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**USER'S GUIDE
TO THE QUALITY OF
1986 CENSUS DATA:
COVERAGE**

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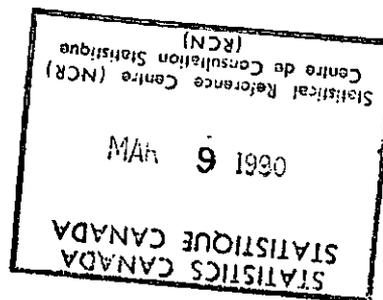
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I. CENSUS UNIVERSES

A. Introduction and Definitions

The primary objectives of the 1986 Canadian Census of Population were to obtain accurate counts of the population and the number of households and dwellings at all geographic levels, as well as a broad range of information on their characteristics. The census is an invaluable source of information that is useful to the various levels of government, to businesses, associations and interest groups, and to the general public. Among other things, such information is used in government planning of social and economic programs, assessment of the need for educational and health facilities, and planning by private enterprise.

In a massive undertaking such as the census, 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. While statistics do not need to be perfect to be useful, users should 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.

In order to inform data users, a number of programs for assessing the quality of census data have been developed. One of these programs seeks to measure census coverage error. The term "coverage error" refers to an error that affects the accuracy of the counts regarding the size of the different universes in the census.

The census involves the enumeration of five universes:

- (a) the population universe;
- (b) the housing universe;
- (c) the household universe;
- (d) the census family universe; and
- (e) the economic family universe.

The 1986 Coverage Error Measurement Program dealt primarily with the first and third universes. It was possible, indirectly, to obtain only partial results on the accuracy of the count of the housing universe. The program did not attempt to assess the coverage of the two family universes.

The rest of Chapter I is devoted to definitions of the three universes covered by the program. Chapter II briefly describes the census operations in which coverage errors may occur. Chapter III presents the different types of coverage errors as well as the parameters used to characterize them. In addition, it describes the Coverage Error Measurement Program, which in 1986 included four main studies conducted during or soon after the census. The next four chapters provide a detailed description of these studies. Chapter VIII compares several estimates produced by the program with others from independent sources. Results of the program are integrated in Chapter IX.

B. Population Universe

This first universe is defined largely in terms of what it includes and what it excludes. In general, it is defined as follows:

- Included are:
- all Canadian citizens and landed immigrants whose usual place of residence (see Definitions at the end of this document) on Census Day is in Canada;
 - all Canadian citizens and landed immigrants who, on Census Day, are stationed at a military base or attached to a diplomatic mission outside Canada, along with their families;
 - all Canadian citizens and landed immigrants at sea or in port, aboard merchant ships under Canadian registry or Canadian naval or coast-guard vessels.

- Not included are:
- foreign diplomats and military personnel and their families;
 - work permit holders and their families;
 - student visa holders and their families;
 - residents of other countries visiting Canada temporarily.

The above definition indicates who should be included in the population universe but not where these persons should be enumerated. There are two possible approaches to this latter question. The first is the "de facto" approach, by which all persons present in the country are enumerated where they are located on Census Day. The second approach is the "de jure" method, by which persons are enumerated at their usual place of residence in Canada, even if they are temporarily away on Census Day. The approach employed in the census of Canada is the "de jure" method (modified slightly to allow for the enumeration of certain groups of Canadians stationed abroad, or on board vessels, as defined above).

C. Housing Universe

For the purposes of the housing universe, also called the housing stock, a dwelling is defined as a set of living quarters in which a person or group of persons resides or could reside. There are two main types of dwellings:

- (a) The private dwelling, which is defined as a distinct set of living quarters with a private entrance from outside or a common hallway or stairway inside the building. The entrance must not be through someone else's living quarters.
- (b) The collective dwelling, which is of an institutional, commercial or communal nature, in which a person or group of persons resides or could reside. Included are motels, hotels, hospitals, student residences, rest homes, religious institutions, prisons, rooming-houses, etc.

The dwelling in question may be occupied by usual residents or solely by foreign or temporary residents (see Definitions).

These two main types of dwellings are subject to a more detailed classification. Private dwellings can be regular, marginal or under construction. Regular dwellings are those built or renovated to be inhabited year-round or permanently. Marginal dwellings are those that are unsuitable for year-round or permanent occupancy because they lack the installations necessary for year-round comfort (for example, summer cottages). A dwelling under construction is a new dwelling not yet complete. A dwelling is considered complete when services (e.g., electricity, water) have been connected and the dwelling's structural parts are installed, such as doors, windows, roof and walls (and in the case of high-rise apartments, passenger elevators). Collective dwellings and regular dwellings are further divided into

dwellings that are either occupied by usual residents, occupied solely by temporary or foreign residents, or unoccupied. Collective dwellings, marginal dwellings and dwellings under construction are included in the housing universe only if they are occupied, either by usual residents or solely by temporary or foreign residents. (In the case of unoccupied collective dwellings, data were collected but are not included in publications.)

In summary, the housing universe may be defined as follows:

Included are: - all regular private dwellings (occupied or unoccupied) and dwellings that are either marginal or under construction but are occupied on Census Day;
- all collective dwellings that are occupied, either by usual residents or by temporary or foreign residents.

Not included are: - unoccupied collective dwellings;
- private dwellings that are either marginal or under construction and are unoccupied on Census Day.

D. Household Universe

The third universe consists of households. A household is defined as a person or group of persons belonging to the population universe, occupying a given dwelling, and not having a usual place of residence elsewhere in Canada. It usually consists of a family grouping, with or without lodgers or employees. It may also consist of two or more families sharing the same dwelling, a group of unattached persons or a single person. Persons who are temporarily absent on Census Day are considered as belonging to the household situated at their usual place of residence. This universe is divided into three subuniverses: (a) private households - those occupying a private dwelling; (b) collective households - those occupying a collective dwelling; and (c) households outside Canada, consisting of Canadian government employees and diplomatic and military personnel and their families stationed outside Canada and persons aboard Canadian vessels. In summary, the household universe is defined as all private and collective households as well as certain households outside Canada.

E. Relationships among Universes

Table 1 gives a summary of the three basic universes.

Table 1. 1986 Census Universes: Inclusions and Exclusions

	Popu- lation	House- holds	Dwell- ings
In Canada			
1. Regular private dwellings			
- occupied by usual residents	I	I	I
- occupied by temporary or foreign residents only	E	E	I
- unoccupied	E	E	I
2. Private dwellings, marginal or under construction			
- occupied by usual residents	I	I	I
- occupied by temporary or foreign residents only	E	E	I
- unoccupied	E	E	E
3. Collective dwellings			
- occupied by usual residents	I	I	I
- occupied by temporary or foreign residents only	E	E	I
- unoccupied	E	E	E ¹
Outside Canada			
4. Canadian diplomatic and government personnel posted in an embassy (and their families)	I	I	E
5. Canadian military and government personnel posted at a military base (and their families)	I	I	E
6. Canadians and landed immigrants aboard Canadian merchant ships, naval and coast-guard vessels	I	I	E

¹ Data were collected but are not included in publications.

Note: I = included, E = excluded

II. DESCRIPTION OF CENSUS OPERATIONS

The various census operations may be divided into two major phases: collection and processing. These two activities are briefly described below.

A. Collection

The purpose of the collection phase is to enumerate the population, household and housing universes and to collect the required information on each unit enumerated. This was achieved by listing all dwellings in a Visitation Record (see Definitions), classifying them as either private or collective dwellings and specifying their occupancy status (occupied or unoccupied). Once this operation was completed, a householder was asked to list all occupants of the dwelling included in the population universe (whether present or temporarily absent) and to report their characteristics.

To carry out this phase, the country was divided into 44,042 enumeration areas (EAs) (see Definitions) containing an average of about 200 households. Each EA was assigned to a specially trained census representative (CR).

Four collection methods were used: mail-back, pick-up, canvasser and collective. In all methods, the CR identified and listed all dwellings, either dropping off or completing an appropriate census form at each dwelling.

The "mail-back" methodology was used in urban centres with a population of more than 10,000, as well as certain other centres. At drop-off, householders were instructed to complete the questionnaire as of June 3, 1986 and return it through the mail. Questionnaires received were edited, and a telephone follow-up was undertaken by the CR for those which were incomplete or if a questionnaire was not returned through the mail. However, if this was unsuccessful, follow-up was then attempted by personal visit.

The "pick-up" methodology was used in small urban centres and in most rural areas. At drop-off, householders were asked to complete the questionnaire as of Census Day and were told that the CR would return to collect the completed questionnaire. Under this method, questionnaires were edited at pick-up, and any missing information was obtained on the spot.

Thus, both the "mail-back" and "pick-up" methodology entailed self-enumeration. In remote areas, a "canvasser" methodology was used. Data were collected by the traditional method of personal interviews. Such areas represented about 2% of the total population of Canada.

For the enumeration of collective dwellings, a special list was created the day before Census Day in order to identify all the occupants. In the case of dwellings designated for self-enumeration, such as hotels and motels, an Individual Census Questionnaire was distributed to each person, and the data from any usual residents were transcribed onto a regular census questionnaire. In the case of dwellings not subject to self-enumeration, such as in penitentiaries, psychiatric hospitals, etc., data for usual and temporary residents were transcribed directly from the institution's administrative files.

In addition to the basic demographic and housing information which was collected in all households, some additional data were collected from a sample of households. In

mail-back and pick-up areas, the CR delivered a longer questionnaire to every fifth occupied private dwelling, that is, a 20% sample. The longer questionnaire was also used for all households in canvasser EAs and other population subgroups, such as residents of certain types of collective dwellings and of Indian reserves.

Following completion of collection by the CR, the work was checked by the CR's supervisor (the Census Commissioner) and by a quality control technician. Once the work was approved, the questionnaires and the Visitation Records were forwarded to the data processing operations.

B. Processing

Following completion of the collection phase, the questionnaires were processed in five stages.

1. Regional Office Processing

This operation employed roughly 2,000 specially hired persons located at the regional centres of Revenue Canada in St. John's, Jonquière, Shawinigan, Ottawa, Sudbury, Winnipeg and Surrey. The first part of the processing consisted of examining the questionnaires and the corresponding entries in the Visitation Record in order to determine the type and number of documents and residents. The second part consisted of ensuring that the information on the questionnaires could be read by the data entry operators. For this purpose, "pre-entry grooming" was necessary to minimize data capture errors. In addition, a coding operation was required to convert written responses to certain questions into numeric codes prior to keying. An independent verification of a sample of records was established for this operation to control the quality of the coding.

2. Direct Data Entry

Data capture took place at the seven regional centres of Revenue Canada and employed approximately 1,500 persons. Data were entered on keyboards, transmitted to Revenue Canada headquarters in Ottawa, where they were stored on magnetic tapes. Again, an independent verification of a sample of each batch of work was used to control the quality of the keying operation.

3. Head Office Processing

This process consisted of a combination of manual and automated operations. It was designed to perform structural checks (that is, verification of counts of dwellings, households and persons) at the EA and household levels. A manual review was performed and any inconsistencies identified were corrected.

A second activity at this stage consisted of processing overseas persons, temporary residents, persons on Canadian coast-guard, naval and merchant vessels under Canadian registry. The final activity at this stage was to load the data onto a data base in preparation for the edit and imputation operation.

4. Edit and Imputation

A more sophisticated automated edit and imputation was performed at this stage to ensure that the final data were free of errors and inconsistencies. Imputation was performed in cases of non-response and to resolve conflicts among different

data items (for example, a married 5-year-old). The data collected on a 100% basis were edited and imputed first, followed by the 20% sample data.

It was also during this activity that weights were calculated and assigned to the dwellings, households and persons included in the one-fifth sample of households. The weighting and estimation methods are described in the User Information Bulletin Number 3, reference [3].

