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Population Projections for Census Divisions and Subdivisions, 2024 to 2049: Technical Report

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Projections of census subdivisions with a population of 800 or more are available for the period 2024–2049 in Table 17-10-0162-01. These projections are based on the results of the Projections for Canada (2024-2074), Provinces and Territories (2024-2049), which were released on January 21, 2025.

Introduction

The Canadian Infrastructure Council has commissioned Statistics Canada's Centre for Demography to develop a set of population projections for communities, as defined by the statistical concepts of census divisions (CDs) and census subdivisions (CSDs). These projections provide impartial, evidence-based insights to all levels of government, infrastructure owners, operators and investors to improve infrastructure planning and decision-making across Canada. The data is also expected to inform land use and urban planning, housing needs, transportation and communications.

A new *cohort change* model was developed specifically for the projection of sparsely populated areas such as census divisions and subdivisions. Although this type of model has a long tradition among demographers, this new version incorporates several innovations. Its most notable features include its simplicity, the transparency of its assumptions, the ability to calibrate results against existing projections and the capacity to update results frequently in response to rapid demographic change.

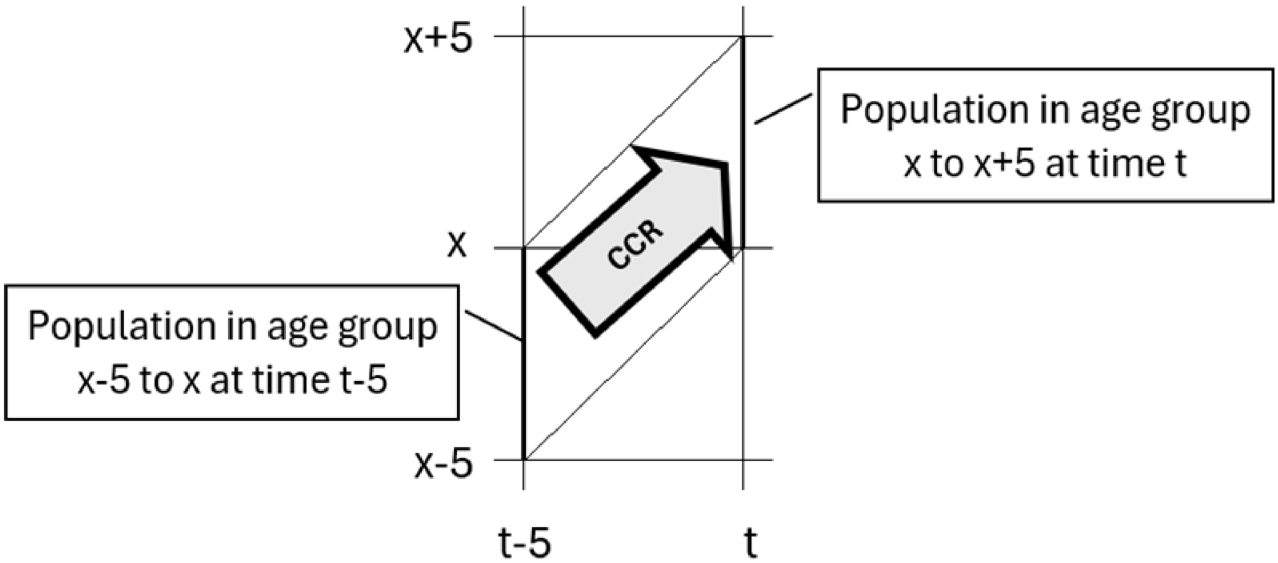
Statistics Canada regularly publishes several series of population projections. Since the early 1970s, Statistics Canada has published projections for Canada, the provinces and territories using the so-called *cohort-component* model (Statistics Canada, 2025a; Dion & Galbraith, 2015). Other sets of projections are also produced using the Demosim microsimulation projection model, well adapted for the projections of a wide range of demographic characteristics (Morency, Vézina, & Dion, 2025). However, while the results from these two projection models provide essential data for program planning and decision-making, the methods are often unusable at very detailed geographical levels, because data on the components of population growth are not available, or because of the wide temporal fluctuations these data may contain (a consequence of small population sizes). In fact, the less populated a region is, the more difficult it is generally to extract the reliable trends from observed data needed to establish plausible projection hypotheses, and the more rapid changes in trends can have an impact on its demographic evolution. These two factors partly explain why the gap between projections and reality tends to increase inversely to population sizes (Tayman & Swanson, 1996; Wilson & Rowe, 2011). This is why simpler, less data-intensive methods are often required for projections of sparsely populated regions.

