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Demosim:
An Overview of Methods and Data Sources

Demosim 2017

by the Demosim team
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. not available for any reference period
.. not available for a specific reference period
... not applicable
0 true zero or a value rounded to zero
0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p} preliminary
^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E} use with caution
F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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Introduction

Demosim is a Statistics Canada's microsimulation demographic projection model designed to project the Canadian population according to various ethnocultural characteristics. Created in 2004, the model—then known as Popsim—was used to produce *Population Projections of Visible Minority Groups*, *Canada, Provinces and Regions, 2001 to 2017* (Statistics Canada 2005).[1] Its subsequent versions, under the name Demosim, were used to prepare *Projections of the Diversity of the Canadian Population, 2006 to 2031* (Statistics Canada 2010), *Population Projections by Aboriginal Identity in Canada, 2006 to 2031* (Statistics Canada 2011), *Projected trends to 2031 for the Canadian labour force* (Martel et al. 2011), *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036* (Statistics Canada 2015-2), and a number of analytical and methodological articles,[2] among others.

In 2015, *Demosim: An Overview of Methods and Data Sources* (Statistics Canada 2015-3) was published for the first time to document the version of the model (Demosim 2015) used to prepare *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036*. These projections were the result of a major method and content redesign of the projection model, which took into account the latest data sources. The release of the projections initiated a new release cycle for prospective products based on the 2011 National Household Survey (NHS), the previous cycles having been based on the 2001 and 2006 censuses.

Since then, a new version of the model (Demosim 2017), also based on the 2011 NHS, has been completed. The new version of Demosim was developed to help prepare two analytical reports, *Immigration and Diversity: Projections of the Population of Canada and Its Regions, 2011 and 2036* and *Language Projections for Canada, 2011 to 2036*. Although consistent with the 2015 version of Demosim, it includes a few additions and modifications that require updating the methodological documentation (see summary of changes in Box 1).

This document provides an overview of how the 2017 version of the Demosim projection model works. It describes the base population, data sources and methods for each component. The assumptions and scenarios used in presenting the results from this version are described, for purposes of interpreting the results, in the analytical reports of which this report is a technical supplement.

Lastly, the description of Demosim in this report should be seen as an extension of the documentation related to previous versions of the model.[3] Even though the versions of the model used in this projection cycle have been completely redesigned and updated, the description of Demosim herein has been constructed and developed based on this documentation.

1 See also Bélanger et al. (2008) for a presentation of this first version of the model.

2 For example, articles have been published on Demosim's education module (Spielauer 2010), the relationship between immigration and Canada's age structure (Caron-Malenfant et al. 2011), the relationship between education and the labour force participation of Aboriginal people (Spielauer 2014) and the contribution of immigration to the renewal of Canada's population (Dion et al. 2015).

3 See Statistics Canada (2005), Statistics Canada (2010) and Statistics Canada (2011) for a description of the Demosim versions used in the projections based on the 2001 and 2006 censuses. Some of the changes made to the current version of Demosim were described in Caron-Malenfant (2015).

Box 1. Summary of the changes since the 2015 version of Demosim

The key modifications made to Demosim since the 2015 version described in Statistics Canada 2015-3 are as follows:

- A Canadian citizenship variable has been added to the base population. To keep it up to date during projections, a module for the acquisition of Canadian citizenship of immigrants was added to Demosim, and then modifications were made accordingly to the module for assigning characteristics to newborns.
- The internal migration module was modified to take the linguistic variables and the francophone character (or absence thereof) of the destination regions into account in more detail.
- A number of changes have also been made to the modules for linguistic transitions over an individual's lifetime and for intergenerational language transmission, in particular with respect to selecting the transitions that are modelled for simulation purposes and the explanatory variables included in the models.

Base population

The base population for this version of Demosim is essentially derived from the 2011 National Household Survey (NHS) microdata file,[4] a database containing approximately 7.3 million records that represent the Canadian population living in private households on May 10, 2011. The main variables of the base population are as follows:[5]

- Age;
- Sex;
- Place of residence: census metropolitan area (CMA), province or territory, Indian reserve, and Inuit Nunangat;
- Aboriginal group;
- Registered Indian status;
- Registration category on the Indian Register (6(1) or 6(2));
- Marital status (including mixed unions);
- Place of birth (province/territory or country/world region);
- Immigrant status and time elapsed since immigration;
- Generation status;
- Immigrant admission category;
- Canadian citizenship;
- Visible minority group;
- Religion;
- Mother tongue;
- Language spoken most often at home;
- Knowledge of official languages;
- Highest level of schooling;
- Head-of-household status;
- Head-of-family status;
- Labour force participation.

4 For a description of this survey, please see the Statistics Canada website at www12.statcan.gc.ca/nhs-enm/index-eng.cfm?HPA (accessed February 23, 2015).
5 The model includes other variables as well. Most of them are auxiliary variables (e.g., number of children and date of birth) that have been included to ensure the best possible projection of the other variables.

Registration category on the Indian Register and immigrant admission category are two variables that were added through file linkages, as they were not included in the NHS database. Registration category, which defines the conditions for children to inherit registered Indian status from their parents, was obtained from a pre-existing linkage between the Indian Register and the 2011 NHS (through the 2011 Census), to identify, among NHS respondents who reported being Registered Indians, those who had status under subsection 6(1) of the *Indian Act* and those who had status under subsection 6(2).[6] In 66% of cases, registration category was determined through file linkage. For the remaining 34%, categories 6(1) and 6(2) were either deterministically imputed using information on the registration of other census family members, or else were imputed using a probabilistic model (logistic regression).[7] Immigrant admission category (economic, humanitarian (refugees), family reunification or other) was obtained using pre-existing linkages between the Immigration, Refugees and Citizenship Canada landing files from 1980 to 2011 and the 2011 NHS (through the 2011 Census). The linkage was successful for 82% of those who reported in the NHS being admitted to Canada as immigrants in 1980 or later. For the remaining 18%, the variable was probabilistically imputed using multinomial logistic regression models. For immigrants admitted before 1980, the admission category remains unknown.

Some adjustments were also made to the NHS microdata file so that the Demosim base population reflects the entire Canadian population as closely as possible.

The population living on the 31 Indian reserves that were incompletely enumerated in the 2011 Census and the five additional Indian reserves that did not respond to the NHS were added to the Demosim base population. For 13 of the 31 incompletely enumerated reserves in the census, the NHS questionnaire was administered during a special collection several months later than the planned date, as forest fires prevented the collection from being carried out.[8] The records from this special collection were added to the Demosim base population. For the population of the 18 other Indian reserves that were incompletely enumerated in the census, it was assumed that the population was consistent with estimates produced by the Social Survey Methods Division of Statistics Canada. Records were then imputed with characteristics that were representative of similarly sized reserves enumerated in the same province. A similar imputation was performed for the five reserves enumerated in the census but not in the NHS, calibrating their population to the 2011 Census counts by age group and sex.

Lastly, adjustments were made to obtain a population that was representative of the population estimates of May 10, 2011, which included people living in collective dwellings, and which account for net undercoverage in the census. The adjustment for collective dwellings involved multiplying the sampling weights of individuals by the ratio of the 2011 Census population (which includes collective dwellings) to the NHS population by age, sex and place of residence.[9] Net undercoverage rates were then applied to the sampling weights by age, sex and place of residence.

All of these adjustments increased the total population by about 1.4 million people. These adjustments had a greater impact on certain population subgroups—notably young adults, who had higher net undercoverage rates, and Registered Indians, because of the adjustment for the incompletely enumerated reserves.[10]

6 A category 6(1) parent may always pass his or her registered Indian status to the child but a category 6(2) parent may only pass it on if the other parent is also registered. See the "Concepts" section of the report *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036* for more details on registration categories.

7 Among the cases imputed, 83% were imputed probabilistically and 17% deterministically.

8 For more information on this special collection, please see the Statistics Canada website at: www12.statcan.gc.ca/nhs-enm/2011/ref/no13reserves/index.cfm?Lang=E&fpv=10000 (accessed February 23, 2015).

9 Since the NHS questionnaire was not administered in collective dwellings, the number of variables available for making this adjustment was small. Therefore, the assumption was made that collective dwellings have the same composition as private dwellings for each combination of age, sex and place of residence. As well, this adjustment includes a reweighting for the 6,600 individuals enumerated abroad.

10 To learn more about coverage in the 2011 Census, see Statistics Canada (2015).

Demosim's general functions and features

Demosim is a **microsimulation** model, which means that it projects individuals in the population one by one, rather than projecting the population on the basis of aggregate data, as is done with cohort-component and multistate models.[11] Demosim simulates the life of each person in its base population, as well as the newborns and immigrants who are added to the population during the simulation.[12] The individuals advance through time and are subject to the likelihood of 'experiencing' various events simulated by the model (for example, the birth of a child, death, a change in education level or change in knowledge of official language) until they die, emigrate or reach the end of the simulation.

The probabilities (or risks) of 'experiencing' each event depend on the individual's characteristics. The probabilities are used to derive waiting times, which—being a function of the probabilities associated with the events, individual characteristics and a random process—correspond to the time that will elapse between the present and the occurrence of each event (see Box 2). The event with the shortest waiting time occurs first. After an event occurs, a new set of waiting times are calculated for the events that depend on the characteristic that has changed; the individual then advances through time to the next event (again, the one with the shortest waiting time), and so on. Since Demosim is a continuous-time model, the various simulated events may occur at any time of the year, although some of them occur on a fixed date (for example, birthdays). As well, some characteristics are imputed annually to the individuals. Events and waiting times are managed using the computer language Modgen,[13] in which Demosim is programmed.