5. Dissemination of Data

The data were disseminated to users in a variety of forms including printed publications, microdata files, machine-readable summary tables and custom-tailored products. In order to ensure that individual respondents could not be identified in any of the products, a number of disclosure prevention techniques were employed. These included the random rounding to a multiple of five in tabulations (except population and dwelling counts) and the suppression of small geographic areas and small cells in tables.

III. COVERAGE ERRORS AND THEIR MEASUREMENT

A. Definitions

Coverage errors are errors that can affect the accuracy of census counts regarding the size of the various universes: population, family, household and housing. There are two types of coverage errors: those resulting in undercoverage and those resulting in overcoverage.

Undercoverage occurs when a unit belonging to the universe covered by the census is not enumerated. The converse, overcoverage, may occur in three cases: when a unit belonging to the universe in question is enumerated more than once, when a unit outside the universe is erroneously enumerated, or when a fictitious unit is included in the universe.

B. Sources of Errors

Such errors may occur during either the collection or processing of census data. Examples of coverage errors during processing are the cancellation of records for valid persons or households, the loss of questionnaires or records, or the inappropriate creation of persons or households by imputation. However, in most cases, coverage errors result from collection errors that can be attributed to the procedures, to the manuals or maps used, to census representatives or to the respondents themselves. Thus, dwellings may be overlooked because they are hidden from view or appear to be uninhabitable. In addition, dwellings (or households or persons) may be missed or double-counted owing to the use of inaccurate maps, as this can lead to misinterpretation of EA boundaries, or to failure to enumerate part of an EA. Persons may be omitted when, by error, their dwelling is classified as unoccupied or they have not been included on the questionnaire owing to a misinterpretation of the instructions concerning persons to be included.

During the planning of the 1986 Census, a number of control measures were taken to minimize these potential sources of errors. These measures included:

- (a) careful definition and mapping of enumeration areas, and field checks of maps prior to enumeration to ensure there were no gaps or overlaps of boundaries;
- (b) pre-identification of collective dwellings for verification by field staff;
- (c) quality control of enumeration during collection, regional office processing and data capture;
- (d) instructions on whom to include or not to include on the census questionnaire.

These various procedures served to reduce the number of coverage errors but not to eliminate them. Hence it is important to evaluate the magnitude of the remaining coverage errors.

C. Coverage Error Measurement Program

The purpose of a coverage error measurement program is to investigate the incidence of coverage errors in the census with respect to the universes described above, and to assess their effects on published census counts. To achieve this objective, the program would ideally yield estimates of undercoverage,

overcoverage and net coverage error of each of the various census universes: population, households, dwellings and families.

Unfortunately, such an ideal would have been too costly and in some cases impossible to achieve. It was, therefore, decided to confine the study to the following components of coverage error:

- (a) undercoverage of the population and of households;
- (b) overcoverage of the population and of households;
- (c) classification errors involving unoccupied dwellings.

The studies listed below were conducted within the framework of the 1986 Coverage Error Measurement Program:

- (a) Vacancy Check;
- (b) Temporary Residents Study;
- (c) Reverse Record Check;
- (d) Overcoverage Study.

The Vacancy Check estimated the number of households and persons missed because their dwelling was misclassified as unoccupied. These estimates were used to adjust population and household totals to take account of this classification error. In addition, the Vacancy Check yielded estimates of the number of unoccupied dwellings that were outside the housing universe. The Temporary Residents Study produced estimates of one component of population undercoverage, namely persons missed because they were temporarily away from their usual place of residence, and the estimates were also used to adjust the official census totals. The Reverse Record Check yielded estimates of the remaining undercoverage of the population and households after allowing for vacant dwellings and temporary residents. Finally, the Overcoverage Study was an attempt to measure, for the first time in Canada, the order of magnitude and nature of certain components of population and household overcoverage.

These studies constituted the 1986 Coverage Error Measurement Program. Chapters IV to VII present a description and analysis of each of the studies and the results obtained.

D. Parameters

In this section, the parameters used in quantifying coverage errors are defined. The concepts dealt with here apply equally to the population, household and dwelling universes.

Let T represent the total number of units in the universe in question, and let C be the published census count for this universe. The error or bias resulting from the use of C instead of T is then:

$$B = T - C$$

This is called the net coverage error.

As previously noted in Section A on page 15, this error may be caused by undercoverage or overcoverage. Let U denote the total undercoverage - that is, the total number of units in the universe in question that were missed in the census - and let E represent the total number of units in the said universe that were enumerated at least once; then

$$T = U + E$$

and we may write

$$B = (U + E) - C = U - (C - E)$$

where the second term of the above equation,

$$O = C - E$$

is defined as overcoverage. This error results not only from counting units more than once but also from counting units that are outside the universe in question.

These errors are often expressed in relative terms, that is, as a proportion of the total number of units in the universe in question. We thus have the following definitions:

(a) undercoverage rate: $R_U = U/T = U/(C + U - O)$;

(b) overcoverage rate: $R_O = O/T = O/(C + U - O)$;

(c) net coverage error rate: $R_B = R_U - R_O$.

IV. VACANCY CHECK

A. Introduction

One of the universes of the 1986 Census is the housing universe, also known as the housing stock. As Table 1 shows, in order to enumerate the housing universe correctly, it is necessary to determine, in the case of marginal dwellings, how many were occupied on Census Day. The inclusion of unoccupied marginal dwellings would result in overcoverage of the housing stock. Furthermore, if a dwelling occupied on Census Day were misclassified as unoccupied, this would result in undercoverage of households and persons. The Vacancy Check serves to estimate the accuracy of the unoccupied dwelling count.

The data collected in this study are used to:

- (a) estimate the number of unoccupied dwellings that were outside the housing universe;
- (b) estimate the number of occupied dwellings misclassified as unoccupied;
- (c) estimate the number of households and individuals missed as a result of this misclassification;
- (d) determine the causes of these misclassifications.

In addition, as in the 1981 Census, the estimates obtained under item (c) above were used to adjust the data for households and persons to take account of these errors.

B. Methodology

1. Stratification and Sample Selection

The population targeted by the study consisted of all unoccupied dwellings identified in the census as of June 3, 1986. Owing to cost and practical considerations, the survey frame (study data base) excluded some such dwellings, namely, all unoccupied dwellings within:

- (a) canvasser EAs;
- (b) collective EAs (see Definitions); and
- (c) Indian reserves.

These exclusions represent approximately 2.5% of all unoccupied private dwellings.

A sample of 1,391 enumeration areas was drawn from the whole of Canada. Beforehand, the EAs had been divided into two groups: (1) EAs in the urban cores of census metropolitan areas (CMAs) (see Definitions) and (2) other EAs.

The first group of EAs was stratified by CMA within each province. A simple random sample of EAs was selected within each CMA. In all, 685 EAs were selected from this group.

To reduce costs of field work and, in addition, to obtain better control, a two-stage sample was selected from the second group. The primary sampling units were census commissioner districts (CCDs) (see Definitions). These were stratified by province and territory. A sample of CCDs was selected randomly and without replacement in each province and territory. Within each CCD selected, five EAs were selected randomly and without replacement.

The sample included all unoccupied dwellings listed in the Visitation Record (VR) for the sampled EAs. In all, 16,498 unoccupied dwellings were selected. Table 2 shows the sample distribution by province or territory.

Table 2. Sample Size by Province or Territory, 1986 Vacancy Check

Province or territory	Number of EAs	Number of unoccupied dwellings
Newfoundland	67	994
Prince Edward Island	40	420
Nova Scotia	79	904
New Brunswick	67	880
Quebec	265	4,216
Ontario	258	2,046
Manitoba	92	787
Saskatchewan	155	1,657
Alberta	164	2,312
British Columbia	133	1,534
Yukon	36	248
Northwest Territories	35	500
Canada	1,391	16,498

2. Field Interviews

For each EA in the sample, all dwellings classified as unoccupied on Census Day were visited again during the third week of July 1986. A questionnaire was prepared for each unoccupied dwelling. Occupants and neighbours were interviewed to determine the true occupancy status of the dwelling on June 3, 1986. If the dwelling was found to have been occupied, the number of occupants was noted, along with possible causes for the misclassification.

3. Processing, Coding and Edit

Once the field interviews were completed, the questionnaires were sent to Ottawa for processing.

First, any questionnaires not belonging to the sample were eliminated (some questionnaires came from EAs outside the sample). Then, a preliminary edit was carried out in order to determine whether the questionnaires were properly filled out. Certain responses were also coded prior to data capture.

Once data capture was completed, the questionnaires were subjected to an extensive set of consistency edits. The questionnaires failing edits were then examined individually to try to resolve the inconsistency.

For each dwelling found to have been occupied on Census Day, the VR was also checked to determine whether the dwelling had in fact been listed as an occupied dwelling as well as an unoccupied dwelling. (Occupied and unoccupied dwellings were listed in separate sections of the VR.) If so, the names of the persons included in the study questionnaire were removed, and the dwelling was placed in the "not in housing stock" category.

The number of questionnaires completed was checked against the number of entries in the "Unoccupied dwelling" section of the VR for each EA. Dwellings not found in the VR were removed while dwellings listed as unoccupied in the VR, but not appearing on the sample file, were considered as non-response.

4. Non-response, Imputation and Weighting

Total non-response (i.e. no information for a particular dwelling) was dealt with through an adjustment to the weights within various subprovincial areas (the three largest CMAs: Montréal, Toronto and Vancouver, together with the remaining urban and rural parts of each province and territory).

Afterwards, item non-response (i.e. no information on particular items, namely, occupancy status, number of usual residents, dwelling type and reason dwelling is unsuitable for year-round occupancy) was dealt with through imputation. Occupancy status was imputed first, and was then used in imputation of the other items where data were missing.

Then the weights were adjusted so that their sum would give the known number of unoccupied dwellings listed in the VRs. Adjustment groups were defined for urban and rural parts of each province and territory.

To adjust the census data bases, a national-level profile of misclassified dwellings was first established, for both the rural and urban parts, using the type of private dwelling and number of persons missed because of this misclassification. These national profiles were used to create estimates of the number of misclassified dwellings by number of persons in the household, type of dwelling and rural/urban parts at the province and territory level. On the basis of these estimates, enumerated households with the same characteristics (number of persons, type of private dwelling) were selected at random, and their weights in the census were increased by one unit. For each household selected, the weight of one unoccupied dwelling from the same EA was set to zero so that the total number of dwellings would not be increased.

C. Results

The main results are shown in Tables 3, 4 and 5. Table 3 gives the estimated number and proportion of dwellings misclassified as unoccupied by region, by urban-rural breakdown, by availability and by type of private dwelling. The term "Available" dwelling indicates that the dwelling in question was classified by the CR as available for rent or sale. Table 4, using the same breakdown, gives the number of unoccupied dwellings outside the housing universe. Table 5 shows the undercoverage rates for households and persons and the overcoverage rates for dwellings.

1. Occupied Dwellings

This category also includes dwellings occupied by foreign or temporary residents only, as well as dwellings for which one or more persons were enumerated elsewhere in Canada. Table 3 shows that 11% of dwellings classified as unoccupied were in fact occupied. This misclassification is distributed very unequally between rural areas (4.2%) and urban areas (15.7%).

As regards regions, there is a significant difference between Quebec and Ontario and the rest of the provinces.

It may also be noted that, according to the study, there is no significant difference between the three largest CMAs. For these, the overall proportion is 20.4%, with a standard error of 4.2%.

For Canada as a whole, there is no significant difference between the error rates for available and unavailable dwellings. However, the "Unavailable" category may be segmented into subcategories defined on the basis of reasons for unavailability, and some of these reasons have different error rates. The greatest difference is between the error rate for dwellings used for seasonal purposes (4.0%) and the error rate for dwellings used by corporations (18.7%). Similarly, if the "Available" subgroup is broken down between urban and rural parts or examined within CMAs, no difference emerges. Thus, according to the survey, there is no evidence that availability influences the process that leads to this classification error.