The following sections describe the details of the cohort change method and its application to the development of a set of demographic projections for communities in Canada.

The Cohort Change Method

Hamilton and Perry (1962) propose a method of population projection that requires only a measurement of the population by age group at two distinct points in time. By comparing the two measurements, we can calculate cohort change ratios (CCR), which are then assumed to be constant in the future. For example, the size of the population aged 30 to 34 at time *t+5* can be projected by applying to the population aged 25 to 29 at time *t* the CCR measured between the population aged 25 to 29 at *t-5* and that aged 30 to 34 at time *t*. Figure 1 illustrates the CCR calculation using only population sizes by five-year age group at two periods five years apart.

Figure 1
Calculating CCR for an age group



Source: Statistics Canada, Centre for Demography.

Within a given region, the cohort aged 30 to 34 at time *t* is largely made up of people who were 25 to 29 at time *t-5*, but it is also made up of immigrants and people from elsewhere in Canada who have settled there between times *t-5* and *t*. Similarly, people aged 25 to 29 at time *t-5* who died or left the region in the following five years are not included in the population aged 30 to 34 at time *t*. The CCR encapsulates all the demographic events that can influence population size, but without specifically describing its contours. This has several advantages. Firstly, it is not necessary to obtain data for all these components, data which are sometimes unavailable or of poor quality for sparsely populated regions. Secondly, developing projection assumptions for each of the components of population growth can be a time-consuming task, often proving difficult when low counts tend to cause a great deal of volatility in time series.

The same procedure cannot be used to project the population born during a projection interval. Taking the parameters of the previous example, according to the original methodology proposed by Hamilton and Perry, the population aged 0 to 4 at time *t+5* is projected by applying to the population aged 0 to 4 at time *t* a factor of increase based on the number of past births. Other methods have subsequently been proposed, mainly based on a child/woman or child/adult ratio calculated within the population at time *t*.

The cohort change method also has certain disadvantages. Firstly, it only serves to project the population, and not the demographic events (births, deaths, immigration, etc.) that may be of interest to some users. Secondly, it assumes that past cohort growth rates will also apply in the future, an assumption whose plausibility diminishes as the projection horizon stretches. For this reason, its use is often recommended for relatively short temporal horizons. In addition, the method can produce outliers in regions where population growth has been particularly low or particularly high (Swanson, Schlottmann, & Schmidt, 2010; Baker, Swanson, & Tayman, 2021). Finally, as with any projection exercise, regardless of the method used, the presence of unusual upheavals that may have influenced the course of demographic events, such as a pandemic or natural disaster, can increase the uncertainty of projections (Hamilton & Perry, 1962).

Method Specifications

Various modifications of the original method have been proposed over time, notably with the aim of producing plausible projections over a longer time horizon exceeding ten years and minimizing the limitations described above. A convincing example is the approach developed by Hauer (2019) for projecting counties in the United

States up to 2100, which we adopt in part, and to which we otherwise make certain modifications.[1] Compared with the Hamilton-Perry model, Hauer's model includes the following modifications:

- Projection is either multiplicative, using a cohort change ratio (as in the original Hamilton-Perry method), or additive, using a *cohort change difference* (*CCD*), depending on whether the total population projected with the CCD is growing or shrinking over the course of the projection. This change minimizes explosions or implosions during the projection, since a positive rate of increase applied repeatedly can give rise to exponential growth, and conversely, a difference applied continuously can give rise to negative population numbers.
- Cohorts are projected based on a weighted average of values observed over a long historical period, rather than on the basis of a measurement taken over a single period. This approach reduces the risk of obtaining outliers that cannot be applied over the long term. To this end, the CCRs, CCDs and child/woman ratios used in the projection are the result of extrapolations obtained using a simple exponential smoothing model[2] fitted to the observed data. The exponential smoothing model gives greater weight to recent trends by giving exponentially increasing weight over time to the values in the time series.
- Projection results are calibrated so that the projected total for all geographical units corresponds to the population projected independently for the United States using Shared Socioeconomic Pathways (climatedata.ca, 2024). On the one hand, this approach prevents growth from getting out of hand (Hauer, 2019), but it also improves the predictive strength of the models (Wilson, 2016; Wilson & Grossman, 2022).