This approach is used to yield projections at a level of detail that is not possible using standard models because of their matrix nature. The simultaneous and consistent projection of a large number of variables made possible through microsimulation permits the use of more characteristics, both as determinants of simulated events and for tabulating results. Demosim has also shown flexibility in formulating assumptions and projection scenarios, as well as an ability to reproduce the results of cohort-component models at an aggregate level.[14]

The use of this method assumes that the probabilities (or risks) associated with simulated events have been calculated in advance. Calculations are done using existing data sources (censuses, surveys and administrative data) to which various methods are applied. The next section describes these methods in more detail.

11 For a description of the microsimulation methods used in population projections, see Van Imhoff and Post (1998) and Willekens (2011).
12 Non-permanent residents are processed differently. See the "Creation of individuals during the simulation" section.
13 Modgen was developed by Statistics Canada's Modelling Division (now Social analysis and modelling Division). Modgen and its documentation are available on the Statistics Canada website at www.statcan.gc.ca/eng/microsimulation/modgen/modgen (accessed February 23, 2015).
14 On this last point, see the comparison between the results of Demosim and those of Statistics Canada's cohort-component model, presented at Statistics Canada's 2010 International Methodology Symposium (Cyr et al. 2010).

Box 2. On calculating waiting times, as well as the concepts of transition rate (risk) and probability

In a continuous-time model like Demosim, events can occur at any time. Their occurrence depends on waiting times, which are associated with each individual based on his or her present characteristics. The individual waiting times required to run a microsimulation model like Demosim cannot be obtained from observation data; they must be derived.

Waiting times are derived from the transition rate (which quantifies the risk) denoted by λ. The transition rate is defined by the number of events observed divided by the number of person-years lived. An example of a transition rate in demography is the mortality rate (m_x), found in mortality tables alongside the death probability (q_x), which represents the probability that a person will die during the year.

The waiting time before an event occurs follows an exponential distribution of parameter λ. Under this exponential law, it is assumed that the risk of experiencing an event (e.g., death) remains constant during a given period of time. The risks in Demosim are thus assumed to be constant, as long as the characteristics that determine the modelled event remain unchanged for the individual. Since most events in Demosim are age-dependent, this period for these events is a maximum of one year.

The probability of an event occurring before or exactly at time t is given by the exponential distribution function:

$$P(T \leq t) = F(t) = 1 - e^{-\lambda t}$$

The inverse exponential distribution function, $t = -\ln(1 - F(t)) / \lambda$, indicates the time t at which a proportion $F(t)$ of the population will have experienced the event, knowing that the transition rate is λ.

Demosim uses a random process in conjunction with the inverse exponential distribution function to generate individual-level waiting times for each simulated event. First, a random value is obtained from the uniform distribution U[0,1]. This value is inserted into the inverse exponential distribution function in place of $F(t)$. For example, if an event has a transition rate of λ = 0.15 and the random number generated is 0.5, then the waiting time generated for this event will be $t = -\ln(1 - F(t)) / \lambda = -\ln(1 - 0.5) / 0.15 =$ 4.62 years. Any lower random value will give a waiting time below 4.62 years, and any higher value will give a longer waiting time.

The projection parameters often consist of probabilities rather than transition rates. When this is the case, they need to be converted to transition rates by isolating λ in the exponential distribution function to obtain $\lambda = -\ln(1 - F(t)) / t$, and then replacing $F(t)$ with the annual probability and t with 1 year. Therefore, an annual probability of dying of 0.10 has a transition rate of 0.1053 because $\lambda = -\ln(1 - 0.10) / 1 = 0.1053$.

Although the concept of probability is frequently used in this document, it should be noted that the Demosim model actually uses risks to derive waiting times. Furthermore, the term “risk” is used in reference to the more precise concept of transition rate only for the sake of simplicity.

To learn more about calculating waiting times, please consult Willekens (2011).

Main projected components in Demosim

This section, which aims to document the main components projected by Demosim, is subdivided into three main parts. The first is concerned with events that are modelled using waiting times, the second discusses characteristics that are imputed annually, and the third gives an overview of how individuals are created during the simulation.

It should be noted that from this point onward, the document will at times refer to the concept of "module" because Demosim is built in a modular way, with each of its components corresponding to a module. A module includes the computer code specifying the dimensions and functioning of the modelled event, including its relation to other parts of the model and its associated parameters. Table 1 presents the different components of the projection model and summarizes the methods and data sources used in modelling these components.[15]

15 Demosim also includes a component for the departure of children from the parental home that is not presented here because, unlike all the other components, it has not changed since the release of *Projections of the Diversity of the Canadian Population, 2006 to 2031* (Statistics Canada 2010). Readers interested in the contents and functioning of the module are invited to read this publication.

Table 1
Methods and data sources of components used to calculate the Demosim parameters

Components	Data sources	Main methods
1) Events with waiting times		
Fertility	- 2011 National Household Survey (NHS); - Vital Statistics.	-Own-children method; -Rates; -Complementary log-log regressions.
Mortality	-Vital Statistics; -1991-to-2006 Census Mortality Follow-up Study; -First Nation Client File.	-Li-Lee projection; -Proportional hazards regressions.
Internal migration	-2001 and 2006 censuses; -2011 NHS.	-Complementary log-log regressions; -Matrices; -Rates.
Emigration	-Demographic estimates; -Longitudinal Administrative Database linked with immigration data.	-Rates; -Proportional hazards regressions.
Registration on the Indian Register and reclassification of registration category over an individual's lifetime	-Indian Register; -Linkage between the Indian Register and the 2011 Census/NHS.	-Registrations/reclassifications rates with predetermined targets.
Intragenerational ethnic mobility of Aboriginal people	-1996 and 2006 censuses; -2011 NHS.	-Residual method.
Intragenerational religious mobility	-1991 and 2001 censuses; -2011 NHS.	-Residual method.
Intragenerational linguistic mobility	-Linkages between the 2001 and 2006 censuses and the 2006 and 2011 censuses.	-Multinomial regressions; -Matrices; -Distributions.
Acquisition of Canadian citizenship	-2011 NHS.	-Logistic regressions.
Change in level of education	-2001 General Social Survey; -2011 NHS.	-Logistic regressions; -Alignment methods.
2) Characteristics imputed annually		
Marital Status	-2001 and 2006 censuses; -2011 NHS; -Linkage between the Indian Register and the 2011 Census/NHS.	-Logistic regressions; -Rates.
Head of household and head of family	-2011 NHS.	-Headship rates.
Labour force participation	-Labour Force Survey; -2001 and 2006 censuses; -2011 NHS.	-Participation rates; -Logistic regressions.
3) Creation of individuals during the simulation		
Creation of newborns	-2011 NHS; -Linkage between the Indian Register and the 2011 Census/NHS.	-Deterministic imputation; -Matrices; -Distributions; -Multinomial regressions.
Immigration	-2011 NHS; -Data from Immigration, Refugees and Citizenship Canada.	-Imputation; -Distributions.
Non-permanent residents	-2011 NHS; -Data from Immigration, Refugees and Citizenship Canada.	-Imputation; -Distributions.

Source: Statistics Canada, Demography Division.

Events with waiting times

The first category of events contains those events that are modelled using waiting times (see Box 2). These events make it possible to create a dynamic and distinct life course for each simulated individual. Events in this category are fertility, mortality, internal migration, emigration, registration on the Indian Register and reclassification of registration categories over a lifetime, intragenerational ethnic mobility of Aboriginal people, intragenerational religious mobility, intragenerational linguistic mobility, acquisition of Canadian citizenship by newcomers and changes in education level.

Fertility

The fertility module has been designed to obtain a projection of births that reflects the differences in fertility between the various groups projected—for example, Aboriginal people and immigrants. The module contains, on one side, the 'base probabilities' of an individual having given birth to one or more children during the year preceding the 2011 NHS. These base probabilities were calculated by age, number of children in the home, and having or not having an Aboriginal identity, using the own-children method[16] applied to the NHS data.[17] They include adjustments for children not living with their mother, and for mortality. They are also adjusted to reflect what is observed in Vital Statistics. The base probabilities are then combined with the results of complementary log-log regressions (see Box 3) computed using the same NHS data to which the own-children method was applied. The regressions aim to estimate the probability—for various combinations of age group, number of children in the home and Aboriginal identity[18]—of having given birth to one or more children during the same period according to other variables. These variables are marital status, education, Aboriginal group, registered Indian status, immigrant status, time elapsed since immigration, generation status, immigrant admission category, place of birth, visible minority group, religion, mother tongue and detailed place of residence (on or off Indian reserves, Inuit Nunangat, CMA, and province and territory).[19] For the sake of consistency between the base probabilities and the regressions results, both estimate the number of women having given birth to one or more children, and not the total number of births (since multiple births are possible). To obtain the total number of births, an adjustment consisting of ratios between the number of births during the period and the number of women who have given birth, by Aboriginal identity or visible minority group, is applied.