Table 3. Estimated Number of Occupied Dwellings Misclassified as Unoccupied, 1986 Vacancy Check

Characteristics	No. of vacant dwellings	Occupied	Standard error	Rate %	Standard error %
Canada¹	505,008	55,410	3,160	11.0	0.6
Urban	295,998	46,536	2,969	15.7	1.0
Rural	209,010	8,874	1,277	4.2	0.6
Regions					
Atlantic	44,537	3,595	528	8.1	1.2
Quebec	162,260	20,509	2,113	12.6	1.3
Ontario	124,550	14,668	1,930	11.8	1.5
Prairies	102,954	9,197	906	8.9	0.9
British Columbia	69,880	7,316	837	10.5	1.2
Territories	827	125	8	15.1	1.0
All CMAs	208,847	35,135	3,100	16.8	1.5
Selected CMAs					
Montréal	47,035	9,761	1,458	20.7	3.1
Toronto	25,607	5,048	1,366	19.7	5.3
Vancouver	16,645	3,374	799	20.3	4.8
Availability					
Available	161,960	19,302	1,820	11.9	1.1
Unavailable	343,048	36,108	2,407	10.5	0.7
Seasonal	126,514	5,070	845	4.0	0.7
Rented or sold	42,646	7,442	1,116	17.5	2.6
Corporation ²	13,068	2,447	788	18.7	6.0
Exp. for demo. ³	4,630	95	56	2.1	1.2
Other					
(undetermined)	156,190	21,055	1,981	13.5	1.2

See footnotes at end of table.

Table 3. Estimated Number of Occupied Dwellings Misclassified as Unoccupied, 1986 Vacancy Check - Concluded

Characteristics	No. of vacant dwellings	Occupied	Standard error	Rate %	Standard error %
Urban area					
Available	131,263	18,174	1,807	13.8	1.4
Unavailable	164,735	28,363	2,187	17.2	1.3
Rural area					
Available	30,697	1,128	306	3.7	1.0
Unavailable	178,313	7,746	1,115	4.3	0.6
All CMAs					
Available	87,333	13,834	1,755	15.8	2.0
Unavailable	121,514	21,301	2,228	17.5	1.8
Type of private dwelling					
Single house	268,355	18,621	1,599	6.9	0.6
Duplex	15,399	1,953	320	12.7	2.1
Semi-detached house	14,048	1,643	332	11.7	2.4
Row house	21,427	1,718	412	8.0	1.9
Apt. in a building with less than 5 storeys	133,187	22,483	2,064	16.9	1.5
Apt. in a building with 5 storeys or more	39,123	7,822	1,388	20.0	3.5
Other	13,469	1,170	236	8.7	1.6
All CMAs					
Single house	57,061	7,157	971	12.5	1.7
Apartment	121,799	23,859	2,511	19.9	2.1
Other	29,987	4,119	643	13.7	2.1

1 Canada excluding Indian reserves and collective and canvasser EAs.

2 Dwelling suitable for year-round use which is maintained by an individual, company, corporation or agency to provide temporary accommodation for family, clients or employees.

3 Expropriation for demolition.

There is a discernable difference in the error rates for the specific types of dwellings inventoried in the census; the two extremes are single houses (6.9%) and apartments in buildings with five storeys or more (20.0%). The difference tends to be smaller in urban centres but is still significant.

Owing to these classification errors, a number of households and persons were not enumerated in the 1986 Census. Because some of the 55,410 dwellings misclassified as unoccupied had in fact also been correctly enumerated by the CR as occupied dwellings, the number of households actually underenumerated was somewhat less than 55,410. Table 5 shows that undercoverage of households due to such errors is 0.53% (representing 48,000 households), while undercoverage of persons is 0.37% (94,000 persons). Greater proportions of households and persons were missed in the urban areas (0.57% and 0.42% respectively) than in the rural areas (0.37% and 0.22%). These differences are statistically significant.

2. Classification of Unoccupied Dwellings Outside the Housing Universe

The enumeration of unoccupied dwellings outside the housing universe results in overcoverage of dwellings. These dwellings fall into the following categories:

- (a) dwellings used for commercial purposes;
- (b) dwellings not habitable year-round;
- (c) double-counted dwellings - e.g., dwellings listed in the Visitation Record as occupied as well as unoccupied.

It is often very difficult to decide whether a given dwelling is habitable year-round, as in the following cases:

- (a) dwellings under construction and almost completed;
- (b) houses at various stages of deterioration;
- (c) cottages, ski chalets, etc.

The estimates given in Table 4 are based on unoccupied dwellings which were identified in the study as not part of the housing stock. However, it should be noted that the information was gathered some 50 days after the census, and that the results to some extent may reflect differences of opinion rather than actual errors. Consequently, the results must be used with caution.

Overall, dwellings outside the housing stock represent 19.9% of all dwellings classified as unoccupied. The problem is more pronounced in the rural areas (31.7%) than in the urban areas (11.5%).

It may be noted that 85% of cases outside the housing stock are not available for occupancy. The study also shows that most dwellings not in the housing stock were single houses (76%).

Finally, Table 5 shows that dwelling overcoverage is estimated at 1.1% of all dwellings; in rural areas, however, overcoverage reaches 3.8%.

Table 4. Estimated Number of Unoccupied Dwellings Not in Housing Stock, 1986 Vacancy Check

Characteristics	No. of unoccupied dwellings	Not in housing stock	Standard error	Rate %	Standard error %
Canada¹	505,008	100,325	6,740	19.9	1.3
Urban	295,998	33,997	2,837	11.5	1.0
Rural	209,010	66,328	6,133	31.7	2.9
Regions					
Atlantic	44,537	11,093	772	24.9	1.7
Quebec	162,260	34,139	4,122	21.0	2.5
Ontario	124,550	25,870	4,241	20.8	3.4
Prairies	102,954	16,745	1,972	16.3	1.9
British Columbia	69,880	12,372	2,443	17.7	3.5
Territories	827	106	2	12.8	0.2
All CMAs	208,847	24,845	2,507	11.9	1.2
Selected CMAs					
Montréal	47,035	5,318	944	11.3	2.0
Toronto	25,607	3,088	1,030	12.1	4.0
Vancouver	16,645	3,011	769	18.1	4.6
Availability					
Available	161,960	14,652	1,375	9.0	0.8
Unavailable	343,048	85,673	6,816	25.0	2.0
Seasonal	126,514	39,720	6,264	31.4	5.0
Rented or sold	42,646	5,371	1,181	12.6	2.8
Corporation ²	13,068	2,450	495	18.7	3.8
Exp. for demo. ³	4,630	3,581	648	77.3	14.0
Other					
(undetermined)	156,190	34,551	2,730	22.1	1.7

See footnotes at end of table.

Table 4. Estimated Number of Unoccupied Dwellings Not in Housing Stock, 1986 Vacancy Check - Concluded

Characteristics	No. of unoccupied dwellings	Not in housing stock	Standard error	Rate %	Standard error %
Urban area					
Available	131,263	9,472	1,065	7.2	0.8
Unavailable	164,735	24,525	2,500	14.9	1.5
Rural area					
Available	30,697	5,180	889	16.9	2.9
Unavailable	178,313	61,147	6,346	34.3	3.6
All CMAs					
Available	87,333	6,770	1,001	7.8	1.1
Unavailable	121,514	18,075	2,171	14.9	1.8
Type of private dwelling					
Single house	268,355	76,694	6,322	28.6	2.4
Duplex	15,399	2,817	454	18.3	2.9
Semi-detached house	14,048	1,906	527	13.6	3.8
Row house	21,427	1,810	437	12.2	2.0
Apt. in a building with less than 5 storeys	133,187	13,315	1,442	10.0	1.1
Apt. in a building with 5 storeys or more	39,123	1,472	393	3.8	1.0
Other	13,469	2,312	322	17.2	2.4
All CMAs					
Single house	57,061	10,189	1,447	17.9	2.5
Apartment	121,799	10,783	1,334	8.9	1.1
Other	29,987	3,873	733	12.9	2.4

1 Canada excluding Indian reserves and collective and canvasser EAs.

2 Dwelling suitable for year-round use which is maintained by an individual, company, corporation or agency to provide temporary accommodation for family, clients or employees.

3 Expropriation for demolition.

Table 5. Undercoverage Rates for Households and Persons and Overcoverage Rates for Dwellings, 1986 Vacancy Check

Characteristics	Undercoverage				Overcoverage	
	Households ²		Persons ³		Dwellings ⁴	
	Rate %	Standard error %	Rate %	Standard error %	Rate %	Standard error %
Canada¹	0.53	0.03	0.37	0.02	1.14	0.09
Urban	0.57	0.04	0.42	0.03	0.48	0.04
Rural	0.37	0.06	0.22	0.04	3.79	0.47
Regions						
Atlantic	0.43	0.06	0.27	0.04	1.55	0.13
Quebec	0.76	0.08	0.53	0.06	1.48	0.20
Ontario	0.38	0.05	0.27	0.04	0.81	0.14
Prairies	0.48	0.05	0.34	0.04	1.09	0.13
British Columbia	0.57	0.07	0.44	0.06	1.17	0.24
Territories	1.10	0.08	0.74	0.10	0.96	0.03
All CMAs	0.54	0.05	0.39	0.04	0.48	0.06
Selected CMAs						
Montréal	0.75	0.12	0.56	0.08	0.47	0.09
Toronto	0.35	0.10	0.25	0.08	0.26	0.09
Vancouver	0.57	0.14	0.46	0.13	0.57	0.15

1 Canada excluding Indian reserves and collective and canvasser EAs.

2 Obtained by calculating the ratio of the number of households missed (owing to the misclassification of unoccupied dwellings) to the total number of households that should have been enumerated, that is, the number of enumerated households plus the undercoverage of households obtained by the 1986 Reverse Record Check (see Chapter VI).

3 Obtained by calculating the ratio of persons missed (owing to the misclassification of unoccupied dwellings) to the total number of persons who should have been enumerated, that is, the number of enumerated persons plus the undercoverage of persons obtained by the 1986 Reverse Record Check.

4 Obtained by calculating the ratio of the number of structures not in the housing stock and erroneously classified as unoccupied dwellings to the total number of dwellings in the housing stock, that is, the total number of enumerated dwellings minus the enumerated dwellings not in the housing stock.

V. TEMPORARY RESIDENTS STUDY

A. Introduction

According to the "de jure" census method, persons are to be counted at their usual place of residence. One of the known causes of undercoverage is a failure to enumerate some persons who are away from home on Census Day. This error results in population (and possibly household) undercoverage. The purpose of this study is to estimate the level of population undercoverage resulting from this source of error. On the basis of these estimates, individuals are added to the final data base, so that the official population counts take this particular source of undercoverage into account.

B. Methodology

1. Stratification and Sample Selection

The population covered by this study consists of all persons in the population universe who were temporarily away from their usual place of residence in Canada on Census Day. These persons are called "temporary residents" (TRs). Temporary residents were enumerated at the place where they were staying on Census Day on a special form on which they were asked to provide the address of their usual place of residence and answers to a few basic questions. In 1986, some 481,000 persons were reported as being temporarily away from their usual place of residence on Census Day. These forms were sent to Ottawa from the regional processing sites for processing.

Two forms were used for the enumeration of temporary residents: Form 3 was used for private dwellings, ships and collective dwellings other than jails and hospitals and Form 1A was used for jails and hospitals. Forms 3 for private and collective dwellings were separately stratified according to the address of the usual place of residence, while Forms 1A were stratified according to the address of the institution. There were 37 address strata: the 25 census metropolitan areas (CMAs) in Canada together with the Yukon and Northwest Territories, Prince Edward Island and the non-CMA portions of the nine remaining provinces.

One hundred and eleven strata were therefore created for the study. In each stratum, a systematic sample of forms was selected. The forms for which it was impossible to determine the stratum (unclassifiable forms) were kept separate and ordered by province of temporary place of residence. No sample was selected from this group. Table 6 shows the distribution of the sample by province or territory.

