

B.C. Population Estimates and Projections: Methodological Highlights



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Overview

BC Stats has updated its population estimates for 2021 and its population projections for 2022 to 2045. The methodology used for the population projections and estimates was updated in this release, and this note describes the main improvements in these methodologies.

The new methodology for population estimates introduces the following improvements: i) eliminates gaps in population pyramids generated by methodological distortions between the client roster of the Medical Service Plan (MSP) of B.C. and the Census data, ii) adjusts population distributions of smaller geographies to match population estimates by Statistics Canada across all geographical levels, and iii) adjusts population estimates to guarantee population counts that are integers and consistent across all geographies and hierarchical relationships.

This release also introduces a new methodology for the Population Extrapolation for Organizational Planning with Less Error (P.E.O.P.L.E.) model. The expanded methodology has the following features: i) introduces a bottom-up approach to account for new data availability and understanding of local population trends, ii) enhances the migration component to account for economic migration, and iii) incorporates information on residential building permits, community plans and other indicators of available housing.

These population estimates and projections are produced for municipalities (Census Sub-divisions, CSDs), but in instances where the boundaries of other geographies like School Districts (SDs), Trustee Electoral Areas (TEAs), service areas for the Ministry of Children and Family Development (CFD service area), and Community Health Service Areas (CHSAs) cross municipal boundaries, additional geographies were used.

Methodology Update for Population Estimates¹

BC Stats uses the roster of MSP clients and data from the 2016 Census of Population to produce population estimates of small geographies like CHSAs and SDs. The population estimates of these geographies are aggregated to form population estimates of geographies at a larger hierarchy like Local Health Areas (LHAs) and Health Service Delivery Areas (HSDAs).

The new methodology of population estimates compensates for disproportionately large/small population counts by adjusting the population distribution using neighbouring cohorts. Therefore, this methodology creates population counts by age and sex with fewer outliers as shown in Figures 1 and 2 below.

Figure 1 Population Estimate using Previous Methodology for CHSA 1150 North Thompson

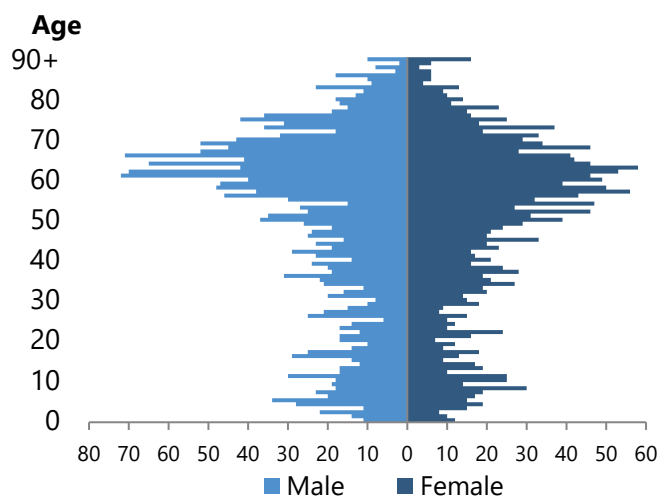
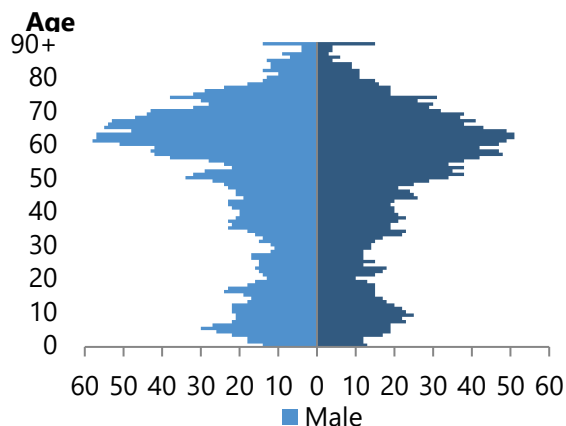


Figure 2 Population Estimate using the Updated Methodology for CHSA 1150 North Thompson



Previously, the sub-provincial population estimates of BC Stats and Statistics Canada were produced independently, which led to discrepancies between population counts for HSDAs. The updated methodology harmonizes the population estimates produced by BC Stats for these geographies with the estimates published by Statistics Canada.