Mortality

The mortality module has a similar structure to the fertility module, as it also uses base rates combined with regressions results (see Box 3). The mortality module aims to simulate the future number of deaths, taking into account the differences between the projected groups. Because of the fragmented nature of the available data, mortality is modelled separately for Inuit and non-Inuit populations, and among non-Inuit, separately for the population aged 25 and older and that aged 24 and younger.[20]

1. For non-Inuit aged 25 or older, the base rates consist of mortality rates projected by age and sex at the national level, consistent with the methods documented in the technical report of the most recent national projections (Dion et al. 2014).[21] The base rates are then combined with the results of proportional hazards regressions (Cox models), stratified by sex and broad age groups. These regressions estimate the risk of dying by Aboriginal ancestry group, visible minority group, time elapsed since immigration, education, living on an Indian reserve, and province or territory of residence. The models were estimated with the data from the *1991-to-2006 Canadian Census Mortality Follow-up Study*,[22] which linked 1991 Census data for the population aged 25 and older to Vital Statistics data up to 2006.

16 For a description of this method, which is derived from the relationship between the youngest children and the women likely to be their mother, see Grabill and Cho (1965) and Desplanques (1993). For examples of the application of the method to Canadian data see Bélanger and Gilbert (2003), Caron-Malenfant and Bélanger (2006), Morency and Caron-Malenfant (2014), Ram (2004), or previous releases of microsimulation projections (Statistics Canada 2015-2; Statistics Canada 2011; Statistics Canada 2010; Statistics Canada 2005).
17 The database includes all the adjustments made to the Demosim base population except for the imputation of incompletely enumerated reserves.
18 In this case, having or not having an Aboriginal identity.
19 The models also include some interactions among variables.
20 No data source contains all the information required to model the mortality of each of the projected groups, which is why multiple sources are used.
21 The projection is performed using a variant of the Li-Lee model (2005).
22 See Wilkins et al. (2008) and Tjepkema and Wilkins (2011).

Box 3. Combining base rates or probabilities with regression results

In a number of Demosim modules, the likelihood of certain events is estimated using base rates combined with relative factors derived from results of regressions. Combining base rates and regression results increases the flexibility for developing projection assumptions and makes it possible to incorporate information from various data sources for event modelling. However, some difficulties are associated with it.

First, the reference category of regression models is normally not the entire population, but only one or more subgroups. A conversion or adjustment is therefore required if the results of such regressions are to be combined with one or more rates that refer to the entire population.

A second difficulty lies in differences between the composition of the population used to calculate the regression models and the composition of the population to which these regression results are applied, that is the base population for the projection. When a data source other than the Demosim base population is required to calculate parameters, the weighted sum of probabilities from the regression will not necessarily be equal to the sum that would be obtained by weighting these same probabilities using the population from another data source.

To address these difficulties, a calibration method is used to adjust the y-coordinate at the origin of the regression models without changing the model's other coefficients. This adjustment is made in such a way as to reproduce target rates (base rates) within a population whose composition is the same as the composition of the Demosim base population.

To illustrate the method, let us suppose that we performed a logistic regression estimating the probability than an event Y will occur according to a set of characteristics X. This regression was carried out on a survey that we will call source *A*. This data source *A* has a population whose composition according to the X characteristics differs from the composition of the Demosim base population, to which, however, the probabilities from source *A* will be applied. We will call the Demosim base population data source *B*. Let us suppose that we also want to assume that the probability that the event in question will occur reaches a pre-established target, as is often the case when making projections.

Keep in mind that with a logistic regression, the probability P_A (with *A* referring here to data source *A*) that event Y will occur given the set of characteristics X $(P_A(Y=1|X))$ is calculated using the following formula:

$$P_A(Y=1|X) = \exp(\alpha_A + \beta' X)$$

If we weight the probabilities using weights derived from data source *A* (W_A), the overall probability (or the mean probability in the population) that event Y will occur is

$$\sum w_A * P_A(Y=1|X) = P_A(Y=1)$$

If we apply the probabilities resulting from this regression to another data source—say, source *B*—and we weight it based on the composition of this source (with weights w_B), we will produce an overall probability of event Y occurring that will not be equal to either the one that we would obtain using only source *A*, or the one that we could have obtained using only source *B*.

$$\sum w_B * P_A(Y=1|X) \neq \begin{cases} P_A(Y=1) \\ or \\ P_B(Y=1) \end{cases}$$

Let us now suppose that we want to find an adjustment to reproduce the overall probability for source *A* or source *B*. Since the result of the above equation gives the overall probability neither for source *A* nor for source *B*, it would not be sufficient to multiply it by the quotient of the two (P_B/P_A or the inverse).

The adjustment that we use for this purpose consists in using an iterative method to find an α_{target} that we add to the ordinate at the origin α_A so that

$$\sum w_B * \tilde{P}_A(Y = 1|X) = target$$

where

$$\tilde{P}_A(Y = 1|X) = \exp(\alpha_{target} + \alpha_A + \beta' X)$$

This method, while used in the above example to reach a target such as the overall probability for source *A* or source *B*, can also be generalized to any target. In Demosim, to modify the assumption by changing the base rates (the target to be reached), a new adjustment specific to the desired target can simply be calculated. This type of adjustment can also be adapted to other types of regressions.

This method of calibrating the model makes it possible to preserve the odds ratios of the regression model while accurately reaching the target, assuming a population whose composition does not change from the start of the projection. Therefore, this method makes it possible to maintain compositional effects that may arise during the projection. As well, since the target set by the base rates is reached by adjusting the regression's intercept, it limits the probabilities to no more than 100%, regardless of the target. That also means that relative differences are maintained during the projection in terms of odds ratios (for logistic regression) or risk ratios (for proportional risk regression).

2. For the non-Inuit population aged 24 and younger, mortality is modelled differently for the non-Aboriginal population, the Aboriginal group of First Nations people and the Aboriginal group of Métis. For the non-Aboriginal population, Demosim uses the Li-Lee model to project mortality rates by age, sex and province or territory of residence. For the Aboriginal group of First Nations people, mortality rates come from mortality tables for Registered Indians,[23] and are then projected under the assumption that the difference between these rates and the rates for non-Aboriginal people remain constant.[24] For the Aboriginal group of Métis, as there are no data on this particular population, the rates are obtained by multiplying the rates for Registered Indians by a factor derived from the difference between the mortality of Métis and that of Registered Indians in the population aged 25 to 64, according to the *1991-to-2006 Canadian Census Mortality Follow-up Study*.
3. For the Inuit population, mortality tables were calculated using death data for Inuit living in Nunavut from special Vital Statistics data extractions for the years 2000 to 2002, 2005 to 2007, and 2010 and 2011. Among Inuit, the risks of dying are projected while keeping constant the relative difference observed during these periods between the Inuit population and the overall Canadian population.[25]

23 The mortality tables used for Registered Indians aged 10 to 24 are those published in Amorevieta-Gentil et al. (2014). These tables underestimate the mortality of Registered Indians younger than age 10 because a significant number of parents do not register their children on the Indian Register until the children are older. For this age group, the mortality rates from Amorevieta-Gentil et al. (2014) were adjusted using ratios derived from estimates from British Columbia for the population entitled to Indian registration (British Columbia Provincial Health Officer 2012).

24 More specifically, the ratios between the mortality rates of both groups are kept constant.

25 Here also, the ratios between the mortality rates of both groups are kept constant.

Internal migration

The purpose of the internal migration module is to simulate movements among the 84 geographic regions in Demosim, taking into account the main characteristics included in the projection. Two types of migration are modelled:

1. Interregional migration refers to migration between the model's 50 main regions (CMAs and non-CMAs[26]).
2. Intraregional migration pertains to migration on and off reserve, or within and outside Inuit Nunangat, within each of the main regions where there are Indian reserves or Inuit Nunangat regions.

Modelling internal migration includes several steps. The first steps aim to estimate interregional and intraregional migration based on the relationship between place of residence one year earlier and current place of residence (mobility one year) contained in a database consisting of the 2001 and 2006 censuses and the 2011 NHS, to which a constant geography has been applied.[27]

Interregional migration is modelled in two separate stages. First, complementary log-log regressions models are used to estimate the probabilities of an individual leaving each region based on age, Aboriginal group, registered Indian status, immigrant status, time elapsed since immigration, marital status, place of birth, generation status, visible minority group, number of children at home, age of the youngest child at home, mother tongue, language spoken most often at home, knowledge of official languages and living on an Indian reserve or in an Inuit Nunangat region.[28] Migrants are then assigned a destination region. When assigning the destination region, logistic regression models first determine whether the migrants will settle in a francophone region and, if so, whether they will settle in a predominantly francophone region.[29] The models are stratified by immigrant status and by whether the place of residence is in or outside a francophone region and take into account the same variables used to estimate the probability to leave a region. Matrices that take into account the region of origin, place of birth, mother tongue, Aboriginal group, registered Indian status, visible minority group and age are then used to determine the specific destination region from the model's remaining 49 major regions. If the destination region includes Indian reserves or an Inuit Nunangat region, additional models which take into account registered Indian status or having an Inuit identity determine whether or not the individual will live on a reserve or in an Inuit Nunangat community in the destination region.[30] Intraregional migrations are simulated using origin- and destination-specific migration rates that take into account age and, as the case may be, Aboriginal identity and education.

The following steps are a series of adjustments to the results of the regression models, the origin-destination matrices and the additional vectors. They are performed using the same database as the previous steps, but they correlate information on mobility over the past year with information on mobility over the last five years. These adjustments were intended to allow the Demosim migration parameters to reproduce (at the start of a projection) the contribution of net internal migration to the population growth of each region, as observed on average from 1996 to 2001, 2001 to 2006, and 2006 to 2011. One advantage of basing regional migration schemas on a longer period is reducing the weight of exceptional short-term phenomena that could substantially change net migration counts in a given year.