2. Processing

For each of the sampled forms, the census documents were searched in order to identify the household enumerated at the address of the usual place of residence. A check was then made to see whether the person listed on the Form 3 or the Form 1A was enumerated at his/her usual place of residence. A decision

Table 6. Sample Distribution by Province or Territory, 1986 Temporary Residents Study

Province or territory of usual place of residence	Number of temporary residents	Number of temporary residents sampled
Newfoundland	11,456	415
Prince Edward Island	3,234	256
Nova Scotia	17,112	470
New Brunswick	12,974	352
Quebec	73,806	1,430
Ontario	144,400	2,521
Manitoba	20,988	464
Saskatchewan	27,941	760
Alberta	58,165	936
British Columbia	70,777	980
Yukon	1,254	122
Northwest Territories	3,024	217
Unclassifiable	35,428	0
Canada	480,559	8,923

was reached regarding the enumeration of the person in question. The various possible decisions are explained below:

- (a) enumerated: when the person listed on the Form 3 or the Form 1A was counted at his/her usual place of residence;
- (b) not enumerated: when the person listed on the Form 3 or the Form 1A was not counted at his/her usual place of residence;
- (c) vacant: when the dwelling identified was listed as an unoccupied dwelling;
- (d) dwelling missed: when the dwelling was not enumerated;
- (e) undecided: when the enumeration area of the usual place of residence could not be determined or there was significant doubt regarding the identification of the dwelling identified.

A temporary resident was treated as missed in the census if the decision was "not enumerated" or "dwelling missed". A TR for whom the dwelling was identified as "vacant" was not missed because such persons were identified in the Vacancy Check and added to the final census counts. Table 7 shows the distribution of the different decisions made.

Table 7. Decisions Made in Processing, 1986 Temporary Residents Study

Decision	Number (unweighted)
Enumerated	6,054
Not enumerated	1,095
Dwelling missed	126
Vacant	200
Undecided	1,446
Total*	8,921

* Two forms are not included; in both cases, the respondents were considered as usual residents in the places in which they completed the special form.

The data were processed in three stages:

- (a) resolution of undecided cases;
- (b) incorporation of unclassifiable forms;
- (c) random additions.

"Undecided" cases were resolved by classifying them as enumerated or not enumerated according to the distribution of these codes for decided cases in the same stratum.

Unclassifiable forms were treated as non-response. The province of the temporary place of residence for these forms is known. From the sample of resolved cases, it was possible to estimate the distribution of provinces of usual place of residence for each province of temporary place of residence. Using this information, it was then possible to distribute unclassifiable forms among the provinces of usual place of residence.

To adjust the census data to take account of missed TRs, imputations were made on the data base by randomly selecting enumerated individuals with characteristics similar to a missed TR and increasing their weight in the census by one unit. The number of TRs missed in each geographical stratum was estimated and a national-level profile of the basic characteristics (e.g., age, sex and marital status) of a missed TR was constructed. The number of individuals for whom the weight was to be increased by one was determined using the number of missed TRs by stratum and the proportion of missed TRs by age, sex and marital status group at the Canada level.

C. Results

The main results of this study are presented in Tables 8, 9, and 10. Table 8 shows estimates of missed TRs by province and territory. Table 9 shows the profile of a temporary resident, followed by the profile of a missed temporary resident and that of an enumerated person. Table 10 presents the undercoverage rates for the different basic characteristics for Canada resulting from underenumeration of TRs.

Table 9 indicates that individuals of both sexes between 15 and 24 years of age have a relatively high chance of not being counted when they are temporarily absent from their usual residence on Census Day, as do single (never-married) men aged 25 to 34.

Male temporary residents under 65 years of age are more likely to be missed than females in the same age group.

The undercoverage rate for persons absent from their homes on Census Day, as a percentage of the total population of Canada, is 0.29% (see Table 10). The highest rate is 0.85% for single men aged 25 to 34, followed by the rates for persons aged 15 to 24, with males at 0.73% and females at 0.54%.

**Table 8. Estimated Number of Missed Temporary Residents by Province or Territory,
1986 Temporary Residents Study**

Province or territory	Estimate	Standard error
Newfoundland	2,149	273
Prince Edward Island	603	82
Nova Scotia	2,791	352
New Brunswick	2,801	384
Quebec	13,273	1,062
Ontario	25,518	1,506
Manitoba	4,646	492
Saskatchewan	4,817	477
Alberta	8,387	788
British Columbia	10,454	962
Yukon	361	66
Northwest Territories	631	102
Canada	76,431	2,446

Table 9. Profile of Temporary Residents, Missed Temporary Residents and Enumerated Persons, 1986 Temporary Residents Study

Basic characteristics			Distri- bution for TRs ¹ %	Standard error %	Distri- bution for missed TRs ¹ %	Standard error %	Distri- bution for enumerated persons ¹ %
Age	Marital status	Sex					
0-14	Single	M	4.3	0.5	4.4	1.3	11.0
0-14	Single	F	4.0	0.4	4.1	0.8	10.4
15-24	No restriction	M	13.9	0.8	18.7	2.4	8.3
15-24	No restriction	F	9.4	0.9	12.0	2.0	8.1
25-34	Single	M	6.0	0.5	10.3	1.6	2.6
25-34	Single	F	2.3	0.2	3.6	0.9	1.8
25-34	Ever married	M	6.7	0.5	5.4	1.5	6.2
25-34	Ever married	F	3.9	0.5	2.5	1.3	7.2
35 and over	Single	M	3.4	0.7	5.9	1.4	1.7
35 and over	Single	F	2.5	0.6	2.8	1.4	1.7
35-44	Ever married	M	6.5	0.8	3.3	1.0	6.5
35-44	Ever married	F	3.5	0.5	2.1	0.8	6.6
45-64	Ever married	M	10.3	0.5	6.4	2.2	8.8
45-64	Ever married	F	6.9	0.7	4.7	1.8	9.2
65 and over	Ever married	M	7.0	1.0	4.6	0.7	4.1
65 and over	Ever married	F	9.2	0.4	9.1	1.5	5.6

¹ Totals may not add to 100% due to rounding.

**Table 10. Rates of Undercoverage Due to Underenumeration of Temporary Residents,
1986 Temporary Residents Study**

Basic characteristics				
Age	Marital status	Sex	Rate ¹ %	Standard error %
0-14	Single	M	0.13	0.01
0-14	Single	F	0.14	0.01
15-24	No restriction	M	0.73	0.03
15-24	No restriction	F	0.54	0.02
25-34	Single	M	0.85	0.04
25-34	Single	F	0.40	0.07
25-34	Ever married	M	0.25	0.02
25-34	Ever married	F	0.13	0.02
35 and over	Single	M	0.63	0.06
35 and over	Single	F	0.24	0.11
35-44	Ever married	M	0.16	0.02
35-44	Ever married	F	0.09	0.03
45-64	Ever married	M	0.21	0.01
45-64	Ever married	F	0.14	0.01
65 and over	Ever married	M	0.26	0.03
65 and over	Ever married	F	0.40	0.02
Canada			0.29	0.009

¹ The undercoverage rate is obtained by dividing estimates of missed TRs by the number of persons who should have been enumerated, consisting of the census count plus estimates of the number of missed persons obtained from the 1986 Reverse Record Check.

VI. REVERSE RECORD CHECK

A. Introduction

The Reverse Record Check (RRC) is the most important study of the coverage of the 1986 Census. The main objectives of the 1986 RRC were:

1. to estimate population and private household undercoverage at the national and provincial levels;
2. to study the characteristics of persons and households missed in the census.

Population and household undercoverage (that is, the failure to enumerate persons or households) is generally considered to be one of the largest sources of error affecting census data. It introduces a downward bias to the extent that the published census figures underestimate the true population and household totals. It may also distort the distribution of population and household characteristics calculated from census data to the extent that persons enumerated and persons missed do not possess similar characteristics.

B. Methodology

A sample of persons who should have been enumerated in the 1986 Census was selected from sources independent of the current census. Shortly before the census, efforts were made to determine the most recent address of each selected person (SP). This was followed by a search of the 1986 Census records to determine whether or not the selected person had been enumerated at that address. Cases not found were sent for field tracing in order to determine the 1986 Census address of the person concerned. Census records corresponding to that address were then searched.

The tracing and search operations led to the final classification of each SP as either "enumerated", "missed", "deceased", "emigrated or abroad" or "not traced". The results for the sample were then weighted up to the population level. The Yukon and Northwest Territories were excluded from the study because of the difficulties and high costs of tracing persons in those areas.

1. Frame Construction and Sample Selection

The survey universe, which contains all persons who should have been enumerated in the 1986 Census, comprises the following four frames:

- (a) census frame: all persons enumerated in the 1981 Census;
- (b) birth frame: all persons born between June 3, 1981 and June 2, 1986;
- (c) immigrant frame: all landed immigrants who entered Canada between June 3, 1981 and June 2, 1986;
- (d) missed frame: all persons missed in the 1981 Census.

Sampling was carried out independently within each frame. For frames (a), (b) and (c), the frame consisted of a list of persons. The sample design varied from frame to frame, depending on the nature of the list used. Frame (d) is a conceptual frame. No complete list of persons missed in the 1981 Census exists, but a sample of persons missed is available from the 1981 RRC. Table 11 shows the sample size for each of the frames.

**Table 11. Sample Size by Frame,
1986 Reverse Record Check**

Frame	Sample size (persons)
Census	32,200
Birth	1,776
Immigrant	1,341
Missed	1,061
Total	36,378

The sampling rates within frames were not uniform. In order to improve the sample design, higher rates were used in certain subgroups for which high undercoverage was expected.

The census frame, comprising all persons enumerated in the 1981 Census, was first stratified by province of usual place of residence, then further stratified by method of enumeration (mail-back, pick-up, canvasser) and by size of urban area. Two-stage sampling was used within each stratum. For the first stage, a sample of 1981 EAs was selected with probability proportional to EA size. Within selected EAs, a systematic sample of 10 persons was then selected, with persons aged 15 to 19 having a probability of selection twice that of other persons.

The birth frame, derived from birth registrations in each province, was stratified by year of birth and by province of the mother's usual place of residence. The immigrant frame, derived from records maintained by Employment and Immigration Canada, was stratified by year of arrival in Canada. Systematic samples were then selected within each stratum.

Persons selected for the 1981 RRC and classified as missed constitute a probability sample of all persons missed in the 1981 Census. These persons were therefore considered as a sample from the missed frame for the 1986 RRC.

2. Tracing and Searching Operations

The purpose of the various RRC operations was to classify each selected person as one of the following:

- (a) enumerated in the 1986 Census;
- (b) missed in the 1986 Census;
- (c) deceased before the 1986 Census;
- (d) resident outside Canada at the time of the 1986 Census.

The various operations necessary to achieve this result can be broken down into two stages: tracing and searching. Since the addresses obtained at the time of selection of the sample were generally out of date, a tracing operation had to be undertaken to establish the address of each SP on June 3, 1986. The tracing consisted of a series of operations which varied from frame to frame. They included:

- (a) matching with an administrative file to obtain the most recently available address for the selected person;
- (b) matching carried out as part of census regional office processing operations; this involved a search of the 1986 Census questionnaires to determine whether the selected persons had been enumerated at the most recently available address;
- (c) field tracing by personnel from Statistics Canada's regional offices for cases not found in (or not sent to) regional office processing.

All cases located in matching operations carried out as part of regional office processing were classified as enumerated and considered closed. In other cases, once the tracing operation pointed to a possible address for the selected person, a search of the 1986 Census documents was undertaken to determine whether he or she had been enumerated at the address in question. Similarly, a search of the death register was carried out for selected persons reported as deceased to verify that this information was valid. No verification could be carried out for SPs traced as "having emigrated prior to June 3, 1986", since no emigration records exist in Canada. Persons were classified in the above category only if the source of information was deemed to be reliable.