In particular, this update introduces Iterative Proportional Fitting (IPF) to adjust the age-sex population counts of CHSAs to match the population estimates produced by Statistics Canada for their corresponding HSDAs when aggregated. IPF is a mathematical procedure commonly used in population estimates of small populations, which adjusts the population distributions of small localities to match the total population counts of an independent estimation.² This improvement to the methodology guarantees consistency between the

¹ The new methodology applies only to population estimates of 2017 and onwards since the data from 2016 is from the 2016 Census.

² For a more detailed discussion on IPF see Judson and Popoff (2004).

population estimates produced by BC Stats and Statistics Canada across all geographies.

Finally, the methodological update introduces *hierarchical raking* in the sub-provincial population estimates to guarantee integer numbers across all geographies. *Raking* is an extension of IPF, which uses a probabilistic assignment of fractional population counts to ensure integers in population estimates while still matching the reference population totals.³ The raking procedure is not new to the methodology; however, performing it hierarchically is. First, the LHAs are raked to the HSDA age/sex totals, and second, the CHSAs are raked to the LHA age/sex totals. This ensures that the fractional population counts remain more local to the small geographies rather than distributed across the province.

Once the CHSA population estimates are completed, they are converted to other geographies.

A New Methodology for Population Projections⁴

The P.E.O.P.L.E. model, initially developed in 1999,⁵ was modernized in 2022 with an expanded methodology to account for new sources of information and recent population trends. In 2022,

³ BC Stats uses the population estimates by HSDA published by Statistics Canada as a reference for its population totals. A detailed description of raking in this context can be found in San Diego Association of Governments (1998).

⁴ The accompanying technical document of these highlights has a more detailed discussion of the features of the update to the P.E.O.P.L.E. model.

BC Stats commissioned Applications Management Consulting Inc. (AMC) to support the enhancement of the P.E.O.P.L.E. model. AMC has done population estimates for the Province of Alberta.

The new P.E.O.P.L.E. model is still based on a Component/Cohort-Survival approach where population dynamics evolve according to three sources of population change: i) fertility, ii) mortality, and iii) migration. However, the updated version of this model includes the following improvements: i) introduces a bottom-up approach to account for new data availability and understanding of local population trends, ii) considers regional employment, iii) incorporates information on residential building permits, community plans and other indicators of available housing, and iv) allows to decompose economic migration from other sources of migration.

Bottom-up approach

The population projections of each region are built considering trends in fertility and mortality for municipalities (CSDs), but in instances where the boundaries of other geographies like SDs and CHSAs cross municipal boundaries, additional geographies were used.⁶ In particular, the population projections use the methodology

⁵ The previous methodology of the P.E.O.P.L.E. model can be consulted in BC Stats (1999).

⁶ In these cases, smaller geographies of the Census were employed. In particular, the analysis included population changes in Dissemination Areas or Dissemination Blocks of different years of the Population Census.

proposed by Swanson et al. (2010), an updated version of the Hamilton-Perry model, to capture the population dynamics of each geography.⁷ This allows for population projections that reflect local trends, while the total population of B.C. is simply the aggregation of the population of all regions.⁸

The fertility and mortality trends were analyzed for each geography using data from 2001 to 2021 in the Census and Vital Statistics of B.C. These trends were used to generate population projections of each geography using population estimates for 2021 as the base population.⁹

The update also considered adjustments on fertility and mortality due to the COVID pandemic and the opioid crisis. However, due to lags in the fertility and mortality data during the pandemic, this evaluation is still underway. The population projections in this release use pre-pandemic fertility and mortality trends.