Emigration

The purpose of the emigration module is to project net emigration, which is defined according to the components of the Statistics Canada Demographic Estimates Program (DEP) as the sum of emigration, plus net temporary emigration, minus return emigration. The emigration module has a similar structure to the fertility and mortality modules, as it combines base rates and regression results (see Box 3) for the population aged 18 and older, making it possible to take into account several characteristics, in particular immigrant status, which is known to be a predisposing factor for emigration.[31] For the population aged 18 and older, the base emigration

26 The main regions include all 33 Canadian CMAs and the parts of each province that are not included in a CMA. Some of these regions are further divided into sub-regions that are also part of the main regions: the Montréal CMA is divided into Montréal Island and the rest of the CMA; the Ottawa – Gatineau CMA is divided into the Ontario part and the Quebec part; and the non-CMA parts of New Brunswick and of Ontario are each divided into a part with a concentration of francophones and a non-francophone part (see Caron-Malenfant (2015) for a map of these regions in New Brunswick and Ontario).

27 The database is also adjusted to account for net undercoverage in each of the censuses.

28 The models are specified independently from one region to another. Therefore, there are as many models as there are regions, and the variables selected may differ from one model to another.

29 The regions defined as francophone include all regions of Quebec, as well as the Moncton CMA, the francophone non-CMA part of New Brunswick, the Ontario part of the Ottawa – Gatineau CMA, the Greater Sudbury CMA and the francophone non-CMA part of Ontario. Predominantly francophone regions include all regions of Quebec except for the Montréal CMA.

30 The parameters in this step are obtained from complementary log-log regression models that also take into account age group, immigrant status and time elapsed since immigration, marital status, place of birth, mother tongue, education, visible minority status and the presence of children in the home.

31 This greater propensity is documented in Caron-Malenfant et al. (2011) and in Aydemir and Robinson (2006).

rates were calculated by age and sex at the national level by dividing the net number of emigrants, as estimated by the Statistics Canada DEP from 2002/2003 to 2011/2012, by the population (excluding non-permanent residents[32]) from the same source for the same period.[33] They are combined with the results of a proportional hazards regression model (Cox model) that uses a linkage between the Longitudinal Administrative Database and immigration data from 1995 to 2010 to estimate the propensity of the adult population to emigrate, by country/region of birth, period of immigration, province or territory of residence, age and sex.

For the population aged 17 and younger, net emigration rates were calculated by age, sex, and province or territory using population estimates for 2002/2003 to 2011/2012.

Registration on the Indian Register and reclassification of registration category over an individual's lifetime

The modules involving registration on the Indian Register have three separate purposes: 1) to model registrations that may occur during an individual's lifetime[34] as a result of legislative amendments or the agreement recognizing the Qalipu Mi'kmaq First Nation;[35] 2) to model the reclassifications of registration category from 6(2) to 6(1) that may occur during an individual's lifetime;[36] and 3) to model the late registration of individuals who were entitled to registration at birth.

1. The legislative amendments that could cause individuals to register during their lifetime are the 1985 amendments of the *Indian Act* (Bill C-31) and the *Gender Equity in Indian Registration Act* (Bill C-3) which came into effect as of January 2011. For these legislative amendments, target numbers of registrations were estimated from the number of registrations by year. For registrations under Bill C-31 from May 2011 to August 2014, target numbers were calculated from the actual registrations recorded on the Indian Register. For subsequent periods, target numbers were calculated by continuing the average downward trend in registrations observed on the Indian Register data from 2007 to 2014. For Bill C-3, the initial targets were again the number of registrations from May 2011 to August 2014 according to the Indian Register. For subsequent years, target numbers of this type of registration were obtained from projections by Indigenous and Northern Affairs Canada. For registrations resulting from the agreement recognising the Qalipu Mi'kmaq First Nation, the target numbers were calculated from the registrations that occurred between the order-in-council coming into force on September 22, 2011 (the date of the band's creation) and the Supplemental Agreement of June 2013, whose impact on the number of Qalipu registrations is currently unknown. Once the targets had been determined, the individuals in the base population who were likely to register under these components were identified from among those who did not have registered Indian status (according to distributions specific to each component), and then their time of registration was determined in advance.[37] The vast majority of individuals selected in this way were initially Non-Status Indians.
2. Reclassification from registration category 6(2) to category 6(1) may result from the application of Bill C-3, or for various other reasons.[38] The changes resulting from Bill C-3 were modelled using a method similar to the one described above for registration because of legislative amendments. Target numbers were first determined by age, sex and year of change. From May 2011 to August 2014, the numbers were determined using reclassifications that occurred during that period according to the Indian Register. For subsequent years, target numbers of reclassifications vary at the same rate as registrations under

32 The departures of non-permanent residents are not included in Statistics Canada's emigration data.

33 This period is the same period as that selected in *Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038)* (Statistics Canada 2014). In addition, as in this series of projections, an adjustment is made to increase the number of emigrants from Ontario and British Columbia on the basis of estimates obtained from the Reverse Record Check Survey (Bohnert et al. 2014).

34 Registrations resulting from births are modelled during the creation of newborns. See the "Creation of individuals during the simulation" section.

35 To learn more about the legislative changes and the agreement recognizing the Qalipu Mi'kmaq First Nation, see Box 2 of the *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036* (Statistics Canada 2015-2).

36 Only changes from 6(2) to 6(1) are modelled in Demosim, since there are not enough changes in the other direction. For more information on the concepts, see "Registration categories 6(1) and 6(2) on the Indian Register" and "Reclassification of registration categories from 6(2) to 6(1)" in the glossary. Additional information on these topics is also found in the "Concepts" section of *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036* (Statistics Canada 2015-2).

37 When individuals identified as future Registered Indians give birth to a child, the methods for assigning registered Indian status and the registration category to the newborns are applied as described in the "Creation of individuals during the simulation" section. However, if the birth occurs before the mother's predetermined time of registration or reclassification, intergenerational transmission rules are used to determine whether or not the registered Indian status and registration category of the child determined at birth should be changed when the mother becomes registered or is reclassified.

38 For example, a person whose mother is in registration category 6(1) will be registered in category 6(2) if information on the father is unavailable at the time of registration, and then may be reclassified in category 6(1) if it is later determined that the father also had registered Indian status.

Bill C-3. For reclassifications not resulting from Bill C-3, annual reclassification rates were calculated by age and sex based on 2010 data from the Indian Register. They are assumed to be constant throughout the projection period, except from 2011 to 2014 where they were adjusted to reflect the reclassifications observed on the Indian Register.

3. The late registration of individuals entitled to registration on the Indian Register at birth is modelled separately for children and adults. For children born during the simulation, the modelling is done in two steps. First, children entitled to Indian registration are identified from among the simulated births.[39] Entitlement depends on the mother's registration category, whether or not she was in a mixed union at the time the child was born, and the inheritance rules for registered Indian status. Those entitled to registration but not having a registered Indian status at birth are assigned a probability of registering on the Indian Register that depends on their age and whether or not they live on an Indian reserve. The probabilities were derived so that they can reproduce the progression by age observed in the NHS of the proportion of children with a registered Indian status among children who are in principle entitled to register—namely the children with two parents who are Registered Indians, or with one parent who is in registration category 6(1).[40] Late registration rates derived from the same data are also applied to some children in the base population. Among adults aged 19 years and older, populations at risk are applied late registration rates by age and sex, calculated by dividing the average annual number of registrations of this type from 2008 to 2014, according to the Indian Register, by the 2011 estimated population of Non-Status Indians living off reserve that will not become registered as Qalipu or for legislative reasons.

Intragenerational ethnic mobility of Aboriginal people

The purpose of the Aboriginal intragenerational ethnic mobility module is to simulate changes in reporting of Aboriginal group from one census to the next, a phenomenon that is behind a significant part of the increase in the number of Métis and First Nations people observed at least since 1986 in Canada.[41] The parameters of the intragenerational ethnic mobility of Aboriginal people were calculated using a residual method applied to the 1996, 2001 and 2006 censuses and the 2011 NHS, adjusted for net undercoverage. It involves calculating the share of the growth of a given Aboriginal group that remains unexplained after fertility, mortality and net migration have been taken into account, for each five-year period. This unexplained growth is interpreted as resulting from changes in the Aboriginal group reported in the censuses (or the NHS). The net gains in Métis and First Nations people obtained this way were divided by the population that was non-Aboriginal, non-immigrant and not belonging to a visible minority group at the start of the period to obtain probabilities of an individual joining the First Nations group and Métis group over five years, taking into account age and region of residence. The probabilities were averaged for the three periods considered (1996 to 2001, 2001 to 2006 and 2006 to 2011).[42]

Intragenerational religious mobility

Intragenerational religious mobility refers to changes in religion occurring over an individual's lifetime. The probability of changing religions was estimated by religion, age, immigrant status and place of birth by applying (similar to intragenerational ethnic mobility) a residual method to the 2001 Census and the 2011 NHS (and alternatively to the 1991 and 2001 censuses), adjusted for net undercoverage[43]. Net losses for a given religion were divided by the religion's population at the start of the period to yield 'exit' net rates over 10 years. Individuals who have left a given religion are then distributed among the 'gaining' religions in proportion to the net gains recorded over the same period by these religions.