Ultimately, a certain proportion of the selected persons in the sample could not be traced and therefore could not be classified within any of the four categories. Table 12 shows the results of the classification.

Table 12. Number of Cases in Each Final Category by Frame, 1986 Reverse Record Check

Result	Census frame		Birth frame		Immigrant frame		Missed frame		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Enumerated	28,551	88.7	1,587	89.3	870	64.9	757	71.3	31,765	87.3
Missed	1,320	4.1	35	2.0	115	8.6	131	12.4	1,601	4.4
Deceased	1,142	3.5	10	0.6	10	0.7	31	2.9	1,193	3.3
Emigrated or abroad	275	0.9	16	0.9	97	7.2	37	3.5	425	1.2
Not traced	912	2.8	128	7.2	249	18.6	105	9.9	1,394	3.8
Total	32,200	100.0	1,776	100.0	1,341	100.0	1,061	100.0	36,378	100.0

3. Data Processing and Estimation

The processing of the data was carried out in four main steps:

- (a) coding and data capture;
- (b) computer edit, manual review and correction of errors;
- (c) weight adjustments;
- (d) calculation of final estimates of undercoverage and standard errors.

The first two steps were carried out continuously as cases were finalized. The third step consisted of two weight adjustment procedures. The first was a weight adjustment to take account of persons who could not be traced. This consisted of redistributing the original weight (the inverse of the probability of selection) of cases not traced within certain subgroups of traced cases. The second weight adjustment ensured the necessary consistency with known frame totals.

Estimates of population undercoverage were then obtained by summing the adjusted weights. Estimates of household undercoverage were obtained by first dividing the adjusted weights of persons missed within a household completely missed by the household size at the time of the 1986 Census, and then summing these household weights.

The population undercoverage rate \hat{R}_U is calculated as follows:

$$\hat{R}_U = \frac{\hat{M} - \hat{E}_2 - \hat{E}_3 - \hat{E}_4}{C + (\hat{M} - \hat{E}_2 - \hat{E}_3 - \hat{E}_4)}$$

where

\hat{M} is the estimate of the number of persons missed at their usual place of residence, as obtained from the 1986 RRC;

C is the published census count for 1986;

\hat{E}_2 is the number of temporary residents not enumerated at their usual place of residence, as obtained from the Temporary Residents Study;

\hat{E}_3 is the estimate of the number of persons occupying dwellings classified by the enumerator as unoccupied, as obtained from the Vacancy Check;

\hat{E}_4 is the estimate of the number of persons residing on incompletely enumerated Indian reserves; it is used in calculating population undercoverage rates at the national and provincial levels only.

The Reverse Record Check estimates the total number of persons missed at their usual place of residence. From this, it is necessary to subtract estimates \bar{E}_2 , \bar{E}_3 and \bar{E}_4 to obtain the net number of persons missed, that is, the number of persons not included in the published 1986 Census count. The published census count C already includes \bar{E}_2 , \bar{E}_3 and \bar{E}_4 .

During the 1986 Census, enumerators were denied access to several Indian reserves; in a few other cases, enumeration was only partially completed. Since for these reserves it was not possible to obtain exact population and housing counts, the latter were estimated for the provinces affected. The estimates \bar{E}_4 were obtained by applying the average growth rates for the enumerated reserves to the 1981 Census population for incompletely enumerated reserves. The methodology used to derive the estimates \bar{E}_4 is explained in detail in the User Information Bulletin Number 1, reference [7]. However, it was not possible to estimate the characteristics of the missing aboriginal population. Consequently, it was necessary to consider the population of these Indian reserves as missed in calculating undercoverage by characteristics.

C. Results

The results of the 1986 Reverse Record Check are presented in Tables 13 and 14. Table 13 contains estimates of population undercoverage, while Table 14 contains estimates of private household undercoverage. These undercoverage estimates are expressed as absolute numbers of persons or households missed and as rates.

1. Population Undercoverage

For the 10 provinces as a whole, population undercoverage was estimated at 3.21%. However, this rate is not uniform across the various characteristics. The following observations may be made.

(a) By Province of Residence

The 10 provinces may be divided into three groups: British Columbia; the central provinces - Quebec and Ontario; and the group formed by the other provinces. There are significant differences between these groups but not between the provinces within each group.

(b) By Urban/Rural Distribution and Urban Area Size

No difference is observed between the urban and rural parts. However, it should be noted that most incompletely enumerated reserves are located in rural areas. If the population on incompletely enumerated reserves is excluded from the calculations, the rate in rural areas stands at approximately 3%.

However, the undercoverage rates for the different sizes of urban areas are not the same. In particular, there is a statistically significant difference between areas of 500,000 or more (3.58%) and areas of less than 10,000 (2.21%).

(c) For Census Metropolitan Areas

As may be seen, the undercoverage rate tends to be greater in the urban core (3.43%) than in rural fringe areas (3.08%). However, the estimates are not sufficiently precise to assert that a positive differential exists between the two.

It should be noted that the rates for Toronto (3.95%) and Vancouver (4.42%) are considerably higher than for census metropolitan areas with smaller populations (2.98%). The rate for Montréal lies between the two extremes (3.35%).

(d) By Sex and Selected Age Groups

The undercoverage rate for males is significantly higher than the rate for females. Rates vary considerably by age, and are particularly high for the 20-24-year age group.

(e) By Marital Status and Sex

Divorced persons and never-married persons aged 15 and over were missed at higher rates than others.

The differential between the undercoverage rates for the sexes is largely accounted for by the fact that a greater proportion of never-married males were missed (8.72%) than was the case for females (6.03%). The estimates are not sufficiently precise to confirm whether a positive differential between the rates for divorced males (9.47%) and divorced females (5.39%) exists.

(f) By Mother Tongue

No significant difference is noted between the undercoverage rates for the "French" and "English" categories (3.10% and 3.12% respectively). Persons whose mother tongue was Italian, German or Ukrainian were missed less frequently. Persons in the "Other" category (which include a relatively high proportion of recent immigrants) were missed more frequently.

(g) By Mobility

Persons who remained at the same dwelling as at the time of the 1981 Census were least likely to have been missed in 1986. Persons who immigrated to Canada between the censuses had a relatively high chance of being missed.

(h) By Income in 1985

Persons with an income of less than \$15,000 are missed more often than others.

(i) By Work Status in 1985

The undercoverage rate is not significantly different for full-time and part-time workers. However, there is a significant difference between the rates for those who worked between 1 and 48 weeks (4.30%) and those who worked between 49 and 52 weeks (3.23%).

2. Private Household Undercoverage

The 1986 Reverse Record Check was primarily designed to measure population undercoverage, but estimates of private household undercoverage may be obtained as a by-product.

It may be noted that:

- (a) Among provinces, British Columbia has an undercoverage rate significantly higher than the national average.
- (b) There appears to be no statistically significant difference between rural and urban areas, nor between the various sizes of urban areas.
- (c) Tenure (i.e. whether the dwelling is owned or rented) is however a significant factor in private household undercoverage.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Canada¹	839,257	33,316	3.21	0.12
Newfoundland	11,685	1,911	2.01	0.32
Prince Edward Island	2,802	1,062	2.16	0.80
Nova Scotia	23,593	3,537	2.63	0.38
New Brunswick	20,727	2,739	2.83	0.36
Quebec	206,114	20,195	3.06	0.29
Ontario	320,880	18,160	3.40	0.19
Manitoba	24,360	4,430	2.22	0.40
Saskatchewan	26,045	3,808	2.51	0.36
Alberta	67,083	8,314	2.75	0.33
British Columbia	135,967	12,324	4.49	0.39
Urban and rural areas²	883,989	33,316	3.38	0.12
Urban areas (by size of population)	654,671	25,856	3.28	0.13
500,000 and over	390,301	16,688	3.58	0.15
100,000-499,999	86,303	9,976	2.94	0.33
30,000-99,999	85,234	10,633	3.77	0.45
10,000-29,999	41,697	6,605	2.69	0.41
Less than 10,000	51,136	9,886	2.21	0.42
Rural areas	229,318	17,829	3.73	0.29

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Continued

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
All CMAs²	533,952	20,502	3.40	0.13
Urban core	489,713	18,713	3.43	0.13
Urban fringe	11,340	3,310	3.26	0.92
Rural fringe	32,899	6,986	3.08	0.63
Selected CMAs²				
Montréal	101,386	11,597	3.35	0.37
Toronto	140,972	7,937	3.95	0.21
Vancouver	63,788	8,545	4.42	0.57
All others	227,805	15,212	2.98	0.19
Age and sex²				
Both sexes	883,989	33,316	3.38	0.12
0-4 years	42,069	9,041	2.28	0.48
5-14 years	77,296	9,696	2.12	0.26
15-19 years	77,613	12,548	3.89	0.60
20-24 years	223,750	12,322	9.06	0.45
25-34 years	225,582	15,749	4.76	0.32
35-44 years	89,118	12,062	2.40	0.32
45-54 years	45,643	7,439	1.77	0.28
55-64 years	49,656	7,544	2.09	0.31
65 years and over	53,262	9,127	1.94	0.33

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Continued

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Males	506,459	21,416	3.91	0.16
0-4 years	20,964	6,503	2.22	0.67
5-14 years	38,104	6,138	2.04	0.32
15-19 years	42,837	8,051	4.18	0.75
20-24 years	135,311	8,323	10.71	0.59
25-34 years	138,160	10,443	5.81	0.41
35-44 years	63,967	9,997	3.40	0.51
45-54 years	25,999	6,896	2.00	0.52
55-64 years	21,550	5,423	1.88	0.47
65 years and over	19,567	6,067	1.70	0.52
Females	377,530	22,259	2.87	0.16
0-4 years	21,105	5,490	2.35	0.60
5-14 years	39,192	6,060	2.21	0.33
15-19 years	34,776	8,330	3.58	0.83
20-24 years	88,439	9,255	7.33	0.71
25-34 years	87,422	10,567	3.71	0.43
35-44 years	25,151	5,936	1.37	0.32
45-54 years	19,644	4,767	1.53	0.37
55-64 years	28,106	6,483	2.28	0.51
65 years and over	33,695	7,129	2.11	0.44

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Continued

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Marital status and sex²				
Both sexes	883,989	33,316	3.38	0.12
Married or separated	241,008	19,970	1.89	0.15
Divorced	52,395	8,525	7.07	1.07
Widowed	34,380	6,661	2.68	0.51
Never married	556,206	24,503	4.91	0.21
Less than 15 years	115,792	13,149	2.11	0.23
15 years and over	440,414	20,508	7.53	0.32
Males	506,459	21,416	3.91	0.16
Married or separated	131,642	13,928	2.07	0.21
Divorced	28,864	5,848	9.47	1.74
Widowed	5,219	2,014	2.42	0.91
Never married	340,733	18,319	5.62	0.28
Less than 15 years	56,497	8,710	2.01	0.30
15 years and over	284,236	16,590	8.72	0.46

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Continued

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Females	377,530	22,259	2.87	0.16
Married or separated	109,366	11,945	1.71	0.18
Divorced	23,531	5,319	5.39	1.15
Widowed	29,161	6,612	2.73	0.60
Never married	215,473	13,665	4.09	0.25
Less than 15 years	59,295	8,186	2.22	0.30
15 years and over	156,178	11,585	6.03	0.42
Mother tongue^{2,3}	883,989	33,316	3.38	0.12
English	520,770	21,907	3.12	0.13
French	210,262	22,812	3.10	0.33
Italian	10,734	4,418	1.90	0.77
German	6,144	2,807	1.15	0.52
Ukrainian	5,941	2,706	2.10	0.94
Other	143,165	11,742	7.62	0.58

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Continued

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Mobility by province of residence in 1981²				
Total (population aged 5 years and over)	818,631	30,601	3.42	0.12
Dwelling five years ago:				
Same province	716,310	29,027	3.19	0.13
- Same dwelling	210,227	18,843	1.59	0.14
- Other dwelling	506,083	26,104	5.49	0.27
Other province	56,946	7,424	5.88	0.72
Outside Canada	45,375	3,336	8.92	0.60
Personal income²				
Total (population aged 15 years and over)	741,335	28,427	3.65	0.13
Negative or nil income	111,933	9,877	4.20	0.35
\$ 1 - \$ 2,999	115,347	11,660	5.39	0.52
\$ 3,000 - \$ 5,999	130,443	13,810	6.55	0.65
\$ 6,000 - \$ 9,999	112,620	11,980	3.92	0.40
\$10,000 - \$14,999	116,712	10,653	4.71	0.41
\$15,000 - \$24,999	101,804	11,669	2.80	0.31
\$25,000 and over	52,476	9,699	1.15	0.21

See footnotes at end of table.

