported for persons 15 years of age and over. Furthermore, data may be produced for subsets of these education and labour universes such as total labour force, employed labour force, etc. Similar differences may occur in tabulations for households, dwellings or families. The ***1991 Census Dictionary*** (Catalogue No. 92-301E) provides more detailed information on universes or subpopulations by variable.

IV. Data Assimilation

Data assimilation is the processing phase during which data from the Census questionnaires are edited, coded and captured. The process includes the transformation of the questionnaire responses into machine-readable form.

The four main components of data assimilation are:

- Regional Office Processing;
- Direct Data Entry;
- Head Office Processing;
- Automated Coding;

1. Regional Office Processing (ROP)

At this stage, ROP staff will ensure that information appearing on the questionnaires is suitable for key entry into the computer. This operation employs approximately 2,000 people, and is conducted in Revenue Canada – Taxation (RCT) regional processing centres in St. John's, Jonquière, Shawinigan, Sudbury, Winnipeg and Surrey. In Ottawa it is conducted in the Statistics Canada head office. For the 1991 Census, the operation took place during the period between July and November of 1991.

ROP operations consisted of the following:

(a) Receipt and document preparation

When completed questionnaires reached the Regional Processing Centres, they were logged, counted and prepared for key entry. Preparation included consistency checks between the questionnaires and the Visitation Record – making sure, for example, that the number of household members on both documents matched. Legibility checks ensured that the documents were suitable for computer entry. Finally, all written answers on household relationships (Question 2) were converted to numerical codes.

(b) Reverse Record Check

A sample of persons was selected from the 1986 Census records and external sources, and 1991 documents were searched for these same persons. If a person was found, 1991 characteristics were noted and sent to head office. For those not found, further tracing determined if they had been enumerated elsewhere in Canada or missed altogether. The results of these searches are coded and captured and the file is turned over to the Social Survey Methods Division for weighting and production of undercoverage estimates.

(c) Coding of place of work variables

Written responses to the place of work question on the long census form were converted into numerical codes. In other words, a respondent's place of work address was matched to a census subdivision (municipality) code, using a Place Name Code Book and/or Street Index to determine the geographic code for the census subdivision where the respondent worked during the period January 1, 1990 to June 4, 1991. When census subdivision coding was not possible using the place of work response directly, by referring to the Place Name Code book, then coding was performed using the response to Question 36 (for whom did this person work) by referring to a "List of Establishments" file. The "List of Establishments" file contained the names of businesses and their respective addresses as well as the seven-digit Standard Geographical Classification code that geographically locates businesses within a province, a census division (county), and a census subdivision (municipality). The census subdivision code was entered on the questionnaire to be captured along with other information.

Supervisors and coding consultants resolved any discrepancies in coding before the questionnaires for an enumeration area (EA) proceeded to the next stage. Other sources (city directories, subject-matter personnel, and so on) were occasionally consulted.

In addition to place of work data collected on a 20% basis, there was also a 10% sample of place of work data coded for residents of the province of Ontario, and the Quebec portion of the Ottawa-Hull CMA. Whereas the 20% national sample linked place of work responses to a census subdivision (municipality) code, the 10% sample linked place of work responses to the block-face (BF) or enumeration area (EA) level of geography, which subsequently aggregated to larger geographical units (e.g., CMAs, CSDs, CTs, traffic zones).

(d) Processing

Questionnaires were transferred in work units for direct data entry at Revenue Canada – Taxation regional processing centres: from there, after keying, they were sent to Statistics Canada in Ottawa.

2. Direct Data Entry (DDE)

The data entry activity was completed on behalf of Statistics Canada by Revenue Canada – Taxation (RCT). Questionnaire data was key entered at seven (7) RCT regional centres, transmitted to RCT Headquarters in Ottawa and stored on tape cartridges. This operation employed approximately 1,500 people sworn to secrecy under the ***Statistics Act***.

3. Head Office Processing (HOP)

Head Office Processing is a combination of automated and manual processing designed to carry out structural edits on the census data and to process special enumeration returns. Included are returns for Canadians overseas, temporary residents and merchant and navy ships personnel. HOP also processes coverage study returns such as **Reverse Record Check (RRC), Vacancy Check (VC), and Overcoverage Study (OC).** In addition, HOP is responsible for the preliminary and final population and dwelling counts and for the microfilming of census questionnaires for archival purposes. This operation employs approximately 150 people and is conducted in the Statistics Canada head office in Ottawa.

Head Office Processing consisted of four (4) major activities performed in three (3) phases:

- **DA I – Receipt, Registration and Storage**
  Visitation Records and questionnaires for each enumeration area were received, registered and stored at the head office. Tapes containing respondent data were copied and loaded onto the HOP database.
- **DA II – Data Analysis**
  Automated structural edits were carried out at the enumeration area, household and person levels, and inconsistencies, such as person count conflicts and household number conflicts were resolved manually.
- **DA III – Special Processing**
  Special enumeration returns from Canadians living outside Canada, temporary residents and persons aboard merchant, naval and coast-guard vessels were adjusted to include them. In addition, coverage study returns for checking vacant dwellings, under- and overcoverage were processed, and adjustments were done to the data based on the results of the vacancy check.
- **DA I and/or DA II**
  HOP was also responsible for the preliminary and final population and dwelling counts and for the microfilming of census questionnaires for archival purposes.

4. Automated Coding (AC)

The automated coding operation converted written responses to questions on mother tongue, home language, knowledge of other languages, registered Indian status, place of birth, ethnic origin, major field of study, religion and place of residence 1 year ago and 5 years ago to numeric codes.

The responses were matched against an automated reference file/classification structure containing a series of words or phrases to obtain corresponding numeric codes. An analysis was conducted for each variable to ensure data quality objectives were maintained prior to transferring the records to edit and imputation.

V. Edit and Imputation

In the edit and imputation phase, all remaining errors, discrepancies, inconsistencies and missing answers are identified and corrected by a fully automated series of computer programs. The final set of usable "clean" data (free of invalid, inconsistent and missing responses) is produced, comprising a unique database which provides Canada's most detailed information about the population and its characteristics, ranging from the national to the neighbourhood level.

Errors found at this stage can be the result of respondents answering the questions incorrectly or incompletely, or they can be due to errors generated during coding activities and data capture. After errors are detected, values for missing or incomplete entries are imputed. Imputation, which is the correction of the errors, is done using either a "deterministic" or a "hot deck" method. For deterministic imputation, errors are corrected by inferring the appropriate value from answers to other questions. The "hot deck" approach selects a record that has a number of characteristics in common with the record in error, and imputes the missing information from this "donor" record.

Edit and Imputation Software

Place of work data were processed using software known as SPIDER **(System for Processing Instructions from Directly Entered Requirements)**.

The SPIDER system was developed for the 1981 Census in order to handle the more complex coded variables and absolute values such as income. Most of the questions asked of 20% of the population are processed using SPIDER. SPIDER allows the subject-matter specialists to develop edit and imputation strategies using logic decision tables. These can take the form of conflict or validity conditions and one can specify "hot deck" imputation or deterministic corrective action. SPIDER translates the decision tables into machine-readable PL/1 codes used in processing the data.

1. The Edit and Imputation Processes for Place of Work Variables

The response categories which correspond to the 1991 Census of Population place of work question, and the place of work SPIDER programs, produce variables which may be classified into two unique types:

(a) **Direct variables** appear on the 1991 Census of Population questionnaire as response categories to the place of work question (refer to the place of work question layout on page 3). These categories are as follows:

- (i) Category 1 – "Worked at home";
- (ii) Category 2 – "Worked outside Canada";
- (iii) Category 3 – "Worked at the address specified below";
- (iv) Category 4 – "No usual place of work", which is the response that coding personnel assigned by marking Box 04 on the questionnaire in cases where respondents wrote that they had no usual place of work;
- (v) Category 5 – workplace location. Coding personnel recorded a seven-digit SGC code in Box 05 on the questionnaire to indicate the census subdivision of work.

(b) **Derived variables** do not appear on the 1991 Census of Population questionnaire as response categories to the place of work question. They are a product of SPIDER edit and imputation programs and are based on responses to direct variables. Derived variables indicate the presence of single or multiple responses to direct variables, whether or not multiple responses to direct variables are logically consistent, and whether an assigned place of work code (SGC) is valid or not. Derived variables also serve to "flag" records for corrective action as well as to provide an audit trail of actions taken.

Place of work SPIDER edit programs read the values associated with direct variables and returned a series of tabulations indicating the extent to which responses were consistent, complete and valid. All responses identified

as being incomplete, inconsistent or invalid were assigned specific "flags", which in turn routed them through subsequent edit and/or imputation programs. The primary function of the SPIDER edit programs was to identify inconsistent or invalid responses and to edit such responses "deterministically", thus resulting in consistent and valid responses.

The primary function of SPIDER imputation programs was to identify incomplete responses and impute the necessary data so as to complete a response. More specifically, imputation programs were designed to impute a "place of work status" ("Worked at home", "Worked outside Canada", "Usual place of work", or "No usual place of work") and, where applicable, to impute a census subdivision (SGC code) of work for persons classified as having a "usual" place of work.