However, we are making a number of changes to our application of Hauer's method:

- The choice of projection method (CCR or CCD) is made independently by age group, gender and years (and not uniformly for the total population over the entire projection period). CCR is selected if it is less than or equal to 1. CCD is selected otherwise. This approach entirely avoids explosive growth and negative population projections in all age groups. It also allows for a more plausible evolution of the age structure over time.
- Regions with a population of less than 800 at the start (2001 for CSD) or end (2024) of the time series were excluded. The validation process has shown that below this threshold, the plausibility of the results decreases significantly.
- Projection results are calibrated using a two-stage calibration process. Projections by CDs are initially produced using the cohort change method, after which they are calibrated to age, gender and province/territory projections derived from multiple scenarios based on the most recent population projections for Canada, its provinces and its territories.[3] CSD projections are then produced using the same method and calibrated to the projections by CDs. Regions whose population size is below the minimum threshold are combined into a single region within their respective CD.
- Like Hauer's model, projections are initially produced by 5-year age groups and 5-year time intervals but are subsequently transformed into projections by year of age and annual intervals. The transformation by year of age is carried out using the Beers method (Beers, 1945), which ensures that the sum of the projections by year of age equals the initial projections by 5-year age groups. The transformation into annual intervals is then performed using linear interpolation.

Data Description

The use of an exponential smoothing model to estimate CCRs and CCDs is an improvement on the original Hamilton-Perry method. However, the method requires time series of CD and CSD population counts by gender and five-year age groups that are reliable and consistent over time. As CSD boundaries may change with each new census, it is necessary to reconstruct the boundaries of geographical entities according to a single classification. Here, CSD data have been reconstructed according to the 2021 Standard Geographical

1. We also build on the R code developed by Hauer (2018).
2. This model corresponds to an autoregressive moving average model ARIMA (0, 1, 1).
3. Projections by province and territory are first produced by sex. They are then transformed into gender projections using ratios calculated from 2021 Census data. See Statistics Canada (2025b) for more details.

Classification (SGC) (Statistics Canada, 2022) in order to obtain historical series from 2001 to 2024.[4] This process is sometimes imperfect, and historical breaks may remain in some cases. Moreover, it represents a relatively short reference period for the application of time-series models, which can result in less trend smoothing and more emphasis on recent trends.

The CSDs correspond to municipalities as defined by the laws in force in Canada's provinces and territories, and to areas considered equivalent for statistical purposes, such as Indian reserves, Indian settlements and unorganized territories. Postcensal population estimates for CSDs are derived from census counts, adjusted for net undercoverage, and from estimates of population growth that have occurred, as calculated using tax data (Statistics Canada, 2023a). Intercensal estimates are based on postcensal estimates and adjusted census counts.

Validation

The Hamilton-Perry method generally gives results that are highly plausible within a short time horizon, and comparable to those obtained with the component method (Smith & Tayman, 2003). Applying the method to the projection of census tracts in the USA, Baker, Swanson, & Tayman (2021) note that the results are surprisingly good, and that most of the discrepancies between observed and projected values are due to a small number of outlier regions. They note that the many refinements made to the original method enable plausible projections to be made over a longer horizon, although the uncertainty of the projections increases greatly with time. Wilson & Grossman (2022) and Wilson et al. (2022) have shown that the combined use of CCR and CCD and calibration to independent projection results generally improves projection performance.

To further validate the method, we divided the historical data at provincial and territorial level into two distinct parts, one used to specify the model parameters and the other to validate the projection results. The choice of projecting provinces and territories was made to obtain fairly long historical series, and to be able to compare with previous projections made using the cohort-component model. The results of the cohort change model developed by Statistics Canada proved to be the best in comparison with other models such as the Hauer model and the original Hamilton-Perry model, demonstrating the added value of the modifications made. In particular, allowing the use of CCRs or CCDs independently by age group, gender and year results in more realistic age structures, which in turn improves the performance of the calibration process.

At the provincial and territorial level, the pre-calibration CSD projections yield results that may differ (sometimes significantly) from the short-term M1 medium-growth scenario of the projections produced using the cohort-component model (Statistics Canada, 2025a). However, these differences are to be expected, since the two models reflect projection assumptions that can differ greatly. While the component models incorporate assumptions specifically formulated for each component of population growth, the cohort change model underpins the simpler assumption of historical continuity of observed population growth.

In November 2024, the Government of Canada revised downward the short-term immigration targets of its immigration plan. This downward revision of immigration targets represents a break with recent years, when record numbers of immigrants and non-permanent residents entered the country. The results of the cohort-component model projections reflect this downward revision of short-term immigration targets, while the results of the CSD projections reflect some continuity of recent immigration trends. As a desired consequence of the calibration process, the expected decline in immigration levels to the country, projected at the provincial and territorial level in the cohort-component projection model, is incorporated into the projections of the CSDs made with the cohort change model. Table 1 shows the differences between the aggregate CSD projections at the provincial/territorial level before calibration and the M1 scenario projections obtained using the cohort-component model published on January 21, 2025. Once the calibration has been carried out, the deviations are zero.