Table 13. Estimated Population Undercoverage for Canada Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Concluded

Characteristics	Number of persons missed		Population undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Work status in 1985²				
Total (excluding population under 15 years and institutional residents)	741,335	28,427	3.65	0.13
- Full time	397,304	20,624	3.69	0.18
- Part time	108,538	11,641	3.69	0.38
Number of weeks worked:				
None	235,493	18,151	3.57	0.27
1 to 48 weeks	252,656	15,321	4.30	0.25
- Full time	174,550	11,314	4.50	0.28
- Part time	78,106	9,438	3.90	0.45
49 to 52 weeks	253,186	15,845	3.23	0.20
- Full time	222,754	16,471	3.23	0.23
- Part time	30,432	6,206	3.25	0.64

- 1 In these estimates, the population of incompletely enumerated Indian reserves was considered as "enumerated".
- 2 In these estimates, the population of incompletely enumerated Indian reserves was considered as "missed".
- 3 In the 1986 Census, multiple responses concerning mother tongue were accepted. Therefore, these estimates and rates are not mutually exclusive.

**Table 14. Estimated Private Household Undercoverage for Canada
Excluding Yukon and Northwest Territories, 1986 Reverse Record Check**

Characteristics	Number of private households missed		Private household undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
Canada¹	267,699	16,490	2.90	0.17
Newfoundland	3,627	994	2.23	0.60
Prince Edward Island	663	275	1.60	0.65
Nova Scotia	9,039	1,794	2.97	0.57
New Brunswick	6,002	1,532	2.53	0.63
Quebec	67,756	10,881	2.79	0.44
Ontario	91,719	10,744	2.77	0.32
Manitoba	7,928	2,129	2.03	0.53
Saskatchewan	8,832	1,646	2.41	0.44
Alberta	23,373	4,258	2.72	0.48
British Columbia	48,760	4,838	4.29	0.41
Urban and rural areas¹	267,699	16,490	2.90	0.17
Urban areas	192,855	13,457	2.65	0.18
500,000 and over	110,278	9,334	2.73	0.23
100,000-499,999	31,049	3,816	2.88	0.34
30,000-99,999	22,621	4,292	2.77	0.51
10,000-29,999	14,146	3,437	2.58	0.61
Less than 10,000	14,761	4,429	1.83	0.54
Rural areas	74,844	7,230	3.83	0.37

See footnote at end of table.

**Table 14. Estimated Private Household Undercoverage for Canada
Excluding Yukon and Northwest Territories, 1986 Reverse Record Check - Concluded**

Characteristics	Number of private households missed		Private household undercoverage rate	
	Estimated number	Standard error	Estimated rate %	Standard error %
All CMAs¹	161,542	11,304	2.83	0.19
Urban core	144,790	9,472	2.75	0.18
Urban fringe	5,221	2,682	4.45	2.18
Rural fringe	11,531	2,865	3.47	0.83
Selected CMAs¹				
Montréal	32,348	9,516	2.82	0.81
Toronto	33,871	3,864	2.75	0.30
Vancouver	18,170	2,368	3.30	0.42
Others	77,153	6,855	2.78	0.24
Tenure¹	267,699	16,490	2.90	0.17
Owned	91,622	8,961	1.61	0.15
Rented	176,077	11,629	4.97	0.31
Type of private dwelling¹	267,699	16,490	2.90	0.17
Single-detached house	126,922	9,836	2.40	0.18
Semi-detached house	9,767	2,746	2.30	0.63
Row house	7,034	1,873	1.88	0.49
Apt. in a building with less than 5 storeys	63,109	7,076	3.50	0.38
Apt. in a building with 5 storeys or more	17,502	6,166	2.13	0.74
Mobile home	13,345	3,127	10.38	2.18
Other single-attached house	6,298	2,393	9.88	3.38
Duplex	23,722	4,779	7.04	1.32

¹ In these estimates, the population of incompletely enumerated Indian reserves was considered as "missed".

VII. OVERCOVERAGE STUDY

A. Introduction

The objective of the study on overcoverage in the 1986 Census was to determine the number of Canadian citizens or landed immigrants having a place of residence in Canada on June 3, 1986, who were enumerated more than once.

Overcoverage is said to occur, and a person is said to be overenumerated, if:

- (a) a person is in the population universe and is enumerated more than once;
- (b) a person is not in the population universe but is enumerated once or more;
- (c) a fictitious person is enumerated.

Prior to 1986, no direct measure of overcoverage in the Canadian census was available, but based on the experience of other countries, the amount of overcoverage was believed to be small relative to the amount of undercoverage. In order to verify this hypothesis, an experimental study on overcoverage was carried out during the 1986 Census.

It should be noted that the Overcoverage Study concentrated on the target population in Canada since a form of overcoverage check already exists for that part of the target population outside Canada (abroad or on ships). One of the census questions put to persons in these latter categories concerned addresses in Canada at which they might have been enumerated. These addresses were then verified during data processing. It should also be noted that the Overcoverage Study focused solely on component (a) of overcoverage.

B. Strategy

There are three possible ways in which a person may be enumerated more than once:

- (a) A person may be enumerated in more than one dwelling for a variety of reasons, for example, because of moving close to Census Day, having more than one residence, or temporarily residing elsewhere in the country on Census Day.
- (b) A person may be enumerated on more than one questionnaire from the same dwelling, because of a misinterpretation of the definition of the term "dwelling".
- (c) A person may be enumerated on more than one questionnaire from the same dwelling, but this time because of incorrect demarcation or misinterpretation of the boundaries of enumeration areas (EAs).

To estimate overcoverage from these causes, four studies were conducted:

- (a) the private dwelling study, which attempted to measure overcoverage in two different private dwellings;
- (b) the collective dwelling study, where at least one of the dwellings involved in the double-counting was a collective dwelling;

- (c) the neighbourhood study, which attempted to identify duplication of households in dwellings listed close to each other in the same VR;
- (d) the boundaries study, which attempted to identify duplicate enumerations in adjacent EAs.

The private dwelling study was also used as a vehicle to evaluate the quality of census responses to selected census questions, namely aboriginal status, ethnic origin, mother tongue, home language, official language and dwelling type.

The first study involved going back to a sample of private households during the last week of July and conducting interviews to obtain the information necessary to identify overcoverage. Data collection for the collective dwelling study took place at the same time as the census enumeration while, for the neighbourhood and boundaries studies, there were no questionnaires or field work. The data were taken directly from the census data base.

1. Methodology of the Private Dwelling Study

(a) Stratification and Sample Selection

The target population of this study included all persons residing in mail-back or pick-up EAs. These EAs were divided into three strata:

- the aboriginal stratum;*
- the metropolitan stratum;
- the residual stratum (that is, all EAs not included in either of the above).

The aboriginal stratum consisted of all persons included in census commissioner districts (CCDs) in which the proportion of Métis and non-status Indians was greater than 2% in 1981. This stratum included 140 CCDs. The CCDs were used as the primary sampling units. A selection of 56 CCDs was made with a probability proportional to the proportion of Métis and non-status Indians. Within each CCD selected, a simple random sample of five EAs was drawn without replacement.

The metropolitan stratum was defined as all persons in EAs that were not in the aboriginal stratum and who were located in the urban cores of census metropolitan areas (CMAs). This stratum was subdivided according to the different CMAs. The EAs were used as the primary sampling units. They were selected by means of simple random sampling.

The residual stratum was further stratified by province or territory. The CCDs were considered as the primary sampling units and a simple random sample was selected within each province or territory. For each CCD selected, a sample of five EAs was taken randomly without replacement.

* *An aboriginal stratum was defined because one of the secondary objectives of the Overcoverage Study was to evaluate the quality of the census question on aboriginal status.*

A specified number of occupied private dwellings was drawn from each selected EA. For a mail-back EA, 10 occupied dwellings were randomly selected; for a pick-up EA, six. All persons enumerated in the census in the selected occupied private dwellings were included in the overall study sample.

For sample selection in mail-back EAs, households which returned their questionnaires by mail were identified separately from those which did not, as it was thought that this might be an indicator of a coverage problem (see reference [2]).

Table 15 shows the sample distribution by province and type of stratum.

Table 15. Sample Distribution by Province or Territory for Private Dwelling Study, 1986 Overcoverage Study

Province or territory	Aboriginal		Metropolitan		Residual	
	No. of EAs	No. of persons	No. of EAs	No. of persons	No. of EAs	No. of persons
Newfoundland	5	162	12	279	46	1,191
Prince Edward Island	-	-	40	845	-	-
Nova Scotia	-	-	20	503	55	1,066
New Brunswick	-	-	12	284	54	1,141
Quebec	7	119	155	3,861	103	1,978
Ontario	20	383	162	4,139	85	1,780
Manitoba	65	1,489	29	709	15	313
Saskatchewan	48	1,079	41	944	80	1,438
Alberta	72	1,529	77	1,960	49	852
British Columbia	32	641	64	1,592	44	786
Yukon	3	47	-	-	-	-
Northwest Territories	10	261	-	-	-	-
Canada	262	5,710	612	15,116	531	10,545

(b) Processing

Processing for the private dwelling study was done in three stages: matching, address search and administrative files search.

(i) Matching

Since the study target population consisted of all persons enumerated in private dwellings on June 3, 1986, it was necessary to link up the information obtained in the interviews conducted at the end of July 1986 with the census records for the dwellings that had been selected in the sample. To establish the linkages, the person's year of birth, sex and marital status were used. The results of this matching are given in Table 16.

Table 16. Results of Matching for Private Dwelling Study, 1986 Overcoverage Study

Results of matching	Number of persons
Persons listed on both census and study questionnaires	24,810
Persons listed in census questionnaire but not in the study questionnaire	6,561
Total persons listed in census questionnaire	24,810 + 6,561 = 31,371
Persons listed only in the study questionnaire	1,306
Total persons listed in the study questionnaire for households that could be contacted	24,810 + 1,306 = 26,116

The study sample included the 31,371 persons listed in census questionnaires for the selected dwellings. The 1,306 persons listed in the study questionnaire but not on the census questionnaire were eliminated as being out of scope for the purposes of the Overcoverage Study. The number of persons in the census who were not listed on the study questionnaire was 6,561. A large proportion of these cases, 80% (5,202), was due to the fact that the usual residents of the dwellings selected could not be contacted at the time of the study. To take account of this type of non-response, the weights of the households that were contacted were adjusted by the ratio of the number of households selected to the number contacted.

(ii) Address search

As soon as the matching was completed, a search of the census questionnaires for the addresses given in response to the questions on coverage in the study questionnaire was carried out to identify whether or not the person was enumerated at two different addresses. In total, 969 questionnaires contained at least one address in response to these questions. This stage of processing identified 44 persons who had been enumerated at two different locations during the census, for a weighted total of 12,100 persons across Canada.

(iii) Administrative files search

It was felt that the 1,359 persons (6,561 - 5,202) listed on the census questionnaire but not on the study questionnaire might have a greater tendency to be overenumerated than the rest of the persons in the sample. However, as no information was available on these persons, it was decided to use administrative records to try to identify any other addresses at which they might have been enumerated. The search was restricted to a subsample of 519 persons, 316 persons from those known to have moved out from the selected dwelling before the study interview, and 203 other persons listed in the census but not on the study questionnaire.