Together, the SPIDER edit and imputation programs ultimately produced consistent, complete and valid responses to the 1991 Census of Population place of work question. The entire edit and imputation procedure consisted of three major processes, namely the edit process, imputation by the "hot deck" method, and the post-derive process. The types of responses corrected or imputed under each of these methods are described in the following paragraphs.

2. Edit Process and Imputation by the "hot deck" method

The edit programs are responsible for performing actions referred to as "deterministic" imputation. "Deterministic" imputation involves correcting errors by inferring the appropriate value on the basis of other answers given on the questionnaire. Deterministic imputation is based on a consistent record, taking into account certain geographic constraints, such as the area of residence. During the deterministic edit process, attempts are made to correct records which are missing information or contain invalid information. Persons who have not provided a place of work status response ("Worked at home", "Worked outside Canada", "Usual place of work" or "No usual place of work") are assigned the "Worked at home" response if they report being an employee of the head of household or if they are a farm operator. Persons enumerated outside Canada who reported to a job in the week prior to the census are assigned the response as "Worked outside Canada".

To ensure that edited place of work responses are consistent and valid, a series of monitoring tables were produced to evaluate the effects of the edit programs. This monitoring process ensured that the programs edited only those responses in need of editing, and indicated whether or not the edited database contained consistent and valid data. Where an invalid census subdivision code (SGC) was recorded, attempts were made to correct it. For example, if the province code was invalid but the remainder of the code was valid, attempts were made to correct the province code so as to make the entire code valid. Records which still contained invalid data, or were missing data, proceeded to the imputation process.

Records without either a valid place of work status or a place of work census subdivision code, or both, were flagged during the edit process for "hot deck" imputation. In the "hot deck" imputation process, a valid "donor" record with characteristics (such as area of residence and industry of work) similar to those of the record missing data ("recipient record") was located and the missing data were copied from the donor record to the recipient record. Each record subjected to "hot deck" imputation was processed individually.

In the event that it was not possible to locate a suitable donor record, a default imputation procedure was used. In this case, the most common technique used was the assignment of the "usual place of work" status, and the assignment of the census subdivision of residence as the census subdivision of work. Again, a series of monitoring tables was produced to evaluate the effects of the imputation programs and ensure that imputed responses were complete. This monitoring process also ensured that the programs imputed only responses in need of imputation.

Table 1 contains three columns of data. These columns display the distribution of place of work responses/coding prior to the execution of SPIDER **edit** programs, immediately following edit programs (post-edit), and immediately following the execution of SPIDER **imputation** programs (post-imputation). The pre-edit distribution provides an indication of the extent to which pre-edited responses were in need of deterministic edits. The post-edit distribution reflects the effects of deterministic edits, displays the "intermediate state" of place of work responses, and indicates the extent to which post-edit responses were in need of "hot deck" imputation. The post-imputation distribution illustrates the "final state" of variables, after "hot deck" imputation. These distributions have been derived from

unweighed place of work records. The asterisks (*) indicate combinations of responses which are considered valid at each stage of processing.

Table 1. Pre-edit, Post-edit and Post-imputation Place of Work Response Distributions

Place of work response distributions	Pre-edit	Post-edit	Post-imputation
Non-response:	4.16%	5.63%	0.00%
Single response/Code:			
Box 01: Worked at home	7.44% *	0.00%	0.00%
Box 02: Worked outside Canada	0.80% *	0.87% *	0.91% *
Box 03: Worked at the address specified below	0.73%	2.07%	0.00%
Box 04: No usual place of work	<0.01% *	0.60% *	0.70% *
Box 05: SGC code	6.13%	4.71%	0.00%
Two responses/Codes:			
Worked at home and Worked outside Canada	<0.01%	0.00%	0.00%
Worked at home and Worked at the address specified below	0.05%	0.00%	0.00%
Worked at home and No usual place of work	<0.01%	0.00%	0.00%
Worked at home and SGC code	0.60%	8.19% *	8.68% *
Worked outside Canada and Worked at the address specified below	0.01%	0.00%	0.00%
Worked outside Canada and No usual place of work	<0.01%	0.00%	0.00%
Worked outside Canada and SGC code	0.03%	0.00%	0.00%
Worked at the address specified below and No usual place of work	<0.01%	0.00%	0.00%
Worked at the address specified below and SGC code	78.43% *	77.41% *	89.1% *
No usual place of work and SGC code	1.01% *	0.52% *	0.60% *
Three responses/Codes:			
Box 01, Box 02 and Box 03	<0.01%	0.00%	0.00%
Box 01, Box 02 and Box 04	<0.01%	0.00%	0.00%
Box 01, Box 02 and Box 05	<0.01%	0.00%	0.00%
Box 01, Box 03 and Box 04	0.00%	0.00%	0.00%
Box 01, Box 03 and Box 05	0.25%	0.00%	0.00%
Box 01, Box 04 and Box 05	<0.01%	0.00%	0.00%
Box 02, Box 03 and Box 04	<0.01%	0.00%	0.00%
Box 02, Box 03 and Box 05	0.02%	0.00%	0.00%
Box 02, Box 04 and Box 05	0.01%	0.00%	0.00%
Box 03, Box 04 and Box 05	0.22%	0.00%	0.00%
Four responses/Codes:			
Box 01, Box 02, Box 03 and Box 04	0.00%	0.00%	0.00%
Box 01, Box 02, Box 03 and Box 05	<0.01%	0.00%	0.00%
Box 01, Box 02, Box 04 and Box 05	<0.01%	0.00%	0.00%
Box 01, Box 03, Box 04 and Box 05	<0.01%	0.00%	0.00%
Box 02, Box 03, Box 04 and Box 05	<0.01%	0.00%	0.00%
Five responses/Codes:			
Box 01, Box 02, Box 03, Box 04 and Box 05	<0.01%	0.00%	0.00%

The figures in Table 2 illustrate the percentage of records which were subjected to "hot deck" imputation, within each individual place of work status category. The data in this table were derived from unweighed place of work records and are categorized according to person's place of residence. These figures are to be interpreted, for example, as follows:

"Of **all** Newfoundland residents who work 'at home', 5.01% were imputed."
"Of **all** Nova Scotia residents who work 'outside Canada', 1.60% were imputed."
"Of **all** Prince Edward Island residents categorized as having 'no usual place of work', 13.15% were imputed."
"Of **all** New Brunswick residents categorized as having a 'usual place of work', 6.69% were imputed."

Table 2. Place of Work Status Imputation Rates for Provinces/Territories of Residence and Canada

	Place of work			
Place of residence	At home	Outside Canada	No usual place of work	Usual place of work
Newfoundland	5.01%	1.50%	13.62%	6.65%
Nova Scotia	4.19%	1.60%	11.50%	8.64%
Prince Edward Island	4.37%	2.10%	13.15%	6.39%
New Brunswick	5.83%	2.48%	12.43%	6.69%
Quebec	6.24%	3.76%	12.84%	8.02%
Ontario	6.25%	5.18%	15.15%	8.26%
Manitoba	5.25%	4.07%	13.43%	7.64%
Saskatchewan	5.08%	2.03%	9.31%	7.60%
Alberta	4.29%	4.01%	7.85%	6.89%
British Columbia	6.43%	6.24%	20.10%	7.79%
Yukon Territory	11.69%	0.00%	23.42%	14.68%
Northwest Territories	3.54%	0.00%	12.39%	5.44%
CANADA	5.72%	4.39%	14.50%	7.83%

3. The Post-derive process

The post-derive process was responsible for generating a census agglomeration (CA) or census metropolitan area (CMA) of work. The CA/CMA of work was simply derived from the census subdivision of work. This completed the edit, imputation and post-derive processing for all records, except for those Ontario/Quebec residents sampled for submunicipal (block-face/enumeration area) place of work coding.

4. Submunicipal processing

The 20% national sample linked place of work responses to a census subdivision of work. However, one-half of the responses in the 20% sample, representing persons resident in the province of Ontario and in the Quebec portion of the Ottawa-Hull CMA, were subject to additional processing as the result of a submunicipal (block-face/enumeration area) place of work coding operation. The submunicipal place of work coding operation sought to code places of work to submunicipal geographic areas (block-faces/enumeration areas) located in the province of Ontario or in the Quebec portion of the Ottawa-Hull CMA.

The submunicipal place of work coding operation used more detailed reference materials than were used during the national census subdivision coding operation. The submunicipal coding operation was independent of the national coding operation, and, as a result of this independence, it was possible for the two operations to code an

individual place of work response to two distinct census subdivisions of work. In most instances, place of work census subdivision codes which resulted from the national coding operation were altered where there was disagreement between the codes resulting from the two coding operations. However, in rare instances, the submunicipal place of work code was altered so as to conform with the code assigned during "national" census subdivision processing.

A distinct set of SPIDER edit and imputation programs, executed during submunicipal processing, were designed to ensure that submunicipal place of work codes were complete, valid and consistent with the results of the prior national census subdivision coding operation. In no case was the place of work status ("work at home", "work outside Canada", "usual place of work" or "no usual place of work") altered by submunicipal processing.

Where coders were unable to ascertain a submunicipal place of work code, submunicipal workplace codes were imputed using the hot deck method. Matching conditions included attempting to match recipients with donors based on "national" census subdivision of work, area of residence, and industry of work. If no match could be found, the default action taken was the assignment of the submunicipal place of residence as the submunicipal place of work.