4. For the purposes of the projection, the years heavily affected by the immediate effects of the COVID-19 pandemic (2020, 2021 and 2022) have been imputed using linear interpolation. This minimizes the immediate effects of the pandemic over the entire projection period.

Table 1
Percentage deviations from projection scenario M1 results

Province and territory	2029	2034	2039	2044	2049
			percent		
Newfoundland and Labrador	4.1	7.9	11.8	15.7	19.6
Prince Edward Island	6.5	12.7	18.9	24.3	28.9
Nova Scotia	5.3	10.3	15.7	20.5	24.8
New Brunswick	5.5	10.9	16.6	21.7	26.4
Quebec	6.4	10.7	14.7	18.2	21.2
Ontario	8.8	14.3	19.0	23.0	26.1
Manitoba	7.5	12.7	17.1	20.9	24.1
Saskatchewan	4.5	7.1	8.7	9.6	10.3
Alberta	5.6	9.4	12.6	14.8	16.5
British Columbia	8.9	14.3	18.8	22.5	25.4
Yukon	7.7	14.9	21.9	28.2	34.0
Northwest Territories	1.9	2.0	1.3	0.1	-1.0
Nunavut	2.3	3.6	4.4	4.8	5.4

Note: These deviations are measured before the results are calibrated to those of scenario M1. Once this calibration has been carried out, the deviations are zero.
Source: Statistics Canada, Centre for Demography.

A total of 2,868 CSDs (representing 2.2% of the total population in 2024) were excluded due to small population sizes (Table 2). No CSDs were excluded due to outliers. It is important to note, however, that despite an intensive validation process, it was not possible to analyze the results for each of the projected regions individually. A systematic and optimal evaluation of the results would require the involvement of local experts (Swanson, Schlottmann, & Schmidt, 2010), which is obviously not possible here.

Table 2
Number of projected census subdivisions by province and territory

Province and territory	Initial	Excluded (less than 800 people)	Total projected
		number	
Newfoundland and Labrador	372	281	91
Prince Edward Island	98	63	35
Nova Scotia	95	28	67
New Brunswick	266	85	181
Quebec	1,282	553	729
Ontario	577	205	372
Manitoba	239	87	152
Saskatchewan	951	799	152
Alberta	423	212	211
British Columbia	751	472	279
Yukon	35	30	5
Northwest Territories	41	34	7
Nunavut	31	19	12
Total	5,161	2,868	2,293

Source: Statistics Canada, Centre for Demography.

Data Limitations

All projection data is subject to considerable uncertainty, and their accuracy depends on a number of factors. Certain events—economic crises, wars, pandemics or natural disasters, for example—are difficult (if not impossible) to predict and may influence the growth and composition of the Canadian population. Population projections should never be interpreted as predictions of what the future holds. Rather, they should be understood as an exercise in examining what the Canadian population could become in the coming years, based on certain plausible scenarios.

These considerations are even more important in the context of the present projections, as uncertainty tends to grow inversely proportional to population size. While the various components of population growth are often characterized by a degree of inertia within large population groups, this is often not the case in sparsely populated areas such as CSDs. At this scale, factors such as the availability of land for new housing development, modifications in land zoning, local development objectives and the ability to adapt to demographic change can induce rapid fluctuations. In fact, the method largely assumes that future growth should be similar to that observed in the past, but this assumption does not hold in all circumstances. Furthermore, the quality of the observed data can also, in some cases, be a major limitation of the projections. This is particularly the case where regions have been split up or merged, and it has been necessary to reconcile the data in order to create a geography that is constant over time. Finally, the length of the available time series is another limiting factor. A longer series could enable a more robust forecasting of CCRs and CCDs.

Conclusion

The cohort change model projections meet important needs for planners at the community level. An important feature of this model is the possibility to produce new projections quickly as new provincial and territorial projections become available or following the annual update of the CSD population estimates. Frequent and timely updates are particularly relevant in a context of rapid demographic change. Another strength of the model is its broad coverage, since the projections cover almost 98% of the Canadian population. Moreover, for CSDs with populations too small to be projected independently, aggregations can be produced upon request to user specifications.

Although the results produced by the cohort change model do not incorporate assumptions specific to each CSD, they are useful benchmarks illustrating demographic trends. Users are free to alter the results as needed based on their own assumptions about factors that may constrain or promote future population growth in their community, particularly regarding land and housing supply.

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