39 The concept of registration that is referred to here is "self-reported registration." This is not the same as "entitlement to registration," which in principle refers to a larger population, since a certain number of individuals entitled to registration do not register.

40 These proportions increase gradually up to the age of 3, reaching 98% on Indian reserves and 92% off reserve, and then fluctuate in no clear direction for subsequent ages. For this reason, it is assumed that all late registrations occur before age 3.

41 For example, see Guimond (1999), Guimond et al. (2007) and Caron-Malenfant et al. (2014) for estimates of ethnic mobility in Canada between 1986 and 2006.

42 In three regions (Thunder Bay, Regina and Saskatoon), the First Nations Aboriginal group experienced net losses as a result of intragenerational ethnic mobility on average from 1996 to 2011. In these cases, exit rates to non-Aboriginal people were calculated by taking the non-registered First Nations population as the population 'at risk' of changing. As well, ethnic mobility was assumed to be nil on Indian reserves and in the territories, given the greatest homogeneity of those population, with regards to identity. Intragenerational ethnic mobility among the Inuit population is also assumed to be nil. Lastly, because it is possible that the declaration of Aboriginal identity in Newfoundland and Labrador between 2006 and 2011 was affected by the recognition of the Qalipu Mi'kmaq First Nation, and it would be inadvisable to make long-term projections based on the effect of an event that is unlikely to occur again, the parameters of ethnic mobility for this province are based only on the 1996 to 2006 period.

43 See Caron-Malenfant et al. (forthcoming) for a detailed description of the method used.

Intragenerational linguistic mobility

The intragenerational linguistic mobility module models changes that may arise during one's lifetime to the language spoken most often at home and to the knowledge of official languages.[44] It includes two separate sets of parameters:

1. Changes in the language spoken most often at home have been estimated using logistic regression models that draw on data from linkages between the 2001 and 2006 censuses.[45] The models have been stratified by immigrant status, whether the place of residence is in or outside Quebec, and the linguistic profile at the start of the period, defined by the language spoken most often at home and the mother tongue.[46] The models estimated the likelihood of a change in the language spoken most often at home over the given five-year period, taking into account age, sex, region of residence, generation status, age at immigration, period of immigration, geolinguistic origin of immigrants and knowledge of official languages. Only the most frequent transitions have been modelled; therefore, the least common transitions based on the data from the linkage between the 2001 and 2006 censuses cannot occur during the simulation.[47]
2. Changes in the knowledge of official languages have been modelled using logistic regressions specific to the initial linguistic profile (defined on the basis of the knowledge of official languages and the language spoken most often at home), the immigrant status and whether the place of residence is in or outside Quebec. The models are estimated using data from the linkage between the 2006 and 2011 censuses, taking into account age, sex, time elapsed since immigration, age at immigration, generation status, place of birth, place of residence, education and mother tongue. Here too, only the most frequent transitions have been modelled, so the others cannot occur during the simulation.[48]

Acquisition of Canadian citizenship

In Demosim, the acquisition of Canadian citizenship refers to the process through which immigrants become naturalized citizens after they arrive in Canada. This event was modelled by applying a logistic regression model to the 2011 NHS data, adjusted for net undercoverage, that estimates the likelihood of having obtained Canadian citizenship on the basis of the number of years elapsed since immigration, place of birth, immigrant admission category, visible minority group and age at immigration. Because of the rules for obtaining citizenship through naturalization, immigrants settling in Canada during the simulation cannot become citizens until they have lived in Canada for three years. As well, since the data indicate that the percentage of immigrants with Canadian citizenship stops increasing once 15 years have elapsed after immigration status is acquired, the rates of acquisition of citizenship are considered nil after 15 years of residence in Canada.

Change in level of education

The last event projected using waiting times is change in education level. The probabilities associated with this event were derived by combining 2001 General Social Survey (GSS) and 2011 NHS data adjusted for net undercoverage which, together, include the information required for the projection. First, probabilities of change in education level by year of birth, age, sex and immigrant status were obtained by applying logistic regression models to historical data from the 2001 GSS. The population of the 2001 GSS was then projected to 2011 using the calculated probabilities, which were calibrated in three separate steps. An initial calibration was done to specifically reproduce the NHS distributions by education level, year of birth, age, sex and immigrant status. A second calibration added differential probabilities by visible minority group, Aboriginal identity and registered Indian status to reproduce the distributions of these groups in the NHS. The third calibration added differentials by province and territory of birth.

44 In this version of Demosim, mother tongue is considered static, even though it can change during one's lifetime, since it is defined in Canadian censuses as the first language learned in childhood and still understood. A person may no longer understand the first language learned. This has been analyzed by Lepage (2011).

45 As a result of gaps in the comparability of data on the language spoken most often at home between the 2006 and 2011 censuses (see Houle and Corbeil 2013), the mobility related to this variable has been modelled on the basis of the period from 2001 to 2006. However, the 2006 and 2011 data are comparable with respect to knowledge of official languages. Therefore, for knowledge of official languages, the linkage between the 2006 and 2011 censuses has been used instead of the linkage between the 2001 and 2006 censuses.

46 For example, for non-immigrants living outside Quebec, separate models were estimated for (1) persons whose mother tongue and language spoken most often at home is English; (2) persons whose mother tongue is neither English nor French, but speak English most often at home; and so on.

47 The transitions modelled represent 90.2% of all estimated transitions from 2001 to 2006.

48 The transitions modelled represent 97.2% of all transitions based on the linkage between the 2006 and 2011 censuses.

Characteristics imputed annually

Some components of Demosim are not meant to project events but rather to impute certain characteristics to individuals, including marital status, head-of-family and head-of-household status as well as labour force participation. These characteristics are assigned once a year on a fixed date.

Marital status

Marital status is a variable that is projected mainly for its use in determining other events during the simulation, particularly fertility, to which it is closely related. The marital status module is derived from logistic regression models that are estimated using data from the adjusted 2011 NHS for the population aged 15 and older. The initial models determine whether or not the individual is in a union. If the individual is in a union, other models determine the type of union (married or common law). The models are stratified by sex and by having or not having an Aboriginal identity. They take into account age, number of children at home, immigrant status, generation status, time elapsed since immigration, place of birth, mother tongue, visible minority group, religion, Aboriginal group, registered Indian status and place of residence. The probabilities derived from these models evolve during the projection based on trends observed in the 2001 and 2006 censuses and the 2011 NHS (adjusted), which showed an increasing propensity for couples to live in a common-law union. The marital status module finds its complement in the mixed union parameters that are used to assign characteristics such as generation status to newborns (see the "Creation of individuals during the simulation" section).[49]

Head of household

A head-of-household status[50] is assigned to individuals annually to obtain a projection of the number of private households by certain characteristics, including a household's Aboriginal composition. The headship rates method[51] is used to establish a relationship between the number of heads of household and the population, by certain characteristics of the projected population. This rate is then multiplied by the projected population to obtain a future number of private households. For the purposes of these projections, different types of households were identified in the data from the 2011 NHS according to a combination of household characteristics (Aboriginal composition, household size and the presence of individuals younger than 19 years of age, etc.[52]). The number of heads of household for each type by age, Aboriginal group, registered Indian status, marital status and place of residence was determined and then divided by the total population with the same characteristics to obtain headship rates for use in the annual imputation of head-of-household status during the simulation.[53] Head-of-household status is used strictly to derive a number of households. It is not used as a determining factor for other events during simulation. The same holds true for labour force participation.

Labour force participation

The purpose of the labour force participation module is to impute a status to individuals aged 15 and older regarding their labour force participation. The module has been designed to take into account differences in labour force participation among the various groups projected (for example, Aboriginal people, visible minority groups and immigrants). It includes two sets of parameters. The first is composed of labour force participation rates by sex and age group taken from Labour Force Survey (LFS) data. The parameters are then adjusted to take into account populations excluded from the survey, in particular Indian reserves. The second is composed of the results of logistic regressions that estimate (separately by sex and age group) the probability of being in the labour force by the following variables: Aboriginal group, registered Indian status, visible minority group, immigrant status,

49 Unlike marital status, mixed unions are not assigned automatically each year to the whole population aged 15 years and older, but only to women when they give birth to a child. For that reason, the methods used to assign mixed unions are described in the section on creating newborns (to which they relate).

50 Note that Demosim also has a module for imputing head-of-family status. It uses the same methods as the head-of-household status module.To avoid redundancy, only household projection methods are described here. For more information on methods for projecting families and households in Demosim, see Morency (2015).

51 This method, widely used to project numbers of households, is documented in United Nations (1973).

52 A household's Aboriginal composition refers to the presence of at least one Aboriginal person in the household (for example, at least one person with registered Indian status, or people not having registered Indian status but at least one person identifying as Métis, etc.). Household size includes the following categories: one person, two to five persons, and six persons or more. Household type is a combination of a household's Aboriginal composition, household size and the presence of individuals younger than 19 years of age. For example, there are Aboriginal households two to five persons in size with no individuals younger than 19, and Aboriginal households two to five persons in size with at least one individual younger than 19, etc.