Additional information on submunicipal-level place of work data is available in the following document: Statistics Canada. ***1991 Census of Population: Place of Work Certification Report, Sub-CSD Coded Data,*** November 1993, 1991 Census of Canada (unpublished).

VI. Data Evaluation

1. General

Throughout the census-taking process, care was taken to ensure high-quality results. Rigorous quality standards were set for data collection and processing, and the Public Communications Program assisted in minimizing non-response. A Data Quality Measurement Program was established to provide users with information on the quality and limitations of census data.

Although considerable effort is made throughout the entire process to ensure high standards of data quality, resulting data are subject to a certain degree of inaccuracy. To assess the usefulness of census data for their purposes and to understand the risk involved in drawing conclusions or making decisions on these data, users should be aware of their inaccuracies and appreciate their origin and composition.

Error can arise at virtually any stage of the census process from preparation of materials to data collection and through the various processing stages. Some errors occur at random and tend to cancel each other out when individual responses are aggregated for a large group. For errors of this nature, the larger the group the more accurate the corresponding estimate and therefore it is important to be cautious when dealing with estimates derived using small aggregated groups of responses. On the other hand, some errors which occur more systematically are more serious to data users than random errors.

For census data in general, the principal types of errors are as follows:

- **Coverage Errors**
  Occur when individuals and/or dwellings are missed, incorrectly included, or double counted;
- **Non Response Errors**
  Occur when responses are not available from some households and/or individuals due to extended absence or for other related reasons;
- **Response Errors**
  Occur when respondents, or in some instances Census Representatives, misinterpret a census question and record an incorrect response;
- **Processing Errors**
  Can occur during **coding**, when write-in responses are transformed into numerical codes by clerks, **data capture**, when responses are transferred from questionnaires to computer tapes by key entry operators, and **imputation**, when a valid, but not necessarily correct, response is inserted by the computer into a record to replace missing or invalid data;
- **Sampling Errors**
  Only apply to supplementary questions on the long (2B) questionnaire, asked of only a twenty percent (20%) sample of households, arise due to the fact that they are weighted to represent the whole population and inevitably differ somewhat from results that would have been obtained had the questions been asked of the total population.

All of the above errors have both random and systematic components. Usually the systematic component of sampling errors is very small in relation to its random component. For other non sampling errors both random and systematic components may be significant.

Four studies are undertaken to measure coverage errors:

- Vacancy Check
- Temporary Residents Study

- Reverse Record Check
- Overcoverage Study

Two studies are conducted to evaluate response errors:

- Reverse Record Check Content Study
- Overcoverage Content Study

Four studies are undertaken to evaluate the effect of sampling errors on the sample data:

- Sampling Bias Study
- Weighting Evaluation
- 2A/2B Consistency Study
- Sampling Variance Study

Two further studies are done to evaluate the data:

- Edit Sample Study
- Clustered Non-response Study

Besides these studies, before the data are approved for dissemination, the Certification Task is performed to detect any anomalies not identified during the other stages. This process involves analysing the evolution of trends for the variable to be published.

On some Indian reserves and settlements, (total of 78), enumeration was not permitted, was interrupted before completion or the quality of collected data was considered to be inaccurate. These areas are called **Incompletely Enumerated Indian Reserves and Indian Settlements**. Under these circumstances, data are not available for these areas, not included in tabulations, and are noted accordingly where applicable. Caution should be exercised when analyzing data from areas affected by incomplete enumeration especially in small areas where the impact is the greatest.

The inclusion of **non-permanent residents** in the 1991 census will affect the variables that were collected on a one hundred percent (100%) basis such as age, sex, mother tongue, and marital status. Census data on immigration will have to be examined carefully to determine the extent of the variations caused by enumerating non-permanent residents.

For additional information on non-permanent residents, please refer to Chapter III on Collection and Coverage.

2. Data Evaluation Process

Place of work data were evaluated using different sources. Responses to the 1991 Census of Population place of work question were analyzed for both internal and external validity.

2.1 Internal Validity

A series of quality control tabulations were designed to monitor the evolution of place of work data as they proceeded through the variety of SPIDER edit and imputation programs. The production and active monitoring of tabulations designed to reflect the effects of edit and imputation programs ensured that responses to the 1991 Census of Population place of work question were internally consistent, valid and complete. The 1991 Census of Population edit and imputation database was actually composed of five regional databases. The place of work monitoring tabulations designed for internal validity analyses were produced for each of the databases.

The production of monitoring tabulations at various levels of geography facilitated timely and efficient evaluation of the quality of place of work responses/codes. This monitoring process was initiated at the "regional" database level and, as time permitted, progressed towards evaluation of data at provincial, census metropolitan area, census agglomeration and census subdivision levels of geography. In analyzing the quality of place of work data initially at the regional level, it was possible for place of work analysts to identify data immediately which were not of the quality expected. By initiating the monitoring process at higher geographic levels, analysts were able to "zero-in" on problematic geographic areas, in a timely fashion. In practice, it proved unnecessary. No major problems were identified with the quality of 1991 Census of Population place of work data, or with the SPIDER edit, imputation, and post-derive processes.

2.2 External Validity

Place of work data were also analyzed using data sources external to the 1991 Census of Population in order to evaluate the reliability of response patterns and municipal-level coding.

2.2.1 Historical Sources of Data

A vast part of the 1991 place of work reliability-evaluation process was conducted with reference to 1981 Census of Population place of work data. Statistics Canada's conceptualization and measurement of the census place of work variable remained stable from 1981 to 1991, as illustrated by the Census Dictionary definitions reproduced here:

1991 Census Dictionary – Labour: Place of Work

"Refers to the usual place of work of non-institutional residents 15 years of age and over who have worked since January 1, 1990. The variables usually relate to the individual's job in the week prior to enumeration. However, if the person had not worked in that week but had worked since January 1, 1990, the information related to the job held longest during that period." (p. 71) [Given the definition of this variable, the place of work universe comprises both the **experienced** and the **employed** labour forces].

1981 Census Dictionary – Place of Work

"Refers to the usual place of work of non-inmates 15 years of age and over who worked since January 1, 1980. The variables usually relate to the individual's job in the week prior to enumeration. However, where the person did not work in that week but had worked since January 1, 1980, the information relates to the job held longest during that period." (p. 41) [Given the definition of this variable, the place of work universe comprises both the **experienced** and the **employed** labour forces.]

Definitions of the experienced and employed labour forces are provided in the Appendix.

Place of work analysts evaluated expected and observed 1991 place of work data for all 499 census subdivision components of Canada's CMAs, each of Canada's 25 CMAs, and each of Canada's 115 CAs. Where observed data deviated from expected data, beyond established confidence intervals, it was the responsibility of the analyst to provide defensible explanations for such deviations. In conducting time-series analyses of evolving geographic locales, such as (geographic) **places** of work, analysts found it necessary either to restrict 1991/1981 comparisons to spatial units where physical boundaries remained unchanged from 1981 to 1991 or, wherever possible, to adjust geographic boundaries of either 1991 or 1981 Census geographical units in the interest of selecting identical geographic areas.

The 1991 Census of Population place of work data was subjected to several stages of detailed analysis before the data was classified as reliable and of sufficient quality to be deemed releasable. A very brief summary of the procedures followed, formulas used, and tables produced for the external validity evaluation process are outlined on the pages which follow.

Stage One: Absolute Size of the 1991 Resident Employed Labour Force

Stage One of the external validity analysis focused on the **absolute size** of the 1991 Census of Population employed labour force residing in each census subdivision component of census metropolitan areas, each census agglomeration and each census metropolitan area.

Over the decade spanning the years 1981 to 1991, many (if not most) of Canada's census subdivisions grew in population. During the latter portion of this decade (1986-1991), Canada's population grew by approximately 7.9%. Some census subdivisions experienced positive population growth, e.g., 35.4% (Maple Ridge, British Columbia), 31.9% (Kanata, Ontario), and 24.6% (Kelowna, British Columbia), whereas other census subdivisions experienced negative population growth, e.g., -10.0% (Kirkland Lake, Ontario), -5.4% (Swift Current, Saskatchewan), and -4.5% (Moose Jaw, Saskatchewan).

Growth and decline in the population of census subdivisions affects the size of the employed labour force residing in each census subdivision. Analysts deemed it reasonable to hypothesize that changes in the size of a census subdivision's resident employed labour force would be positively correlated with changes in the size of a census subdivision's "age 15+" population. It was **not expected** that a census subdivision's "age 15+" population would increase significantly, nor that over the same period of time the number of census subdivision residents included in the employed labour force would remain stable, or decline. Nor was it expected that the opposite would occur, namely that a census subdivision's "age 15+" population would decrease significantly, with the absolute number of census subdivision residents included in the employed labour force remaining stable, or increasing. Given the hypothesized relationship between "population growth" and "size of the resident employed labour force", analysts used growth in the "age 15+" population as a proxy indicator of expected growth in the resident employed labour force.