In cases where an address different from the census address was obtained for any of the selected persons, a search was carried out to determine if overcoverage had in fact occurred. The estimate from this component of the private dwelling study was 10,100 persons, across Canada, counted more than once. Thus, the total estimate of overcoverage obtained from the address search and the administrative files search was 22,200 persons.

2. Methodology of the Collective Dwelling Study

The scope of the collective dwelling study was limited to three types of collective dwellings for which the overcoverage problem was believed to be greatest. These were general hospitals, treatment centres and establishments for the physically handicapped, and jails.

(a) Stratification and Sample Selection

This population was stratified into three size groups based on the number of usual residents in the collective. Within each stratum, a sample of collective dwellings was selected randomly without replacement. All usual residents enumerated in a selected dwelling became part of the study sample. This resulted in a sample size of 1,392 persons from 39 dwellings.

(b) Questionnaire and Collection

During the enumeration of collective dwellings on June 3, 1986, the Census Representatives assigned to the sampled dwellings completed both the census and the study questionnaires, using information from the administrative files of the dwelling. Basic demographic characteristics, addresses and names of usual residents were transcribed onto the study questionnaire which also asked for alternative home addresses.

(c) Processing

All persons listed on the study questionnaires but not enumerated in the census in these collective dwellings were deleted, as they were not of interest in an overcoverage check. Then, a search of census documents was carried out to determine if usual residents of the collective dwellings had been enumerated at another address.

When the alternative address obtained in the study was so imprecise that it was impossible to locate the dwelling, an imputation of the overcoverage indicator was performed. This was assigned according to the distribution obtained from the resolved cases in the same collective dwelling.

3. Methodology of the Neighbourhood Study

(a) Stratification and Sample Selection

Mail-back and pick-up EAs were stratified into four regions: the four Atlantic provinces, Quebec, Ontario and Western Canada, comprised of the Prairie provinces, British Columbia and the territories.

A simple random sample of 100 EAs was selected within each region and within each EA, a sample of 50 occupied private dwellings was selected randomly without replacement. Table 17 gives the number of persons in the sample for each region.

**Table 17. Sample Size for Neighbourhood Study,
1986 Overcoverage Study**

Region	No. of persons in sample
Atlantic	12,965
Quebec	12,693
Ontario	12,766
Western Canada	12,647
Canada	51,071

(b) Processing

The objective of this study was to determine the number of persons who were enumerated twice in two private dwellings listed close together in the same VR. To obtain this result, an automated match was carried out. Basic characteristics (year and month of birth, sex and marital status) of sampled

persons were matched with those of all persons residing in neighbouring occupied private dwellings. "Neighbouring" was defined to mean that the difference between two household numbers considered in the matching was no greater than four.

There was a positive match between two persons only if all their basic characteristics coincided exactly. All positive matches were reviewed manually. However, it should be noted that any person selected for whom at least one basic characteristic was missing or invalid on the census data base (before edit and imputation) was classified as a non-response. Once a person was classified as a non-response, no attempt at matching was made.

Two weighting adjustments were performed: to correct the non-response and to take account of the known number of persons in the population. These adjustments were carried out for the four regions.

4. Methodology of the Boundaries Study

(a) Stratification and Sample Selection

As in the neighbourhood study, the EAs were stratified into the same four geographic regions. The EAs were considered as the primary sampling units. A simple random sample of 100 EAs was drawn in each region. All persons in occupied private dwellings in these EAs were included in the study sample. Table 18 shows the sample sizes for the different regions.

**Table 18. Sample Size for Boundaries Study,
1986 Overcoverage Study**

Region	No. of persons in sample
Atlantic	57,211
Quebec	64,612
Ontario	68,246
Western Canada	53,826
Canada	243,895

(b) Processing

To check whether the boundaries of the EAs had been respected, the three "closest" EAs for each sampled EA were identified. Then, the persons in a selected EA were matched with the persons in these closest EAs by using the basic characteristics of year and month of birth, sex and marital status of the sampled persons.

In view of the very great number of potential false positive matches, it was decided to match households rather than individuals. This means that a positive match signified that all the basic characteristics of all persons in the two households coincided exactly. All positive matches were checked manually. If a basic characteristic was either missing or invalid, the household was considered as a non-response case. Non-responses were processed as in the neighbourhood study, that is, by adjusting the weights for each of the regions.

C. Results

In total, the four studies found an estimated 45,600 persons who were counted more than once. Table 19 shows the breakdown of this total by the four studies. However, because of the experimental nature of the studies, this figure should be only regarded as a lower bound on the total level of overcoverage in the 1986 Census.

An analysis of the results reveals that in mail-back areas, there was a higher tendency for overcoverage in questionnaires not returned by mail. It was also noted that the double-counting of households that are not listed close to each other in the same VR was due mainly to the household having moved rather than to the household having more than one residence. In addition, other important components of overcoverage appear to be students and residents of collective dwellings.

In addition to measuring overcoverage, the study provided some information about its causes. An investigation of these causes may help to reduce the amount of overcoverage in future censuses.

Table 19. Integration of Results, 1986 Overcoverage Study

Study	Estimate	Standard error
Private dwellings	22,200	6,050
Collective dwellings	7,100	1,350
Neighbourhood	16,300	3,200
Boundaries	0	0
Total	45,600	6,950

Note: In the private dwelling, neighbourhood and boundaries studies, the sum of the weights for persons who were double-counted represents twice the number of such persons. The estimates were therefore divided by two, as were their standard errors.

The following observations are intended to identify the limitations of the various studies.

1. In the private dwelling study, for approximately one half of the persons listed only on the census questionnaire, the administrative files search did not identify another address at which they might have been enumerated. This proportion is slightly higher for persons not listed in the study as it is for known movers. However, there is reason to think that if another address had been available, the estimate of overcoverage might have been higher.
2. The estimate of the collective dwelling study is based on only 6% of the population of usual residents of collective dwellings. For certain types of collective dwellings not included in the study, such as student residences and construction camps, the number of persons who may have more than one place of residence is fairly high and might also have resulted in high overcoverage.
3. In the collective dwelling study, a single dwelling in the sample accounted for more than half of the overcoverage recorded. This dwelling could be an isolated case, and therefore the number of persons overenumerated in this type of dwelling may actually be lower. However, even if this dwelling is excluded, the overcoverage rate in collective dwellings is high relative to that in private dwellings.
4. In the case of a person enumerated in two different places, the estimation method used assumes that the information concerning the other place of residence would be provided at each of the locations where the person resided. If this is not the case, the total number of persons overcovered could be higher than estimated.
5. Because of its methodology, the estimate of the neighbourhood study is an underestimate, since only neighbouring dwellings (difference in household numbers of less than five) were studied.
6. Although the boundaries study did not detect any overcoverage, the possibility still exists. It is possible that boundary-related errors were not detected because of the very strict matching rules that were used in the study.

VIII. COMPARISON OF ESTIMATES FROM 1986 REVERSE RECORD CHECK WITH OTHER SOURCES

A. Estimation of the Change in Net Coverage Error Between the 1981 and 1986 Censuses

The net coverage error consists of the difference between undercoverage and overcoverage. The 1986 Coverage Error Measurement Program cannot give a reliable estimate of net coverage error since the RRC can provide only estimates of undercoverage while the Overcoverage Study has several limitations affecting the reliability of its estimate of overcoverage. But assuming that overcoverage was the same in both the 1981 and 1986 Censuses, it is possible to estimate the change in net coverage error, D, between them. The estimate of the change in gross undercoverage from the RRC, expressed as \hat{D}_{RRC} , is given by

$$\hat{D}_{RRC} = \hat{U}_{1986} - \hat{U}_{1981}$$

where \hat{U}_{1986} is the 1986 Census undercoverage estimate obtained by the 1986 RRC, and \hat{U}_{1981} is the corresponding estimate from the 1981 RRC.

The estimate obtained for D is

$$\hat{D}_{RRC} = 839,000 - 497,000 = 342,000$$

with a standard error of 40,000 persons.

Another estimate of D may be obtained by a demographic method. It is expressed as \hat{D}_D . Let C_{1986} (C_{1981}) be the official count of the 1986 (1981) Census for the 10 provinces. If there were no coverage error, we would have

$$C_{1981} + A = C_{1986}$$

where A represents the net population change of the 10 provinces.

This change is given by the total number of births and immigrants to the 10 provinces minus the number of deceased and persons that have emigrated from the 10 provinces. Assuming that each census introduces a net coverage error, expressed as B indexed by the year of the census, we obtain

$$C_{1981} + B_{1981} + A = C_{1986} + B_{1986}$$

and hence

$$\hat{D}_D = B_{1986} - B_{1981} = A - (C_{1986} - C_{1981})$$

The population increase between the two censuses was estimated at 1,247,000 (see reference [5]). Replacing A, C_{1986} and C_{1981} by their values, this yields an estimate of 243,000 for D.

It should be noted that the demographic components (births, immigration, emigration, deaths) of A are subject to certain errors that affect their accuracy and precision. Estimates of emigration and interprovincial migration are particularly subject to errors, since no uniform system of registration for these events exists (no registration is required for a Canadian citizen to emigrate, for example). Emigration and interprovincial migration must be estimated indirectly by other means. For a full description of the methods used, see reference [4].

B. Comparison With Other Sources

In addition to estimating the number of persons missed in the 10 provinces, the 1986 RRC (owing to its classification of persons as enumerated, missed, emigrated, deceased), can give estimates of totals that have also been estimated on the basis of other independent studies. These totals are as follows:

1. the number of persons enumerated in the census in the 10 provinces;
2. the number of persons deceased between June 3, 1981 and June 2, 1986;
3. the number of emigrants leaving Canada between June 3, 1981 and June 2, 1986;
4. the number of missed persons residing on incompletely enumerated Indian reserves;
5. the number of missed persons residing in private dwellings misclassified as unoccupied by Census Representatives.

Table 20 compares the 1986 RRC estimates with those from independent sources. In most cases, the agreement is well within the bounds of sampling error. The one exception is for the estimate of persons enumerated in the census, where the census count is some 327,000 persons higher than the estimate from the Reverse Record Check. The standard error of the Reverse Record Check is only 49,000 persons; thus, it is highly unlikely that the difference is due to sampling error alone.

Part of the difference is accounted for by certain exclusions to the frames used for the Reverse Record Check. Canadian citizens and landed immigrants who were outside Canada at the time of the 1981 Census, who were not included in the 1981 Census (see Table 1), and who returned to Canada prior to the 1986 Census are not included in any of the frames. Similarly, persons who resided in the Yukon or Northwest Territories at the time of the 1981 Census and who moved to one of the 10 provinces prior to the 1986 Census are not included in any of the frames. Estimates made for the 1981 Census, however, suggest that these exclusions would account for no more than 100,000 persons.

Part of the difference may also be accounted for by overcoverage in the census itself. The 1986 Overcoverage Study found only an estimated 45,600 persons overcounted, but because of the limitations of the Overcoverage Study, the true level of overcoverage may have been higher, possibly substantially higher, than this figure.

Finally, the Reverse Record Check is subject to non-sampling as well as sampling errors. Such errors may arise in the tracing, searching, classification and data processing activities and result in errors in the final estimates that are not reflected in the sampling error alone.

For a more detailed evaluation of the quality of the estimates of undercoverage from the Reverse Record Check, see reference [1].