53 Heads of household were selected from among the household maintainers identified by the 2011 NHS. In households with more than one maintainer, the head was selected randomly from among the maintainers. The number of households projected is the number of private households. Since the projected population, to which the headship rates are applied, includes an adjustment for collective dwellings, headship rates were created by dividing the number of heads without the adjustment for collective dwellings by the population including the adjustment for collective dwellings. Lastly, the headship rates account for net undercoverage of households by province or territory and by household size (one person or two or more persons). For Inuit Nunangat regions, Nunavut household net undercoverage rates were applied. Information on the household net undercoverage rates used is available in Statistics Canada (2016).

time elapsed since immigration, generation status, place of birth, marital status, presence of children and age of youngest child, education, knowledge of official languages, and place of residence. The logistic regressions use data from a file that combines data from the 2001 and 2006 censuses and the 2011 NHS (adjusted). These two sets of parameters are combined each January to determine the labour force participation for the upcoming year. An alternative version of this module, based only on the 2011 NHS, also includes immigrant admission category.

Creation of individuals during the simulation

Aside from individuals in the Demosim base population, individuals may be added to the population during the simulation as a result of births, immigration and the arrival of non-permanent residents. New individuals are added by creating complete records, that is, records having all the characteristics required for them to be projected by Demosim. The process for assigning characteristics to new individuals is described below.

Creation of newborns

The creation of newborns from births occurring after the start of the simulation requires the use of methods that differ according to the characteristic to be assigned to the new individuals. First, a number of characteristics to be assigned to newborns do not require any parameters to be calculated and can be assigned automatically, for example marital status (not in a union), education (less than high school), immigrant status (non-immigrant), Canadian citizenship (Canadian citizenship at birth), etc. Other characteristics are assigned probabilistically. The sex of the child is determined by applying a sex ratio of 105 boys born for every 100 girls, as has been observed in Canada for several decades. Religion, the three linguistic variables, visible minority group and Aboriginal group are assigned based on parameters derived by applying the own-children method to data from the adjusted 2011 NHS. Linking the youngest children in this data source to the woman most likely to be the mother makes it possible to calculate the probability that the child has a given set of characteristics, depending on the characteristics of the mother (see the characteristics considered in Table 2). Transition matrices and vectors were created for assigning religion, visible minority group and Aboriginal group. For language variables, the probabilities of the most frequent transitions come from multinomial logistic regression models, and the other probabilities from transition matrices. To maintain consistency among the language variables, the mother tongue and the language spoken most often at home are assigned at the same time using the same models.[54] For the same reason, the models for the transmission of knowledge of official languages take into account the results of the models above, in addition to the mother's characteristics.

The methods for assigning registered Indian status, registration category and generation status differ from the methods above by **indirectly** taking into account information about the child's father. Births in Demosim are generated by women, and women are not associated with a spouse. Therefore, it is not possible to **directly** know the father's characteristics at the time of birth. However, spousal characteristics may be associated with mothers through mixed unions. This is done in Demosim when a child is born.

A first mixed-union module determines whether the mother is in a union with a category 6(1) Registered Indian, a category 6(2) Registered Indian or an individual not having registered Indian status. The probability that the mother is in one of these types of unions is estimated using a file derived from adjusted 2011 NHS microdata that—by using information on the relationship among members of the same census family—links women in a union who gave birth during the previous year to their spouse and their children. The same probabilities were also calculated using the 2001 Census to establish trends related to mixed unions. Registered Indian status (including the registration category) is then assigned to newborns probabilistically, using transition matrices that take into account the mother's type of mixed union, as well as other characteristics of the mother and the child (Table 2).[55]

54 This means that mother tongue and language spoken most often at home are assigned to the child together, rather than separately for each variable.
55 For women who are single when their child is born, the transmission matrices do not take into account the type of union (mixed or otherwise).

Table 2
Variables considered in the probabilistic attribution of characteristics to the newborns

Characteristics attributed	Variables considered	
Sex	N/A (fixed sex ratio at birth is applied)	
Religion	Characteristics of the mother:	-Religion; -Place of birth.
Mother tongue and language spoken most often at home	Characteristics of the child:	-Sex.
	Characteristics of the mother:	-Language spoken most often at home; -Knowledge of official languages; -Place of birth; -Age at immigration; -Time elapsed since immigration; -Age group; -Education; -Generation status; -Place of residence.
Knowledge of official languages	Characteristics of the child:	-Sex; -Language spoken most often at home.
	Characteristics of the mother:	-Mother tongue; -Knowledge of official languages; -Place of birth; -Age at immigration; -Time elapsed since immigration; -Age group; -Education; -Generation status; -Place of residence.
Generation status	Characteristics of the mother:	-Immigrant status; -Mixed union status.
Visible minority group	Characteristics of the mother:	-Visible minority group; -Immigrant status; -Age at immigration; -Place of residence.
Aboriginal group	Characteristics of the mother:	-Aboriginal group; -Registered Indian status; -Visible minority group; -Immigrant status; -Age at immigration; -Place of residence.
Registered Indian status and registration category (6 (1) or 6 (2))	Characteristics of the child:	-Aboriginal group.
	Characteristics of the mother:	-Visible minority group; -Registration Category; -Marital status; -Mixed union status.

Source: Statistics Canada, Demography Division.

A second mixed-union module uses the same data source to calculate the probability that the woman is in a union with a spouse whose immigrant status is identical or different at the time the child is born in order to determine the child's generation status. The module consists of logistic regression models that take into account age, religion, visible minority group, Aboriginal group[56], time elapsed since immigration, mother tongue, language spoken most often at home, presence of young children at home and place of residence.[57] Generation status is then assigned to the newborn as follows: the newborn is considered second generation if the mother is an immigrant not in a mixed union, 2.5 generation if the mother is in a mixed union, and third generation or higher if the mother is not an immigrant and not in a mixed union.

Immigration

Immigration also involves the creation of individuals possessing all the characteristics required for their simulation following their arrival in Canada. This module includes two main dimensions. First, the number of new immigrants is projected annually. Second, the characteristics of the new immigrants are determined using a donor imputation method, with donors being selected from among the immigrants in the Demosim base population. The result is a projected immigrant population whose composition is representative of the immigrant population of the donor pool (which itself may be a subset of the immigrant population, for example recently-admitted immigrants). Adjustments are also made to some of the characteristics that are likely to have changed between the time of immigration and the time of the 2011 NHS—the survey on which Demosim is based—so that they will be as close as possible to what they were at the time of arrival. For example, when a new immigrant is created, the age assigned to the new immigrant is the donor's age at immigration (and not the donor's current age); the marital status is imputed on arrival using Demosim's annual marital status imputation parameters; and education on arrival is imputed using the Demosim education module.

Non-permanent residents

The final Demosim component that requires the creation of individuals is the arrival of new non-permanent residents. This component functions similarly to immigration. Like immigrants, non-permanent residents are projected in two steps: 1) determining an annual net gain in non-permanent residents; and 2) imputing the characteristics of the new non-permanent residents using donors who are selected from among the non-permanent residents in the Demosim base population.[58]

To learn more about Demosim

To learn more about the 2017 version of Demosim, please refer to the analytical reports *Immigration and Diversity: Projections of the Population of Canada and Its Regions, 2011 to 2036* (Statistics Canada 2017-1) and *Language Projections for Canada, 2011 to 2036* (Statistics Canada 2017-2). The descriptions of certain concepts and of the selected assumptions and scenarios therein supplement the descriptions in this document.

You can also contact Demography Division, Statistics Canada, by email (statcan.demography-demographie.statcan@canada.ca) or by telephone (1-866-767-5611).

56 In this case, self-identifying or not self-identifying with one or more Aboriginal groups.

57 Here, the mixed union parameters for married women are applied to women not in a union when their child is born, since the concordance of the status of the mother and the child for women not in a union resembles that of married mothers.

58 Because of its special characteristics, the non-permanent resident population is processed separately in Demosim. Individuals are non-permanent residents for only a short time and there is almost no information available on the propensity of non-permanent residents to experience the events simulated. Therefore, and to maintain consistency with Statistics Canada's population estimates data on non-permanent residents (annual net change), it is assumed that composition of the non-permanent resident population is perfectly stable. To achieve this, members of this population do not experience any of the events simulated except for fertility, since children born in Canada of non-permanent residents become Canadian citizens at birth. Thus, the assumption is made that each departing non-permanent resident is immediately replaced by the arrival of a new non-permanent resident with the same characteristics as the one who just left. The resulting stability is echoed by the data, at least regarding the composition of this population by age, sex and place of residence, in spite of slight variations from one period to the next.

Bibliography

AMOREVIETA-GENTIL, Marilyn, David DAIGNAULT, Norbert ROBITAILLE and Robert BOURBEAU. 2014. *La mortalité des Indiens inscrits (1989-2008)*, report from the Groupe d'études sur la dynamique démographique des Indiens inscrits (GEDDII), University of Montréal, Demography Department.

AYDEMIR, Abdurrahman and Chris ROBINSON. 2006. *Return and Onward Migration Among Working Age Men*, Statistics Canada Catalogue no. 11F0019.

BÉLANGER, Alain, Éric CARON-MALENFANT, Laurent MARTEL and René VÉZINA. 2008. "Projecting Ethno-Cultural Diversity of the Canadian Population Using a Microsimulation Approach", minutes of proceedings of the UNECE/Eurostat workshop on demographic projections in Bucharest (Romania).

BÉLANGER, Alain and Stéphane GILBERT. 2003. "The Fertility of Immigrant Women and their Canadian-Born Daughters", *Report on the Demographic Situation in Canada, 2002*, Statistics Canada Catalogue no. 91-209.

BOHNERT, Nora, Patrice DION and Jonathan CHAGNON. 2014. "Projection of Emigration", in BOHNERT, Nora, Jonathan CHAGNON, Simon COULOMBE, Patrice DION and Laurent MARTEL (editors), *Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038): Technical Report on Methodology and Assumptions*, Statistics Canada Catalogue no. 91-620.