Through the use of 1981 and 1991 Census of Population "age 15+" population counts, the expected size of the 1991 resident employed labour force was estimated, for each census subdivision component of each CMA, each CMA, and each CA. With respect to each geographic area, **expected** 1991 resident employed labour force values were estimated by multiplying the size of the 1981 resident employed labour force by a factor equivalent to growth in the "age 15+" population over the 1981 to 1991 period. **Observed** 1991 values were expressed as proportions of expected 1991 values and were then subjected to statistical analysis.

In analyzing observed/expected proportions, analysts statistically determined the extent to which proportions deviated from the mean of the distribution of proportions, for similar geographical units. That is, the observed/expected proportions calculated for CMAs were analyzed as one set of data, the observed/expected proportions of CAs were analyzed as a distinct set of data, and the observed/expected proportions of CSD components which are comprised in specific CMAs were analyzed as (25) distinct sets of data, one set of data for each CMA.

Table 3 and the formulas which follow outline the methods by which such analyses were conducted. Weighted resident employed labour force data pertaining to the St. John's CMA, and **some** of its census subdivision components, have been included in Table 3 for illustrative purposes.

Table 3. Expected and Observed Size of 1991 Resident Employed Labour Force

CMA_i	CSD_{ij}	POP_{1981} (15+)	POP_{1991} (15+)	$\frac{POP_{1991}}{POP_{1981}}$	$ObsRELF_{81}$	$ExRELF_{91}$	$ObsRELF_{91}$	$\frac{ObsRELF_{91}}{ExRELF_{91}}$
St. John's		**112,322**	**134,973**	**1.202**	**62,967**	**75,556**	**75,192**	**0.994**
	1	8,105	17,702	2.184	5,228	11,418	11,409	0.999
	2	63,541	77,887	1.226	34,970	42,865	41,685	0.972
	3	783	832	1.063	439	466	352	0.755
	4	16,769	5,228	0.312	10,216	3,185	3,097	0.972
	5	9,363	13,448	1.436	4,670	6,707	7,243	1.080
	6	130	107	0.823	53	44	55	1.261

Where:

POP_{1981} Size of observed "age 15+" population, 1981 Census of Population

POP_{1991} Size of observed "age 15+" population, 1991 Census of Population

$ObsRELF_{81}$ Size of observed 1981 Census of Population resident employed labour force

$ExRELF_{91}$ Expected size of 1991 Census of Population resident employed labour force

$$ExRELF_{91} = \frac{POP_{1991}}{POP_{1981}} \times ObsRELF_{81}$$

$ObsRELF_{91}$ Size of observed 1991 Census of Population resident employed labour force

$\frac{ObsRELF_{91}}{ExRELF_{91}}$ Size of observed 1991 Census of Population resident employed labour force expressed as a proportion of the expected size of the 1991 Census of Population resident employed labour force

From the data contained in the column ($ObsRELF_{91}$ / $ExRELF_{91}$) in Table 3, an average and a standard deviation were calculated. Using the "average" and the "standard deviation", two confidence intervals (zones of acceptance) were calculated, to which individual ($ObsRELF_{91}$ / $ExRELF_{91}$) proportions were subjected. The two confidence intervals calculated were equal to the "average" ± two and three "standard deviations", respectively. Individual proportions falling within two standard deviations of the average were regarded as non-problematic; proportions which fell beyond two or three standard deviations were subjected to more detailed evaluation so as to determine, on an individual census subdivision, CMA or CA level, whether or not such deviations could be explained by circumstances unique to those specific geographic areas.

Distribution's average proportion:

$$= \frac{\sum_{j=1}^{N} \left(\frac{ObsRELF_{91}}{ExRELF_{91}}\right)_{ij}}{N}$$

Distribution's standard deviation of proportions:

$$= \sqrt{\frac{\sum_{j=1}^{N} \left(\left(\frac{ObsRELF_{91}}{ExRELF_{91}}\right)_{ij} - \text{average proportion} \right)^2_{ij}}{N}}$$

Confidence limits:

= distribution's average proportion ± two standard deviations
= distribution's average proportion ± three standard deviations

With respect to the 17 census subdivision components which comprise the St. John's CMA, analysts calculated the following statistics:

average (CSD) proportion = 1.078
standard deviation of (CSD) proportions = 0.158

Two of the 17 census subdivision proportions fell beyond two standard deviations from the average. Two other census subdivision proportions fell beyond three standard deviations from the average. All four "deviant proportions" were explained as being substantively insignificant. Relative to the other 13 census subdivision components of the St. John's CMA, the 1981 and 1991 "age 15+" population, and sizes of the resident employed labour force, within each of the four "deviant" census subdivisions, were small.

In completing Stage One of the external validity evaluation process, analysts concluded that there were no gross errors in the sizes of 1991 Census of Population resident employed labour forces of CMAs, CAs and census subdivision components of CMAs. Similar analyses were conducted, and similar conclusions reached, with respect to the size of the 1991 Census of Population place of work universe (experienced labour force).

Stage Two: Distribution of 1991 Place of Work Status

Stage Two of the external validity evaluation process focused on the distribution of place of work **status** responses, namely the proportion of the resident employed labour force reporting that they worked "at home", "outside Canada", at their "usual place of work" or at "no usual place of work".

Clearly, it is possible that, for any given census subdivision, CMA or CA, the distribution of persons claiming to work "at home", "outside Canada", at their "usual place of work" or at "no usual place of work" could shift from 1981 to 1991. However, analysts hypothesized that it was not **probable** that "significant" shifts would be observed in isolated geographic areas. If there were significant shifts in the distribution of place of work statuses, such shifts would be observed "across the board", that is, for all or most census subdivisions in a CMA, for all or most CMAs, or for all or most CAs.

Analysts hypothesized that the distribution of 1991 place of work statuses, for any given census subdivision, CMA or CA, would approximately equal the distribution of 1981 place of work statuses. In other words, the **expected** distribution of 1991 place of work statuses was equivalent to the **observed** 1981 distributions. However, during the latter portion of the 1981 to 1991 decade, the concept of "working at home" (including teleworking) gained increasing prevalence in Canada. Analysts therefore refined this hypothesis so as to acknowledge that the "work at home" response category may encompass a larger proportion of Canada's 1991 employed labour force than it did in 1981, at the expense of the "usual place of work" status.

For each geographic area, expected 1991 place of work status distributions were calculated, based on observed 1981 distributions, and contrasted with 1991 observed distributions. The expected and observed distributions themselves were not of central concern, but rather the differences which existed between expected and observed distributions. These differences were subjected to statistical analysis.

In analyzing observed/expected differences, analysts statistically determined the extent to which differences deviated from the mean of the distribution of differences, for similar geographical units, and similar place of work statuses. That is, the observed/expected differences calculated for CMAs were analyzed as one set of data, the observed/expected differences of CAs were analyzed as a distinct set of data, and the observed/expected differences of CSD components of individual CMAs were analyzed as (25) distinct sets of data. Each of these analyses was performed four times, once for each place of work status category. Observed/expected differences which deviated significantly from the observed/expected differences calculated for similar geographical units warranted further investigation.

There are four components to the analysis. Each component corresponds to one of the four place of work **status** response categories: "Worked at home", "Worked outside Canada", "Usual place of work" or "No usual place of work". The table which follows illustrates the methods by which **expected** 1991 "Worked at home" proportions were calculated, and subsequently contrasted with **observed** 1991 "Worked at home" proportions. The weighted resident employed labour force data displayed in this table (for illustrative purposes) pertain to four of the nine census subdivision components of the Halifax CMA.

Table 4. Expected and Observed Distribution of 1991 Place of Work Status: Work At Home (%)

CMA_i (Halifax):

CSD_{ij}	$ObsAtHome_{1991}$	$ExAtHome_{1991}$	$ObsAtHome_{1991} - ExAtHome_{1991}$
Halifax Subdivision B, SCM	5.291	4.386	0.905
Halifax Subdivision D, SCM	4.508	2.768	1.740
Cole Harbour 30, R	0.000	0.000	0.000
Dartmouth, C	3.576	1.771	1.804

Where:

$ObsAtHome_{1991}$ Percentage of 1991 employed labour force observed to claim to work at home, for CSD_{ij} residents.

$ExAtHome_{1991}$ Percentage of 1991 employed labour force expected to claim to work at home, CSD_{ij} residents. This percentage is equal to the percentage of the 1981 employed labour force observed to claim to work at home, for CSD_{ij} residents.

$ObsAtHome_{1991} - ExAtHome_{1991}$
The difference between the percentage of the 1991 employed labour force (CSD_{ij} residents) observed to claim to work at home, and the percentage of the 1991 employed labour force (CSD_{ij} residents) expected to claim to work at home.

Using the "differences" data illustrated within the column "$ObsAtHome_{1991} - ExAtHome_{1991}$", an average and standard deviation were calculated for the distribution of "$ObsAtHome_{1991} - ExAtHome_{1991}$" differences. Again, from these statistics three confidence intervals were calculated (acceptance and rejection regions) to which individual "$ObsAtHome_{1991} - ExAtHome_{1991}$" differences were subjected. Differences falling beyond the zones of acceptance were analyzed in further detail in the interest of determining, on an individual census subdivision, CA or CMA level, whether or not such deviations were explainable by circumstances unique to specific census subdivisions, CAs or CMAs.