Table 20. Comparison of 1986 Reverse Record Check With Other Sources

Population	1986 RRC		Other sources	
	Estimate (x 1000)	Standard error (x 1000)	Estimate (x 1000)	Source
Enumerated	24,737	49	25,064	Census ¹
Deceased	906	25	883	Vital statistics ³
Emigrated	288	19	235 ⁴	Estimate by demographic method ³
Missed on incompletely enumerated Indian reserves	49	8	45	Census ²
Missed in dwellings classified as unoccupied	81	11	94 ⁵	Vacancy Check

- 1 Census count for the 10 provinces, reduced by adjustments from the Temporary Residents Study and the Vacancy Check, as well as by adjustment for persons missed on partially enumerated Indian reserves.
- 2 This figure was obtained by estimating the growth between 1981 and 1986 in the population of completely enumerated Indian reserves and applying this factor to the 1981 population totals for Indian reserves that were not completely enumerated in 1986.
- 3 See reference [5].
- 4 According to further recent analysis using an alternate estimation method, this estimate may be closer to 285,000 persons.
- 5 With a standard error of 6,100 persons.

IX. INTEGRATION OF RESULTS

This chapter seeks to integrate the results of the various studies conducted under the Coverage Error Measurement Program. It also presents an analysis of coverage measurement over time, using the results of Reverse Record Checks of previous censuses.

A. Integration

This section describes briefly the sources of the various results shown in Table 21 on dwelling, household and population coverage errors.

1. Errors Affecting Dwelling Counts

Even though there was no study to measure the accuracy of the enumeration of dwellings, some partial results on overcoverage can nevertheless be obtained indirectly.

Overcoverage of dwellings arises from two sources: dwellings that should not be included in the housing stock and dwellings that were counted more than once. The Vacancy Check estimated the overcoverage arising only from the first source, that is, the estimated number of dwellings that were unoccupied but were not part of the housing universe.

No estimates of undercoverage of dwellings, either occupied or unoccupied, are available for the 1986 Census.

2. Errors Affecting Household Counts

As stated in Chapter VI, the 1986 RRC indirectly provides an estimate of household undercoverage.

The Vacancy Check provides estimates of the number and characteristics of households missed because the dwelling was misclassified as unoccupied. The study on overcoverage in private dwellings and the neighbourhood study were used to determine indirectly the number of households that had been counted more than once.

3. Errors Affecting Population Counts

Part of population undercoverage is explainable by one of the two following reasons. Persons may be missed when:

- (a) their usual place of residence was classified as an unoccupied dwelling;
- (b) they were temporarily away from their usual place of residence, which, however, was classified as an occupied dwelling.

The Vacancy Check enables us to estimate indirectly the number of persons missed because their usual place of residence was misclassified as unoccupied. The Temporary Residents Study measures the latter component of population undercoverage. The estimates from these two studies were used to adjust the

official counts from the 1986 Census. The 1986 RRC enables the measurement of that portion of population undercoverage that is not explained by the two factors described above.

The four mutually exclusive studies described in Chapter VII measured different components of overcoverage, that is:

- (a) overcoverage in different dwellings (all private dwellings or private and collective dwellings);
- (b) overcoverage where the dwellings involved were private dwellings listed close to each other in the same VR;
- (c) overcoverage in the same dwelling enumerated in different EAs.

Table 21 shows the integration of the results of the Coverage Error Measurement Program. From the table, it is evident that it is for the population universe that the most information on coverage errors exists. For example, the table shows that persons who were missed because they were temporarily away or because their dwelling was misclassified as unoccupied are important sources of undercoverage, but together they explain only 170,000 out of a total of 1,009,000 persons missed in the census. Less information is available on overcoverage, and the figure in the table should only be regarded as a lower bound.

The situation is similar for private households, where the Vacancy Check accounts for only 48,000 out of a total 316,000 households missed. Again, the figure for overcoverage should be regarded as a lower bound.

In terms of private dwellings, no estimates of undercoverage (either of occupied or unoccupied dwellings) exist for the 1986 Census, and the only estimate of overcoverage refers to unoccupied dwellings. Missed dwellings undoubtedly occurred and were one of the factors contributing to the population and household undercoverage measured in the Reverse Record Check. Similarly, there was undoubtedly some overcoverage of occupied dwellings which contributed to overcoverage of population and households. Because the 1986 Census Coverage Error Measurement Program did not estimate these components of dwelling coverage error, however, the exact contribution of dwelling coverage error to population and household coverage error is not known.

Table 21. Integration of Results

Study conducted under the Coverage Error Measure- ment Program	Private dwellings		Private households		Population	
	Under- cover- age (x1000)	Over- cover- age (x1000)	Under- cover- age (x1000)	Over- cover- age (x1000)	Under- cover- age (x1000)	Over- cover- age (x1000)
Reverse Record Check ¹	-	-	268	-	839	-
Temporary Residents Study	-	-	-	-	76 ²	-
Vacancy Check	-	100	48 ²	-	94 ²	-
Overcoverage Study	-	-	-	8 ⁴	-	45 ⁴
Total	-	100	316	8⁴	1,009³	45⁴

1 The Yukon and the Northwest Territories are not included in the estimates.

2 These estimates were used to adjust the final household and population counts.

3 Of the estimated 1,009,000 persons missed, 170,000 have already been added to the census official counts through the Temporary Residents Study and Vacancy Check adjustments.

4 These figures should be considered only as a lower bound to overcoverage.

B. Comparisons of Population Undercoverage in the 1976, 1981 and 1986 Censuses

In this section, the population undercoverage rates observed in the 1976, 1981 and 1986 Censuses are compared. The results for 1976 and 1981 are drawn respectively from the 1976 Data Quality report on coverage (see reference [6]) and the 1981 Reverse Record Check.

From Table 22, several observations may be made:

- (a) British Columbia had the highest rate of population undercoverage in all three censuses.
- (b) Between 1981 and 1986, the Canada level undercoverage rate rose from 2.01% to 3.21%. The rates increased in all provinces, although the increases are not statistically significant in all cases.
- (c) Between 1976 and 1981, the undercoverage rates increased for 6 of the 10 provinces, although the Canada level estimate was virtually the same. The greatest increase was in Alberta, which also experienced very high levels of migration during this period.
- (d) The undercoverage rates for the Atlantic provinces tend to be below the Canadian average, with the exception of New Brunswick in 1976.
- (e) The undercoverage rates for the Prairie provinces tend to be below the Canadian average, with the exception of Alberta in 1981.

Finally, it should be noted that the undercoverage rates in Table 22 express, in relative terms, the number of people omitted from the published census counts. In 1981 and 1986, the published census counts included estimates, based on the Vacancy Check, of persons missed because their dwelling was misclassified as unoccupied. In 1976, however, the published census counts did not include such a component. If they had, the 1976 undercoverage rate at the Canada level would have been 1.78% instead of 2.04%.

Table 22. Estimated Population Undercoverage for Canada (Excluding Yukon and Northwest Territories) and Provinces - 1986, 1981 and 1976 Reverse Record Checks

Province	1986		1981		1976	
	Estimated rate %	Standard error %	Estimated rate %	Standard error %	Estimated rate %	Standard error %
Newfoundland	2.01	0.32	1.74	0.45	1.10	0.39
Prince Edward Island	2.16	0.80	1.17	0.54	0.38	0.25
Nova Scotia	2.63	0.38	1.05	0.34	0.86	0.34
New Brunswick	2.83	0.36	1.81	0.30	2.16	0.37
Quebec	3.06	0.29	1.91	0.21	2.95	0.25
Ontario	3.40	0.19	1.94	0.14	1.52	0.17
Manitoba	2.22	0.40	0.98	0.35	1.07	0.33
Saskatchewan	2.51	0.36	0.99	0.37	1.33	0.34
Alberta	2.75	0.33	2.54	0.36	1.49	0.26
British Columbia	4.49	0.39	3.16	0.33	3.13	0.31
Canada (excluding Yukon and Northwest Territories)	3.21	0.12	2.01	0.09	2.04	0.10

X. CONCLUSION

Four main studies were conducted as part of the Coverage Error Measurement Program: the Vacancy Check, the Temporary Residents Study, the Reverse Record Check and the Overcoverage Study.

These studies were used to identify the main characteristics of undercoverage; two in particular - the Vacancy Check and the Temporary Residents Study - were used to correct the 1986 Census counts for known sources of coverage error. The following summarizes the observations made in the preceding chapters.

At the national level, the population undercoverage rate rose more than one percentage point, going from 2.01% in 1981 to 3.21% in 1986; this latter figure represented some 840,000 missed persons. Undercoverage among males was higher than among females. For each sex, the highest undercoverage rate was observed in the age group 20-24.

Undercoverage of private households rose more than 1% from 1981 to 1986, going from 1.70% to 2.90%. This represented approximately 270,000 missed private households in 1986. Undercoverage was markedly higher among households renting their accommodation than among those owning. The type of private dwelling was also an influencing factor in undercoverage. The types of private dwellings that proved most difficult to enumerate were duplexes, other single-attached houses and mobile homes.

The 1986 Census classified nearly 55,000 occupied dwellings as unoccupied. This represents some 48,000 households and 94,000 persons missed. The urban and rural areas have different misclassification rates as do the different types of private dwellings.

There were some 100,000 unoccupied dwellings that were not part of the housing universe. They were mainly single houses located in rural areas.

For the first time, an overcoverage study was conducted in Canada. However, its scope was limited to estimating double-counting of persons; it did not seek to estimate the number of enumerated persons who did not belong to the population universe. Furthermore, the results of the study are subject to various non-sampling errors, the net effect of which is likely to be an underestimation of the number of duplications. It may nevertheless be concluded that, for persons residing in private dwellings, the overcoverage rate is not high. However, in light of results obtained for overcoverage in three types of collective dwellings, this rate is likely to be non-negligible for persons residing in collective dwellings.

In summary, the results of the Coverage Error Measurement Program for the 1986 Census, as presented in this document, provide important information about the quality of census results which can guide data users in making the most appropriate use of the vast array of data from the 1986 Census. The coverage error results have also played an important role in the planning of the next census in 1991. In particular, the increase in the overall level of undercoverage has led to the development of new measures designed to improve coverage in 1991, and results such as those presented in this document have guided the development of coverage improvement programs for 1991.

In terms of the 1991 Coverage Error Measurement Program, a number of improvements are planned. The primary objective is to produce reliable estimates of both overcoverage and undercoverage, which will allow for the first time the estimation of net coverage error. A number of other enhancements are also planned. With improved measurement of coverage errors will eventually come a better understanding of the causes of census coverage errors and improvements in the quality of data from the census of population.

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DEFINITIONS

Census commissioner district (CCD):

Area under the responsibility of a census commissioner. It consists of a group of approximately 20 EAs in the same federal electoral district.

Census metropolitan area (CMA):

The main labour market area of an urban area having 100,000 or more population according to figures from the preceding census.

Collective enumeration area:

A collective enumeration area consists of one or more collective dwellings of a substantial size such as large hotels, hospitals and various institutions. It may consist of more than one collective dwelling type. Military establishments (exclusive of permanent married quarters) are also classified as collective EAs.

Enumeration area (EA):

The spatial unit canvassed by one census representative. It is the smallest geographical unit for which census data are generally available.

Household:

All usual residents of a dwelling.

Rural area:

All territory lying outside urban areas.

Temporary resident (TR):

Person who spent the night of June 2 to June 3 in a dwelling in Canada which was not his or her usual place of residence.

Unoccupied dwelling:

Private dwelling which is suitable for year-round or permanent occupancy but in which no person or group of persons is determined to have been residing on Census Day.

Urban area:

Continuous built-up area having a population of 1,000 or more persons and a density of 400 or more persons per square kilometre according to figures from the preceding census.

Usual place of residence:

A person's permanent residence. If a person has more than one residence, it is the one in which he or she has resided or intends to reside at least six months of the current year. If a person has no residence on Census Day, the dwelling in which he or she spends the night of June 2 to 3, 1986 is considered as his or her usual place of residence.

Usual resident of a dwelling:

Person for whom the dwelling is his or her usual place of residence according to the instructions concerning persons to be included or excluded.

Visitation Record (VR):

The Visitation Record is used to list every private dwelling (occupied or vacant), every collective dwelling and every agricultural holding in an EA. The VR assigns a household number to each dwelling, which uniquely identifies it in the census.