BOUCHER, Alexandre, Norbert ROBITAILLE and Éric GUIMOND. 2009. "La mobilité ethnique intergénérationnelle des enfants de moins de 5 ans chez les populations autochtones, Canada, 1996 et 2001", *Cahiers québécois de démographie*, volume 38, no. 2.

BRITISH COLUMBIA PROVINCIAL HEALTH OFFICER. 2012. *The Health and Well-Being of the Aboriginal Population: Interim Update*, Provincial Health Officer's Special Report.

CARON-MALENFANT, Éric, Anne GOUJON and Vegard SKIRBEKK. (forthcoming). "The religious mobility of immigrants in Canada".

CARON-MALENFANT, Éric. 2015. "Demosim's Population Projection Model: Updates and New Developments", *Proceedings of Statistics Canada Symposium 2014: Beyond traditional survey taking: adapting to a changing world.*

CARON-MALENFANT, Éric and Alain BÉLANGER. 2006. "The Fertility of Visible Minority Women in Canada", *Report on the Demographic Situation in Canada, 2003 and 2004*, Statistics Canada Catalogue no. 91-209.

CARON-MALENFANT, Éric, Patrice DION, André LEBEL and Dominic GRENIER. 2011. "Immigration et structure par âge de la population canadienne : quelles relations?", *Cahiers québécois de démographie*, volume 40, no. 2.

CARON-MALENFANT, Éric, Simon COULOMBE, Eric GUIMOND, Chantal GRONDIN and André LEBEL. 2014. "Ethnic Mobility of Aboriginal Peoples in Canada Between the 2001 and 2006 Censuses", *Population*, volume 69, no. 1.

CYR, André, Julien BÉRARD-CHAGNON, Patrice DION, Dominic GRENIER and Éric CARON-MALENFANT. 2010. *From Traditional Demographic Calculations to Projections by Microsimulations*, workshop presented at the 2010 International Methodology Symposium.

DESPLANQUES, Guy. 1993. "Mesurer les disparités de fécondité à l'aide du seul recensement", *Population*, volume 48, no. 6.

DION, Patrice, Éric CARON-MALENFANT, Chantal GRONDIN and Dominic GRENIER. 2015. "Long-term Contribution of Immigration to Population Renewal in Canada: A Simulation", *Population and Development Review*, volume 41, no. 1.

DION, Patrice, Nora BOHNERT, Simon COULOMBE and Laurent MARTEL. 2014. " Projection of Mortality", in BOHNERT, Nora, Jonathan CHAGNON, Simon COULOMBE, Patrice DION and Laurent MARTEL (editors), *Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038): Technical Report on Methodology and Assumptions*, Statistics Canada Catalogue no. 91-620.

GRABILL, Wilson R. and Lee Jay CHO. 1965. "Methodology for the Measurement of Current Fertility from Population Data on Young Children", *Demography*, volume 2, no. 1.

GUIMOND, Eric. 1999. "Ethnic Mobility and the Demographic Growth of Canada's Aboriginal Populations from 1986 to 1996", *Report on the Demographic Situation in Canada*, *1998 and 1999*, Statistics Canada Catalogue no. 91-209.

GUIMOND, Eric, Norbert ROBITAILLE and Sacha SENÉCAL. 2007. "Définitions floues et explosion démographique chez les populations autochtones du Canada de 1986 à 2001", paper presented at the *Statistiques sociales et diversité ethnique* conference, organized jointly by the Quebec Inter-university Centre for Social Statistics (QICSS) and the Institut national d'études démographiques (Ined).

HOULE, René and Jean-Pierre CORBEIL. 2013. *Methodological Document on the 2011 Census Language Data*, Statistics Canada Catalogue no. 98-314-X2011051.

LEPAGE, Jean-François. 2011. "L'oubli des langues maternelles: les données du recensement sous-estiment-elles les transferts linguistiques?", *Cahiers québécois de démographie*, volume 40, no. 2.

LI, Nan and Ronald LEE. 2005. "Coherent Mortality Forecast for a Group of Populations: An Extension of the Lee- Carter Method", *Demography*, volume 42, no. 3.

MARTEL, Laurent, Éric CARON-MALENFANT, Jean-Dominique MORENCY, André LEBEL, Alain BÉLANGER and Nicolas BASTIEN. 2011. "Projected Trends to 2031 for the Canadian Labour Force", *Canadian Economic Observer*, Statistics Canada Catalogue no. 11-010, August 2011.

MORENCY, Jean-Dominique. 2015. "Projections of Aboriginal Families and Households in Canada", *Proceedings of Statistics Canada Symposium 2014: Beyond traditional survey taking: adapting to a changing world.*

MORENCY, Jean-Dominique and Éric CARON-MALENFANT. 2014. "Variations de la fécondité selon diverses caractéristiques au recensement", presented at the seminar of the Association des démographes du Québec, Congrès de l'ACFAS 2014 (Montréal).

RAM, Bali. 2004. "New Estimates of Aboriginal Fertility 1966-1971 to 1996-2001", *Canadian Studies in Population*, volume 31, no. 4.

SPIELAUER, Martin. 2010. "Persistence and Change of the Relative Difference in Educational Attainment by Ethnocultural Group and Gender in Canada", *Vienna Yearbook of Population Research*, volume 8.

SPIELAUER, Martin. 2014. "The Relation Between Education and Labour Force Participation of Aboriginal Peoples: A Simulation Analysis Using the Demosim Population Projection Model", *Canadian Studies in Population*, volume 41, no. 1-2.

STATISTICS CANADA. 2005. *Population Projections of Visible Minority Groups, Canada, Provinces and Regions 2001 to 2017,* Statistics Canada Catalogue no. 91-541.

STATISTICS CANADA. 2010. *Projections of the Diversity of the Canadian Population, 2006 to 2031*, Statistics Canada Catalogue no. 91-551.

STATISTICS CANADA. 2011. *Population Projections by Aboriginal Identity in Canada, 2006 to 2031*, Statistics Canada Catalogue no. 91-552.

STATISTICS CANADA. 2012. *Census Dictionary: Census year, 2011*, Statistics Canada Catalogue no. 98-301.

STATISTICS CANADA. 2013. *National Household Survey Dictionary, 2011*, Statistics Canada Catalogue no. 99-000.

STATISTICS CANADA. 2014. *Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038)*, Statistics Canada Catalogue no. 91-520.

STATISTICS CANADA. 2015. *Census Technical Report: Coverage. 2011 Census*, Statistics Canada Catalogue no. 98-303.

STATISTICS CANADA. 2015-2. *Projections of the Aboriginal Population and Households in Canada, 2011 to 2036*, Statistics Canada Catalogue no 91-552.

STATISTICS CANADA. 2015-3. *Demosim: An Overview of Methods and Data Sources: Demosim 2015*, Statistics Canada Catalogue no. 91-621

STATISTICS CANADA. 2016. *Population and Family Estimation Methods at Statistics Canada,* Statistics Canada catalogue no. 91-528.

STATISTICS CANADA. 2017-1. *Immigration and Diversity: Population Projections for Canada and Its Regions, 2011 to 2036,* Statistics Canada catalogue no. 91-551.

STATISTICS CANADA. 2017-2. *Language Projections for Canada, 2011 to 2036,* Statistics Canada catalogue no. 89-657.

TJEPKEMA, Michael and Russell WILKINS. 2011. “Remaining Life Expectancy at Age 25 and Probability of Survival to Age 75, by Socio-Economic Status and Aboriginal Ancestry”, *Health Reports*, volume 22, no. 4.

UNITED NATIONS. 1973. *Manual VII. Methods of Projecting Households and Families*, Demographic Studies no. 54 ST/OA/SERA, New York.

VAN IMHOFF, Evert and Wendy POST. 1998. “Microsimulation methods for population projection”, *Population, an English selection*, 10th year, no. 1.

WILKINS, Russell, Michael TJEPKEMA, Cameron MUSTARD and Robert CHOINIÈRE. 2008. “The Canadian Census Mortality Follow-Up Study, 1991 Through 2001”, *Health Reports*, volume 19, no. 3.

WILLEKENS, Frans. 2011. “La microsimulation dans les projections de population”, *Cahiers québécois de démographie*, volume 40, no. 2.

Glossary[59]

Aboriginal ancestry

People who reported an ancestry associated with the Aboriginal peoples of Canada in response to the ethnic origin question in the National Household Survey (NHS). Ancestry refers to the ethnic or cultural origins of the respondent's ancestors, an ancestor being usually more distant than a grandparent. A person can have more than one ethnic or cultural origin. This does not mean that the person identified with his or her ancestors' Aboriginal group or groups.

Aboriginal group

People who reported being an Aboriginal person—First Nations (North American Indian), Métis or Inuk (Inuit)—in response to question 18 of the 2011 NHS.

Aboriginal household

Private household composed of at least one person of Aboriginal identity.

Aboriginal identity

People who reported being an Aboriginal person—First Nations (North American Indian), Métis or Inuk (Inuit)—and/or who reported being a Registered or Treaty Indian, as defined by the *Indian Act* of Canada, and/or who reported being a member of a First Nation/Indian band in the 2011 NHS.

Aboriginal people

See "Aboriginal identity."

Base population

Population used as the starting point for population projections.

Canadian citizenship

A person's legal status as a Canadian citizen, whether by birth or by naturalization.