Distribution's average difference:

$$= \frac{\sum_{j=1}^{N} (ObsAtHome_{1991} - ExAtHome_{1991})_{ij}}{N}$$

Distribution's standard deviation of differences:

$$= \sqrt{\frac{\sum_{j=1}^{N} ((ObsAtHome_{1991} - ExAtHome_{1991})_{ij} - \text{average difference})_{ij}^2}{N}}$$

Confidence limits:

= distribution's average difference ± one standard deviation
= distribution's average difference ± two standard deviations
= distribution's average difference ± three standard deviations

From the nine census subdivision components in the Halifax CMA, analysts calculated the following statistics with respect to the "work at home" status:

average (CSD) difference = 1.330
standard deviation of (CSD) differences = 0.918

Two of the nine census subdivision "differences" calculated within the Halifax CMA fell beyond one standard deviation from the average difference. There were no census subdivision "differences" falling beyond two or three standard deviations from the average. Both of the "deviant differences" were explained as resulting from the following:

One of the census subdivisions, relative to the other census subdivision components of the Halifax CMA, had an **extremely** small resident employed labour force, and there was no significant change in the (also very small) percentage of residents working at home.

The second "deviant" census subdivision experienced growth in both the size of the resident employed labour force and the number of residents "working at home". However, the resident employed labour force increased at a faster rate than the number of residents working at home; therefore, the proportion of persons "working at home" fell below one standard deviation from the average.

In both cases, the observed 1981-to-1991 "differences" in the proportions of residents working at home are considered substantively insignificant.

Analysts conducted similar analyses, and reached similar conclusions, with respect to "outside Canada", "usual place" and "no usual place" place of work statuses. In completing Stage Two of the external validity evaluation process, analysts concluded that there were no gross errors in the distribution of place of work statuses of 1991 Census of Population resident employed labour forces of CMAs, CAs and census subdivision components of CMAs.

Stage Three: Working and Resident Employed Labour Force

The third stage of the external validity analysis process focused on the calculation and comparison of **working/resident** employed labour force proportions. For each census subdivision component of CMAs, each CA and each CMA, analysts evaluated the similarities and differences between the absolute number of employed labour force persons working in CSDs/CMAs/CAs, and the absolute number of CSD/CMA/CA residents in the employed labour force. In comparing working/resident **employed** labour force ratios among similar geographical units, analysts statistically determined the extent to which ratios deviated, and whether such deviations fell within the range of established confidence intervals.

Table 5 illustrates the methods by which analysts calculated 1991 working/resident employed labour force proportions, analyzed 1991 proportions, and calculated "acceptance and rejection" intervals to which individual proportions were subjected. The weighted employed labour force data displayed in Table 5 (for illustrative purposes) pertain to the Victoria, Vancouver and Edmonton census metropolitan areas.

Table 5. Proportion of 1991 Place of Work Working/Resident Employed Labour Force

CMA_i	$ObsRELF_{91}$	$ObsWELF_{91}$	$\frac{ObsWELF_{91}}{ObsRELF_{91}}$
Victoria	139,190	136,735	0.9824
Vancouver	814,050	811,240	0.9965
Edmonton	433,600	429,720	0.9911

Where:

CMA_i	CMA of work and/or residence
$ObsRELF_{91}$	Observed 1991 size of the employed labour force **resident** in CMA_i
$ObsWELF_{91}$	Observed 1991 size of the employed labour force **working** in CMA_i
$\frac{ObsWELF_{91}}{ObsRELF_{91}}$	Observed 1991 size of the employed labour force working in CMA_i, expressed as a proportion of the observed 1991 size of the employed labour force resident in CMA_i

From the data contained in the column ($ObsWELF_{91}$ / $ObsRELF_{91}$) in Table 5, an average and a standard deviation were calculated. Using the "average" and the "standard deviation", three confidence intervals (zones of acceptance) were calculated, to which individual ($ObsWELF_{91}$ / $ObsRELF_{91}$) proportions were subjected. The three confidence intervals calculated were equal to the "average" ± one, two, and three "standard deviations", respectively. Individual proportions falling within a single standard deviation of the average were regarded as non-problematic; ratios which fell beyond one, two and three standard deviations were subjected to more detailed evaluation so as to determine, on an individual census subdivision, CMA or CA level, whether or not such deviations could be explained by circumstances unique to those specific geographic areas.

Distribution's average proportion:

$$= \frac{\sum_{j=1}^{N} \left(\frac{ObsWELF_{91}}{ObsRELF_{91}}\right)_{ij}}{N}$$

Distribution's standard deviation of proportions:

$$= \sqrt{\frac{\sum_{j=1}^{N} \left[\left(\frac{ObsWELF_{91}}{ObsRELF_{91}}\right)_{ij} - \text{average proportion} \right]^2_{ij}}{N}}$$

Confidence limits:

= distribution's average proportion ± one standard deviation
= distribution's average proportion ± two standard deviations
= distribution's average proportion ± three standard deviations

With respect to all 25 of Canada's census metropolitan areas, place of work analysts calculated the following statistics:

average (CMA) proportion = 1.0008

standard deviation of (CMA) proportions = 0.0458

In contrasting working/resident employed labour force proportions (ratios) among similar geographical units, analysts statistically determined the extent to which these ratios deviated from established confidence intervals. Three (Toronto, Hamilton and St. Catharines-Niagara) of the 25 census metropolitan areas' proportions calculated fell beyond one standard deviation of the average proportion. One proportion (Oshawa) fell beyond three standard deviations of the average proportion.

These findings led analysts to contrast 1991 working/resident employed labour force proportions with 1981 working/resident employed labour force proportions, for the CMAs of Toronto, Hamilton, St. Catharines-Niagara and Oshawa. Analysts found that these specific CMAs also deviated in 1981, and concluded that "1991 working/resident employed labour force proportions" were consistent with "1981 working/resident employed labour force proportions".

Analysts concluded that there were no gross errors in the working/resident employed labour force proportions of CMAs, CAs and the census subdivision components of CMAs. Analysts also conducted similar analyses, and reached similar conclusions, with respect to working/resident **experienced** labour force proportions.

In addition to satisfying the objectives of Stage Three of the external validity evaluation process, the analyses of working/resident proportions sensitized analysts to possible workplace reporting/coding errors – Stage Four of the evaluation.

Stage Four: Residence/Workplace Linkages

The fourth stage of the external validity evaluation process focused on the **residence/workplace** linkages of the employed labour force. Many "places" (cities, towns, regions) across Canada have **very similar** names. This "duplicate place name" scenario is most prevalent in the province of Quebec. In addition, census respondents tend to abbreviate the names of the municipalities in which they work ("Saint-Jean-sur-Richelieu" becomes "Saint-Jean"), or fail to differentiate between similarly named places ("Thompson, Rural Municipality" vs. "Thompson, City"; "Kingston, Township" vs. "Kingston, City"). Because of respondents' reporting habits, and the existence of similarly named places (as indicated in the Place Name Code Book used by place of work coding personnel), there was potential for the workplaces reported by some respondents to be incorrectly coded.

Using place of residence and place of work census subdivision data, "pockets" of employed labour force persons residing at questionably large distances from their workplace were identified by analysts. Through the qualitative evaluation of specific residence/workplace linkages, analysts were able to target specific linkages which could be explained by faulty workplace reporting/coding (e.g., duplicate place names, abbreviated place names). Consequently, analysts were able to correct "obvious and substantial" workplace reporting/coding errors by **re-coding** census subdivisions of work.

Table 6 illustrates the three largest "workplace data fixes" executed by analysts. Virtually all "workplace data fixes" were performed in the province of Quebec; however, fewer and less substantial workplace data fixes were also performed in Ontario, Manitoba and Alberta.

Table 6. Questionably Large Distances Between Residences and Workplaces

Place of residence CSD/SGC code	Initial place of work CSD/SGC code	Approx. distance (km)	Re-coded place of work CSD/SGC code	Weighted records
Saint-Jean-sur-Richelieu, V 24 56 080	Saint-Jean, P 24 20 015	300	Saint-Jean-sur-Richelieu, V 24 56 080	2,427
Bellefeuille, P 24 75 010	Matane, V 24 08 055	600	Saint-Jérôme, V 24 75 015	1,061
Saint-Jérôme, V 24 75 015	Matane, V 24 08 055	600	Saint-Jérôme, V 24 75 015	1,348

Where:

Place of residence	Name, type, and SGC code of census subdivision of residence
Initial place of work	Name, type, and SGC code of census subdivision of work assigned by coding personnel
Approx. distance	Approximation of the straight-line distance (in kilometres) between "Place of residence" and "Initial place of work"
Re-coded place of work	Name, type, and SGC code of census subdivision of work assigned by place of work analysts to replace "Initial place of work"
Weighted records	Number of **employed** labour force persons with a **usual** place of work, residing in "Place of residence", initially coded as working in "Initial place of work" and re-coded as working in "Re-coded place of work"

Stage Five: Census Metropolitan Area Central City Employment Ratios

Stage Five of the external validity analysis process focused on the proportions of census metropolitan area workers who work in the **central cities** of CMAs. This analysis was carried out in two parts. Part One focused on the proportion of CMA employed labour force **residents** working in the central city of their residential CMA, whereas Part Two focused on the proportion of all CMA **workers** working in the central city of a given CMA, regardless of their place of residence. Both proportions, based on 1991 Census of Population place of work data, were analyzed with reference to similar proportions calculated from 1981 Census of Population place of work data. Given the hypothesized rise in the number of employment centres located in the periphery (suburbs) of CMAs, analysts expected to find that the proportion of CMA workers working in the central city of CMAs would decline from 1981 to 1991.