An enhanced migration component

The migration component of the model was augmented under the assumption that a large part of interprovincial and international migration is

connected to employment opportunities. Therefore, the new model includes an analysis that links each region's economic profile with B.C.'s employment outlook. This allows sub-provincial population projections congruent with the economic prospects of the province.

The employment of all industries at the 2-digit level of the North American Industry Classification System (NAICS) was analyzed for all Economic Development Regions in B.C. using labour data from the 2016 Census.¹⁰ This data was used in combination with the B.C. Labour Market Outlook 2021 Edition to produce an estimate of economically motivated migration for each region.

Finally, migration trends of each region were analyzed using net immigration data for each CSD from 2001 to 2021 using the Components of Population Change published by Statistics Canada.¹¹ This allows separating economic migration from other types of migration.¹²

Inclusion of housing indicators

In addition to fertility, mortality, and migration trends, the model also considers different housing

⁷ Swanson, D. A., Schlottmann, A., & Schmidt, B. (2010). Forecasting the Population of Census Tracts by Age and Sex: An Example of the Hamilton-Perry Method in Action. *Population Research and Policy Review*, 29(1), 47–63, DOI: 10.2307/2573607

⁸ The provincial-level total population projection is made independently from the sub-provincial level projections. We apply IPF to match both projections.

⁹ The model uses population estimates at the CHSA level for 2021 as a base and produces population projections for these geographies..

¹⁰ Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016320. <https://www150.statcan.gc.ca/n1/en/catalogue/98-400-X2016320>

¹¹ Statistics Canada. Table 17-10-0140-01 Components of population change by census division, 2016 boundaries. DOI: [10.25318/1710014001-eng](https://doi.org/10.25318/1710014001-eng)

¹² The economically motivated migration is computed as the difference between the working-age population (15 to 64 years old) in every region and the population needed to match the employment outlook.

indicators in its population projections. Regions with stronger housing outlooks are expected to have higher population growth. Therefore, the updated model produces population projections that consider future housing conditions.

To determine future housing conditions, the model considers historical trends of building permits for each Census Metropolitan Area published by Statistics Canada,¹³ along with Official Community Plans (OCPs) of the municipalities of the main metropolitan areas in B.C.¹⁴ Geographical data on protected lands and waters in B.C. published by the B.C. government was also incorporated to determine the development potential.

Limitations and next steps

Population projections and estimates come with limitations. In particular, population estimates and projections are based on the 2016 Census but will be re-based to the 2021 Census in the fall of 2023.

Moreover, analysis of fertility and mortality suggests there have not been significant shifts from their long-term trend due to the COVID pandemic and the opioid crisis. However, BC Stats will keep monitoring data on these sources of population change to evaluate if future adjustments are necessary.

In recent years, international migration has been one of the most important sources of population

change in B.C. Therefore, changes in migration policy at the federal level and geopolitical events that might increase immigration levels, like the war in Ukraine, may significantly impact future population growth. These projections assume that current immigration policy will remain constant in the foreseeable future. However, this assumption will be adjusted as future changes to immigration policy are announced or the effects of geopolitical events on immigration become apparent.

Finally, changing climate conditions may play a role in population movements over the timeline of the forecast. The current forecast does not include assumptions that consider climate impacts on a community-by-community basis.

References

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San Diego Association of Governments (1998). *Urban development model, volume 2: Technical description*. San Diego: San Diego Association of Governments.

¹³ Statistics Canada. Table 34-10-0066-01 Building permits, by type of structure and type of work. DOI: [10.25318/3410006601-eng](https://doi.org/10.25318/3410006601-eng)

¹⁴ The new model considers the OCPs for the following metropolitan areas: Greater Vancouver Metropolitan area, Greater Victoria Metropolitan Area, Kelowna, and Abbotsford-Mission.

Note: All labour force statistics are seasonally adjusted, unless otherwise indicated

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