Census metropolitan area

Area consisting of one or more adjacent municipalities centered on a population core. It has a population of at least 100,000, of which 50,000 or more live in the core.

Cohort-component method

Method used for population estimates or projections that is based on the components of demographic change and a base population as input. The phrase "cohort-component method" is usually restricted to methods projecting the future evolution of cohorts by age and sex, as opposed to other methods, such as microsimulation, that also use components of population growth but that project the demographic destiny of individuals.

Collective dwelling

Dwelling used for commercial, institutional or communal purposes, such as a hotel, a hospital or a work camp.

Components of population growth

Any class of event that generates population changes. For example, births, deaths and migration are components that modify either the size of the total population or its composition by age and sex.

59 Since a number of concepts used in the Demosim projections are based directly on the Census and the 2011 NHS, their definitions are the same as (or are adapted from) the definitions found in the 2011 NHS Dictionary (Statistics Canada 2013) and the 2011 Census Dictionary (Statistics Canada 2012). Readers interested in learning more are invited to refer to these two publications.

Ethnic mobility

Refers to "the phenomenon of individuals and families changing the ethnic affiliation that they report" (Guimond et al. 2007). Ethnic mobility has two components: intragenerational (over one individual's lifetime) and intergenerational (from parents to their children) (Boucher et al. 2009).

Fertility

A demographic phenomenon related to live births that can be considered from the point of view of women, the couple and, very occasionally, men.

Generation status based on immigration status

The respondent's generation rank since the settlement of his/her family (meaning direct ascendants) in Canada. In the context of Demosim, immigrants are the first generation; the second generation refers to non-immigrants born in Canada to at least one foreign-born parent; the generations that follow (third or more) comprise non-immigrants born in Canada to two Canadian-born parents. A more detailed version of this variable split the first and second generations into two distinct groups: generations 1 and 1.5; and generations 2 and 2.5. According to this version of the variable, generation 1 refers to immigrants admitted at age 15 or more, while generation 1.5 refers to immigrants admitted at age 14 or less. Generation 2 refers to non-immigrants born in Canada to two foreign-born parents, while generation 2.5 refers to non-immigrants born in Canada to one foreign-born parent and to one parent born in Canada. This definition of generation status differs slightly from the one used in the census, which is based only on the place of birth (without regard to immigrant status).

Headship rate (or primary household maintainer rate)

Proportion of primary household maintainers (or household heads) in a given population.

Highest level of education

A person's most advanced certificate, diploma or degree.

Household head

See "Household maintainer."

Household maintainer

The person in the household who pays the dwelling's rent or mortgage, or taxes, or electricity bill, etc. In the NHS, there may be up to five household maintainers in the same household. For the purposes of Demosim, a primary household maintainer or household head was selected randomly from all of the maintainers present in a household.

Immigrant

Person who has been granted the right to live in Canada permanently by immigration authorities.

Immigrant category of admission

An administrative category under which a person is admitted to Canada as a permanent resident under the *Immigration and Refugee Protection Act.* At the aggregate level, classes are composed of economic immigrants, immigrants admitted as members of a family, immigrants admitted as protected people (refugees) and other immigrants.

Immigration

The sum of all immigrants from other countries landing in Canada, involving a change in usual place of residence.

Indian reserve

In the context of the Census program (which includes the NHS), "on reserve" includes six types of census subdivisions legally affiliated with First Nations or Indian bands: Indian reserves, Indian settlements (except for the five Yukon settlements of Champagne Landing 10, Klukshu, Two and One-Half Mile Village, Two Mile Village and Kloo Lake), Indian government districts, *terres réservées aux Cris*, *terres réservées aux Naskapis* and Nisga'a land, as well as the northern village of Sandy Bay in Saskatchewan.

Internal migration

The sum of all population movements between the geographical units within Canada's geographical boundaries, involving a change in usual place of residence.

International migration

The sum of all movements between Canada and other countries, involving a change in the usual place of residence.

Interregional migration

The sum of all movements among the 50 main geographic entities defined in Demosim, namely the 35 regions derived from the census metropolitan areas and the 15 regions derived from elsewhere in the provinces and territories.

Intraregional migration

The sum of all movements within one of the 50 main geographic entities defined in Demosim, namely one of the 35 regions derived from the census metropolitan areas or one of the 15 regions derived from elsewhere in the provinces and territories.

Inuit Nunangat

Inuit Nunangat is the homeland of Inuit of Canada. It includes the communities located in the four Inuit regions: Nunatsiavut (Northern coastal Labrador), Nunavik (Northern Quebec), the territory of Nunavut and the Inuvialuit region of the Northwest Territories.

Knowledge of official languages

Sufficient knowledge of English or French (or both) to conduct a conversation in any of those languages.

Labour force

The population that is employed or unemployed.

Language spoken most often at home

The language spoken most often by the respondent at home.

Life expectancy

A statistical measure derived from the life table indicating the average number of years of life remaining for a population at a specific age "x", calculated on the basis of the mortality rates observed in a given year.

Linguistic mobility

A generic term that, in the context of Demosim, refers to both the transmission of languages from parents to children (intergenerational linguistic mobility) and the changes that can occur over an individual's lifetime with respect to the languages spoken at home or the languages known (intragenerational linguistic mobility).

Member of a First Nation/Indian band

People who reported that they were members of a First Nation/Indian band in the NHS. In the NHS, an Indian band is defined as a group of Indians for whose collective use and benefit lands have been set apart or money is being held by the Crown, or who have been declared to be a band for the purpose of the *Indian Act*. Many Indian bands have elected to call themselves a First Nation and have changed their band name to reflect this. With the 1985 amendment to the *Indian Act* of Canada (Bill C-31), many Indian bands exercised the right to establish their own membership code, under which it was not always necessary for a band member to be a Registered Indian according to the *Indian Act*.

Microsimulation

Unlike population estimates and projections produced using the cohort-component method, microsimulation simulates the demographic destiny of each individual. The method is based on multiple random drawing at the individual level rather than on aggregated data applied at the population group level.

Mother tongue

The first language learned at home in childhood and still understood.

Net undercoverage

Difference between the number of people who were targeted by the census but who were not enumerated (undercoverage), and the number of people who were enumerated when they should not have been, or who were enumerated more than once (overcoverage).

Non-permanent resident

People who have a work or study permit or who are refugee claimants, and the family members living in Canada with them.

Own-children method

A method that indirectly estimates fertility by using a census or an equivalent data source (Grabill and Cho 1965; Desplanques 1993). This method links the youngest children—here children aged less than one year—to the woman aged 15 to 49 years living in the same family who is most likely to be the mother. The women identified in this way are considered to have given birth recently to a child (here during the last year). Using this link, as well as some adjustments, it is possible to compute fertility rates according to various characteristics.

Population projection

The future population size resulting from a set of assumptions regarding the demographic and non-demographic components of growth.

Private dwelling

A set of living quarters designed for or converted for human habitation in which a person or group of people reside or could reside. In addition, a private dwelling must have a source of heat or power and must be an enclosed space that provides shelter from the elements, as evidenced by complete and enclosed walls and roof and by doors and windows that provide protection from wind, rain and snow.

Private household

A person or group of people (other than foreign residents) who occupy a private dwelling and who do not have a usual place of residence elsewhere in Canada. The number of private households is equal to the number of occupied dwellings.

Projection scenario

A set of assumptions relating to the components, demographic or otherwise, used to make a population projection.

Reclassification of registration categories from 6(2) to 6(1)

Refers to Registered Indians with a registration category of 6(2) who are reclassified to a registration category of 6(1) during their lifetime. In this report, reclassification from registration category 6(2) to category 6(1) may result from the application of Bill C-3 or from various other reasons.

Registered or Treaty Indian (Status Indian)

People who reported that they were Status Indians (Registered or Treaty Indians) in the 2011 NHS. Registered Indians are people who are registered under the *Indian Act* of Canada. Treaty Indians are people who belong to a First Nation or Indian band that signed a treaty with the Crown. Registered or Treaty Indians are sometimes also called Status Indians.

Registration categories 6(1) and 6(2) on the Indian Register

The registration category 6(1) or 6(2) is assigned to Registered Indians when they register on the Indian Register. Registration categories 6(1) and 6(2) correspond to the rules set out in subsections 6(1) and 6(2) of article 6 in the 1985 *Indian Act*, which establish the criteria that people must meet to register on the Indian Register. Within the meaning of the act, people registered under subsection 6(1) differ from those registered under subsection 6(2) with regard to their ability to transmit their status to their children. A parent registered under category 6(1) can always pass on his/her registered Indian status to the child, but a parent registered under category 6(2) can pass on the status only if the other parent is also registered.

Religion

Self-reported affiliation with a religious denomination, group, body, sect, cult or other religiously defined community or system of belief. This concept differs from the concepts of religious practice (e.g., prayer or participation in religious ceremonies) and religiosity (devotion, importance of religion in daily life, etc.).

Religious mobility

A change in religious affiliation, whether between parents and their children (intergenerational religious mobility) or over an individual's lifetime (intragenerational religious mobility).

Total emigration

The number of emigrants minus the number of returning emigrants plus net temporary emigration.

Total fertility rate

The sum of age-specific fertility rates during a given year. It indicates the average number of children that a generation of women would have if, over the course of their reproductive life, they experienced the age-specific fertility rates observed during the year considered.

Visible minority groups

The *Employment Equity Act* defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."