Table 7(a) illustrates the methods by which analysts calculated specific central city employment ratios for **employed** labour force **residents** of CMAs having a **usual** place of work in the central city of their residential CMA. The weighted data displayed in Table 7(a) (for illustrative purposes) pertain to the CMAs of Regina, Saskatoon and Calgary.

Table 7(a). CMA Resident Employed Labour Force Persons Working in "Central Cities" of Residential CMAs

CMA_i	$R/WELF_{91}$	Central $City_{91}$	$\frac{\text{Central City}_{91}}{R/WELF}$	$R/WELF_{81}$	Central $City_{81}$	$\frac{\text{Central City}_{81}}{R/WELF}$	$Difference_{91-81}$
Regina	93,400	84,000	0.8994	79,565	74,605	0.9377	-0.0383
Saskatoon	97,265	85,145	0.8754	71,730	67,395	0.9396	-0.0642
Calgary	391,255	355,805	0.9094	325,205	300,310	0.9234	-0.0141

Where:

CMA_i	Census metropolitan area
$R/WELF_{91}$	1991 employed labour force both residing and working in CMA_i
Central $City_{91}$	1991 employed labour force both residing in CMA_i and working in the central city of CMA_i ("usual place of work" status)
$\frac{\text{Central City}_{91}}{R/WELF_{91}}$	1991 employed labour force both residing in CMA_i, and working in the central city of CMA_i ("usual place of work" status), expressed as a proportion of the 1991 employed labour force both residing and working in CMA_i
$R/WELF_{81}$	1981 employed labour force both residing and working in CMA_i
Central $City_{81}$	1981 employed labour force both residing in CMA_i, and working in the central city of CMA_i ("usual place of work" status)
$\frac{\text{Central City}_{81}}{R/WELF_{81}}$	1981 employed labour force both residing in CMA_i, and working in the central city of CMA_i ("usual place of work" status), expressed as a proportion of the 1981 employed labour force both residing and working in CMA_i
$Difference_{91-81}$	Difference between $\frac{\text{Central City}_{91}}{R/WELF_{91}}$ and $\frac{\text{Central City}_{81}}{R/WELF_{81}}$

In contrasting **1991 "Central City" proportions** with **1981 "Central City" proportions**, analysts created the "differences" data contained in column **"$Difference_{91-81}$"**. From the distribution of "$Difference_{91-81}$" values, an average and standard deviation were calculated. Using the average and standard deviation, two confidence intervals (zones of acceptance) were calculated. The two confidence intervals calculated were equal to the "average" ± two and three "standard deviations", respectively. Individual differences falling within two standard deviations of the average were regarded as non-problematic; differences falling beyond two and three standard deviations were subjected to more detailed evaluation so as to determine, on an individual basis, whether or not such differences could be explained by circumstances unique to specific census metropolitan areas.

Distribution's average difference:

$$= \frac{\sum_{j=1}^{N} (91-81)_{ij}}{N}$$

Distribution's standard deviation of differences:

$$= \sqrt{\frac{\sum_{j=1}^{N} \left((91-81)_{ij} - \text{average difference} \right)_{ij}^{2}}{N}}$$

Confidence limits:

= distribution's average difference ± two standard deviations
= distribution's average difference ± three standard deviations

In evaluating differences between the 1991 and 1981 Censuses, for commuting flows between the census subdivision components of CMAs, analysts concluded that there was no evidence to suggest the existence of place of work coding errors. In relative terms, CMAs which had high 1981 central city employment ratios tended also to display high 1991 central city employment ratios. In absolute terms, 1991 central city employment ratios of CMAs tended to be less than, but similar in magnitude to, 1981 central city employment ratios.

Part Two of this analysis focused on the proportion of the employed labour force working in the central cities of CMAs, regardless of workers' places of residence. Table 7(b) and its accompanying formulas illustrate the methods by which analysts calculated central city employment ratios for the employed labour force working in the central city of CMAs.

The weighted data displayed in Table 7(b) pertain to the central cities and CMAs of Sudbury, Thunder Bay and Winnipeg.

Table 7(b). Employed Labour Force Working in CMA "Central Cities"

CMA_i	$WELF_{91}$	Central $City_{91}$	Central $City_{91}$ / $WELF_{91}$	$WELF_{81}$	Central $City_{81}$	Central $City_{81}$ / $WELF_{81}$	Difference$_{91-81}$
Sudbury	76,095	59,545	0.7825	62,130	48,600	0.7822	0.0003
Thunder Bay	61,020	57,340	0.9404	56,305	52,935	0.9401	0.0003
Winnipeg	329,575	308,070	0.9347	299,760	282,265	0.9416	-0.0069

Where:

CMA_i	Census metropolitan area of work
$WELF_{91}$	1991 employed labour force working in CMA_i
Central $City_{91}$	1991 employed labour force working in the central city of CMA_i
$\frac{\text{Central City}_{91}}{WELF_{91}}$	1991 employed labour force working in the central city of CMA_i, expressed as a proportion of the 1991 employed labour force working in CMA_i
$WELF_{81}$	1981 employed labour force working in CMA_i
Central $City_{81}$	1981 employed labour force working in the central city of CMA_i
$\frac{\text{Central City}_{81}}{WELF_{81}}$	1981 employed labour force working in the central city of CMA_i, expressed as a proportion of the 1981 employed labour force working in CMA_i
Difference$_{91-81}$	Difference between $\frac{\text{Central City}_{91}}{WELF_{91}}$ and $\frac{\text{Central City}_{81}}{WELF_{81}}$

In contrasting **1991 "Central City" proportions** with **1981 "Central City" proportions**, analysts created the data contained in column **"Difference$_{91-81}$"**. From the distribution of "Difference$_{91-81}$" values, an average and a standard deviation were calculated. Using the average and standard deviation, two confidence intervals (zones of acceptance) were calculated. The two confidence intervals calculated were equal to the "average" ± two and three "standard deviations", respectively. Individual differences falling within two standard deviations of the average were regarded as non-problematic; differences falling beyond two and three standard deviations were subjected to more detailed evaluation so as to determine, on an individual basis, whether or not such differences could be explained by circumstances unique to specific census metropolitan areas.

Distribution's average difference:

$$= \frac{\sum_{j=1}^{N} (91\text{–}81)_{ij}}{N}$$

Distribution's standard deviation of differences:

$$= \sqrt{\frac{\sum_{j=1}^{N} \left((91\text{–}81)_{ij} - \text{average difference} \right)_{ij}^{2}}{N}}$$

Confidence limits:

= distribution's average difference ± two standard deviations
= distribution's average difference ± three standard deviations

For Part Two of this analysis, analysts reached similar conclusions as were reached for Part One. When differences between the CMA central city employment ratios in the 1981 and 1991 Censuses were evaluated, there was no evidence to suggest the existence of place of work coding errors. Census metropolitan areas which had high 1981 central city employment ratios tended also to display high 1991 central city employment ratios, while 1991 central city employment ratios of CMAs tended to be less than, but similar in magnitude to, 1981 central city employment ratios.

Stage Six: Commuting Flows of Employed Labour Force

Stage Six of the external validity evaluation process was more complex than the previous five stages because it focused on the inter-CSD **commuting flows** within census metropolitan areas. Emphasis was placed on the evaluation of origin/destination matrices for members of the employed labour force, residing in CMAs, with a usual place of work within their census metropolitan area of residence.

Given the hypothesis outlined in Stage Five – "the relative rise of employment centres in the periphery (suburbs) of CMAs from 1981 to 1991 would lead to a decline in the proportion of CMA workers employed in the central cities of CMAs" – analysts hypothesized that commuting flow patterns within CMAs would show smaller proportions of CMA residents/workers commuting to the central city of CMAs to work.

Focusing only on employed labour force persons residing in census metropolitan areas, with a **usual** place of work within their residential CMA, analysts created origin/destination matrices for each 1991 census metropolitan area. Census metropolitan areas evolve between censuses. In the interest of contrasting 1991 origin/destination matrices with 1981 origin/destination matrices, analysts adjusted the CSD components of 1981 CMAs so as to create 1981 CMAs which were equivalent to 1991 CMAs, with respect to CSD component parts.

Tables 8(a), 8(b) and 8(c) illustrate the methods by which analysts calculated observed 1981 origin/destination matrices, calculated observed 1991 origin/destination matrices, and contrasted 1981 commuting flows with 1991 commuting flows. Analysts reviewed the "differences" between 1981 and 1991 commuting flows within CMAs in the interest of identifying substantial differences.

The commuting flow data contained in these tables pertain to the Kitchener census metropolitan area. These data were computed by calculating the proportion of employed labour force persons with a "Usual place of work" status, residing in a census subdivision component of the Kitchener CMA, and working within a census subdivision component of the Kitchener CMA.

The first row of Table 8(a) (1981 data) is to be interpreted in the following manner. Of the employed labour force residents residing in the Cambridge CSD, who have a usual place of work within the Kitchener CMA:

- 0.862 (86.2%) commute to the Cambridge CSD to work;
- 0.110 (11.0%) commute to the Kitchener CSD to work;
- 0.005 (0.5%) commute to the North Dumfries CSD to work;
- 0.017 (1.7%) commute to the Waterloo CSD to work;
- 0.005 (0.5%) commute to the Woolwich CSD to work.

Census Subdivision Commuting Flows Within Census Metropolitan Areas:

Table 8(a). Employed Labour Force Residing and Working Within CMA_i: Adjusted 1981 Commuting Flows

CMA_i (Kitchener):

Residence/workplace	Cambridge	Kitchener	North Dumfries	Waterloo	Woolwich
Cambridge	0.862	0.110	0.005	0.017	0.005
Kitchener	0.051	0.745	0.002	0.187	0.014
North Dumfries	0.625	0.157	0.185	0.022	0.011
Waterloo	0.029	0.403	0.001	0.543	0.024
Woolwich	0.036	0.255	0.000	0.196	0.513

Where: cell values are equal to the number of CSD_{ij} employed labour force residents having a usual place of work in CSD_j of CMA_i, expressed as a proportion of all CSD_{ij} employed labour force residents having a usual place of work within CMA_i.

Table 8(b). Employed Labour Force Residing and Working Within CMA_i: Observed 1991 Commuting Flows

CMA_i (Kitchener):

Residence/workplace	Cambridge	Kitchener	North Dumfries	Waterloo	Woolwich
Cambridge	0.829	0.118	0.008	0.040	0.005
Kitchener	0.066	0.706	0.004	0.209	0.016
North Dumfries	0.489	0.249	0.166	0.091	0.006
Waterloo	0.036	0.362	0.002	0.569	0.031
Woolwich	0.035	0.253	0.000	0.230	0.482

Where: cell values are equal to the number of CSD_{ij} employed labour force residents having a usual place of work in CSD_j of CMA_i, expressed as a proportion of all CSD_{ij} employed labour force residents having a usual place of work within CMA_i.

The differences between 1991 and 1981 commuting flow proportions outlined in Table 8(c) identify both the direction and magnitude of changes in 1991/81 commuting flow patterns.

Table 8(c). Employed Labour Force Residing and Working Within CMA_I: Differences Between Observed 1991 and Adjusted 1981 Commuting Flows

CMA_I: Kitchener (1991 proportions – 1981 proportions):

Residence/workplace	Cambridge	Kitchener	North Dumfries	Waterloo	Woolwich
Cambridge	- 0.0331	0.0078	0.0024	0.0225	0.0006
Kitchener	0.0145	- 0.0393	0.0015	0.0215	0.0021
North Dumfries	- 0.1359	0.0915	- 0.0189	0.0685	- 0.0052
Waterloo	0.0071	- 0.0407	0.0012	0.0258	0.0067
Woolwich	- 0.0016	- 0.0021	0.0000	0.0340	- 0.0312

Where: cell values are equal to 1991 commuting flow proportions minus corresponding 1981 commuting flow proportions.

In contrasting 1991 and 1981 commuting flow matrices, for the census subdivision components of Canada's 25 census metropolitan areas, analysts did **not** discover any "differences" in commuting flow proportions suggesting the existence of gross place of work coding errors. This phase of the external validity evaluation process served to reassure analysts that 1991 place of work data had been properly coded.

b) External Sources Of Data

External sources of place of work data are not readily available, nor does this type of data necessarily exist for all (or even most) major Canadian metropolitan areas. Place of work data collected by agencies other than Statistics Canada are not necessarily coded to fine levels of geography, nor are the variables measured necessarily identical to those measured by the census of population.

The Regional Municipality of Ottawa-Carleton has created a times-series database by conducting a survey of local employers for each of the years 1976, 1981, 1986 and 1991. Responses collected through the 1991 Ottawa-Carleton Employment Survey coded employment data geographically by civic address and were "rolled up" to larger geographical units (e.g., census tracts and census subdivisions). For evaluation purposes, Ottawa-Carleton's conceptualization of employment rendered this data comparable to 1991 Census of Population place of work data. Analysts acquired 1991 Ottawa-Carleton Employment Survey data and contrasted Ottawa-Carleton's distribution of "places of work" with the 1991 Census of Population's distribution of "places of work" of Ottawa-Carleton residents. Analysts found that Statistics Canada's 1991 Census of Population place of work data were consistent with Ottawa-Carleton's 1991 Employment Survey data.

In 1991, Daedalus Features Incorporated conducted a survey of employers in the metropolitan Vancouver area; the findings of this research were published under the title "Estimation of the 1991 Spatial Distribution of Employment in Metropolitan Vancouver: Description of Methodology and Results". Responses collected through this survey permitted Daedalus Features to measure the number of persons employed in a variety of census subdivisions in the metropolitan Vancouver area. Place of work analysts contrasted the 1991 Census of Population's distribution of "places of work" of Vancouver CMA residents to the Daedalus Features' distribution of "places of work" of Greater Vancouver Area residents, and found that Statistics Canada's 1991 Census of Population place of work results were consistent with Daedalus Features' survey results.

3. Conclusion

Given the results of the tabulations which monitored the effects of place of work SPIDER edit and imputation programs; the results of Stages One through Six of the external validity evaluation process; and the consistency between 1991 Census of Population place of work data, the Ottawa-Carleton survey, and the Greater Vancouver Area survey; analysts concluded that 1991 Census of Population place of work data were consistent, valid, complete, reliable and releasable.

VII. Historical Comparability

Although the overall design of the place of work question has changed between censuses (e.g., through reordering of the mark-off boxes and write-in response box), the basic data available have remained generally consistent and comparable. However, users must be careful in comparing historical data, because of changes in the definition of the 1991 Census population.

Universe and Sample Design

Data users should keep in mind the following issues when doing any time-series comparisons:

Universe – In 1971 and 1981, place of work addresses were coded to the census subdivision (CSD) and census tract (CT) levels of geography. In 1991, place of work responses were coded to the census subdivision level of geography. Only lower levels of geography were coded on a cost-recovery basis by request, as was the case for 50% of the data gathered from residents of the province of Ontario and of the Quebec portion of the Ottawa-Hull CMA. In 1971, the CSD-level data were taken from a 33.3% sample, compared to the 20% samples used in the 1981 and 1991 Censuses. The 20% sample data were then weighted up to provide estimates for the entire population. In the case of the 1991 Census, the place of work universe contained over 3,000,000 persons, weighted up to represent over 15,000,000 persons.

Question Design – Given the observed problems with regard to "central city overstatement" (refer to the report "Place of Work Information in the 1971, 1981, 1991 Censuses of Population"), the place of work question was modified slightly between censuses to improve the quality of coding. The use of Street Indexes to code a place of work address significantly improves the rate of correct coding at census subdivision levels of geography.

Geographic and Administrative Changes – Annexations, incorporations, and amalgamations of census subdivisions can create difficulties in comparing the spatial units and structures which change over time.

Imputation Methodology – In 1971, respondents who gave inaccurate or incomplete information, or no information at all, were assigned the "Not stated" response category. This "Not stated" category also included partial responses, such as those consisting of a province or province/census division name.

In 1981, this "Not stated" category no longer existed. Seven-digit Standard Geographical Classification (SGC) codes were assigned to affected records through SPIDER imputation programs. Characteristics of "Not stated" records were matched with those of donor records.

VIII. Products and Services

This section describes the different 1991 Census products and services which provide data on place of work. Users of census data have very different requirements in terms of the subjects covered and the geographical breakdowns and media (that is, paper, magnetic tape, microfiche and CD-ROM) used. The development of various products made it possible to ensure that users' most common needs were taken into account in designing products and services. A wide variety of publications and machine-readable files are therefore available, and the needs of many users are met through special tabulations.

Products and services are divided into three categories: data products, reference products, and workshops and seminars.

Data Products

For time-series analysis, place of work data at the census subdivision level are available from the 1971, 1981 and 1991 population censuses. The following place of work products are available for the 1991 Census of Population:

1. Nation Series

These publications contain various tables on the population by place of workplace of residence links which show commuting flows between census subdivisions for Canada's employed labour force living within census metropolitan areas.

Tables are also available showing 1991 Census data on the employed labour force 15 years and over by place of residence and sex, showing place of work, for census subdivisions in census metropolitan areas.

2. Area Profile Series

This series gives a statistical overview, or "profile", of geographic areas. A wide range of census variables are linked to various levels of place of work geography (census division, census subdivision, census metropolitan area and census agglomeration), each of which serves as the basis for a series of tabulations.

3. Basic Summary Tabulations

Basic summary tabulations are available for the following tables:

- Employed labour force 15 years and over by place of residence and sex, showing place of work for each census subdivision of residence by each census subdivision of work in each province, and in neighbouring provinces for census subdivisions in cross-provincial census metropolitan areas and census agglomerations.
- Employed labour force 15 Years and over by major occupation groups (based on the 1980 classification) (23), age groups (7) and sex (3), showing place of work for each census subdivision place of residence (with a 5,000+ population) by each census subdivision of work.
- Employed labour force 15 Years and over by industry divisions (based on the 1980 classification) (19), age groups (7) and sex (3), showing place of work for each census subdivision of residence (with a 5,000+ population) by each census subdivision of work.

4. Custom Data Products

Custom data products can also be created from the place of work database to meet users' needs in a more detailed or specific form is possible for standard products. The flexibility built into these services permits many demanding and complex data requests. Clients can therefore obtain products aimed at meeting specific data needs.

The services offer varying degrees of flexibility in terms of content, geographic level and medium.

Reference products

1. ***1991 Census Dictionary*** (Cat. No. 92-301E)

Provides detailed information on all census concepts, variables and geographic terms. For the first time, the Dictionary is also available on diskette.

2. ***1991 Census Catalogue*** (Cat. No. 92-302E)

Gives a full description of products and services available, including information on release dates, prices, media, table titles and catalogue numbers.

3. ***Census Tabulation Guide***

Provides detail on the content and levels of geography of all available standard tabulations. It is available only on IBM- compatible personal computer diskettes designed for systems using the MS-DOS operating system.

Workshops and Seminars

Workshops and seminars are offered to provide new and current census data users with relevant information and to assist them in maximizing the value of census data so as to meet their needs.

Appendix

Population Definitions

Employed Labour Force

Refers to persons who, during the week prior to June 4, 1991:

(a) did any work at all excluding housework or other maintenance or repairs around the home and volunteer work; or

(b) were absent from their job or business because of own temporary illness or disability, vacation, labour dispute at their place of work, or were absent for other reasons.

Data are available for persons 15 years of age and over, excluding institutional residents.

Experienced Labour Force

Refers to persons who, during the week prior to June 4, 1991, were employed or unemployed but who had worked since January 1, 1990. The experienced labour force can be derived by deleting from the total labour force those unemployed persons 15 years of age and over who have never worked or who worked only prior to January 1, 1990.

Industry (Based on 1980 Standard Industrial Classification)

Refers to the general nature of the business carried out in the establishment where the person worked, as indicated by the name of the employer and the kind of business, industry or service. Data are available for persons 15 years of age and over, excluding institutional residents. If the person was not employed in the week prior to enumeration, the information relates to the job of longest duration since January 1, 1990. Persons with two or more jobs were to report the information for the job at which they worked the most hours.

Labour Force Activity

This refers to the labour market activity of the working age population who, in the week prior to June 4, 1991, were **employed** or **unemployed**. The remainder of the working age population is classified as **not in labour force**. Data are available for persons 15 years of age and over, excluding institutional residents.

Geography Definitions

Block-face

The general concept of a block-face is one of a small recognizable geographical unit to which census data can be associated. The goal is to approximate, through aggregation, user-defined query areas for census data extraction and tabulation.

The block-face refers to one side of a city street, normally between consecutive intersections with streets or other physical features (such as creeks or railways).

Census Agglomeration (CA)

The general concept of a census agglomeration (CA) is one of a large urban area, together with adjacent urban and rural areas which have a high degree of economic and social integration with that urban area.

A CA is delineated around an urban area (called the urbanized core and having a population of at least 10,000, based on the previous census). Once a CA attains an urbanized core population of at least 100,000, based on the previous census, it becomes a census metropolitan area (CMA).

Census Division (CD)

Refers to the general term applying to geographic areas established by provincial law, which are intermediate geographic areas between the census subdivision and the province (e.g., divisions, counties, regional districts, regional municipalities and seven other types of geographic areas made up of groups of census subdivisions).

In Newfoundland, Manitoba, Saskatchewan and Alberta, provincial law does not provide for these administrative geographic areas. Therefore, census divisions have been created by Statistics Canada in co-operation with these provinces.

Census Metropolitan Area (CMA)

The general concept of a census metropolitan area (CMA) is one of a very large urban area, together with adjacent urban and rural areas which have a high degree of economic and social integration with that urban area.

A CMA is delineated around an urban area (called the urbanized core and having a population of at least 100,000, based on the previous census). Once an area becomes a CMA, it is retained in the program even if its population subsequently declines.

Smaller urban areas, centred on urbanized cores of a population of at least 10,000, are included in the census agglomeration (CA) program.

Census Subdivision (CSD)

Refers to the general term applying to municipalities (as determined by provincial legislation) or their equivalent (e.g., Indian reserves, Indian settlements and unorganized territories).

In Newfoundland, Nova Scotia and British Columbia, the term also describes geographic areas that have been created by Statistics Canada in co-operation with the provinces as equivalents for municipalities.

Census Subdivision Type

The type indicates the municipal status of a census subdivision. Census subdivisions (CSDs) are classified into various types, according to official designations adopted by provincial or federal authorities. The census subdivision types generally accompany the census subdivision names in order to help distinguish CSDs from one another.

Census Tract

The general concept of a census tract (CT) is that of a permanent, small urban neighbourhood-like or rural community-like area established in large urban-centred regions with the help of local specialists interested in urban and social science research.

Census tracts are delineated jointly by a local committee and Statistics Canada according to the following criteria:

(1) Wherever possible, census tract boundaries must follow permanent and easily recognizable physical features.

(2) The population of a census tract must be between 2,500 and 8,000, with a preferred average of 4,000 persons, except for those census tracts in central business districts, in other major commercial and industrial zones, or in peripheral rural or urban areas that may have either a lower or higher population.

(3) When first delineated, or subsequently subdivided, census tracts must be as homogeneous as possible in terms of the economic status and social living conditions of their populations.

(4) Their shape must be as compact as possible.

All census metropolitan areas (CMAs) and census agglomerations (CAs) in Canada containing a census subdivision (CSD), i.e., municipality, having a population of 50,000 or more **at the previous census**, are eligible for a census tract program. Once a census metropolitan area or census agglomeration is added to the program, it is retained even

if the population subsequently decreases below 50,000. CSDs already within a tracted CMA do not qualify for a separate CT program when they reach a population of 50,000.

Province

This refers to the major political division of Canada. From a statistical point of view, it is a basic unit for which data are tabulated and cross-classified.

Standard Geographical Classification (SGC)

The Standard Geographical Classification (SGC) is Statistics Canada's official classification of geographic areas in Canada. The SGC provides unique numeric identification for three types of geographic areas. These are:

- provinces and territories;
- census divisions (CDs);
- census subdivisions (CSDs).

The three geographic areas are hierarchically related. Census subdivisions (CSDs) aggregate to census divisions (CDs), which in turn aggregate to a province or territory. This relationship is reflected in the seven-digit code:

Province/territory	Census division	Census subdivision
XX	XX	XXX
(2 digits)	(2 digits)	(3 digits)

Territory

This refers to two major political divisions of Canada, namely Yukon Territory and Northwest Territories. From a statistical point of view, these territories are equivalent to provinces, i.e., a basic unit for which data are tabulated and cross-classified.

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Other Census Reference Products

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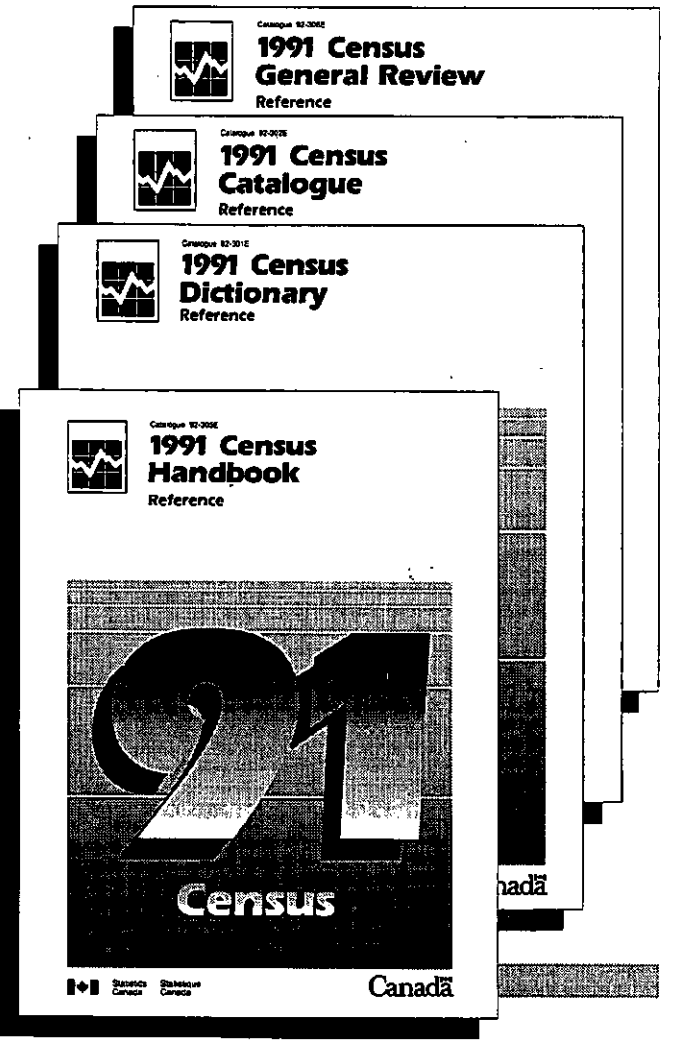

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