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Economic and
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UMDI 2020 Interim Population Estimates by Age, Sex, and Municipality

Context

With support from the Massachusetts Department of Transportation, the UMass Donahue Institute's Population Estimates Program (UMDI) is producing updated population projections for state transportation planning purposes. The UMDI population projections model requires 2020 launch populations expressed in *five-year age/sex/municipality* cohorts while the U.S. Census Bureau's currently released Census 2020 population data (the PL-94.171 "redistricting" dataset) only includes two age breakouts: *under-18 and 18-plus*. To meet the projection model needs, UMDI has produced a series of municipal population estimates by sex and five-year age groups, called the *UMDI 2020 Interim Population Estimates by Age, Sex, and Municipality* (UMDI Interim Estimates). For these estimates, UMDI takes the Census 2020 PL-94.171 population count for each Massachusetts municipality and distributes it among five-year-age/sex cohorts according to estimated proportions developed by UMDI.

Limitations and Disclaimer

The UMDI Interim Population Estimates by Age, Sex, and Municipality are ***estimates only***, for UMDI program use in the interim period between the Census Bureau's release of *Census 2020 PL-94.171* data and the forthcoming *Census 2020 Demographic and Housing Characteristics File* (DHC). According to the Census Bureau's most recently proposed release plan, the DHC will include populations by detailed age and sex by Minor Civil Division (or "MCD" - the Census geographic equivalent of municipality in Massachusetts).

As estimates, the populations by age/sex/MCD published in the UMDI Interim set are subject to inaccuracies. The *Methodology* section in this document describes the methods and data sources used to develop the UMDI Interim Estimates. While UMDI is able to share these interim estimates with other data users to support their data needs, UMDI will not be held liable for uses and decisions based upon the UMDI Interim Estimates. The population counts by age and sex to be released in the Census Bureau's planned Census 2020 Demographic and Housing Characteristics File may supersede and replace the UMDI Interim Estimates as the recommended dataset once they are published.

Methodology

The UMDI Interim Estimates apply estimated age/sex distributions to the U.S. Census Bureau's Census 2020 PL-94.171 redistricting population counts of under-18 and 18-plus populations in each Massachusetts municipality (MCD).

To estimate the age/sex distributions, UMDI starts with a modified *Hamilton-Perry* or *cohort-change-ratio* (CCR) model using 2000 and 2010 decennial Census data by age, sex, and MCD. The CCR method accounts for the aging of each individual cohort from one census to the next and creates a ratio

between a specific cohort population (by age, sex, and geography) age $_a$ in year $_y$ to its corresponding cohort ten years younger, aged $_{a-10}$, and ten year earlier, in year $_{y-10}$. The single ratio captures the combined effect of death and net migration for each age cohort in a specified geography as it ages forward from one Census to the next.[1]

For each age/sex/MCD cohort, the resulting cohort-specific ratio is then applied to the corresponding base population (the Census 2010 population in our model) in order to estimate the population 10 years later (2020 in this case). As a modification to the standard Hamilton-Perry model, before we integrate the resulting CCRs into our model, we cap them at "1" for cohort groups including fewer than 25 people and "2" for groups under 100 people. Population estimates for years 2011 through 2019 are developed by interpolating populations for each single year in the time series between the Census 2010 populations and the 2020 estimates.[2]

In the UMDI Interim Estimates, the resulting population estimates by age/sex/MCD in 2019 are next controlled to the U.S. Census Bureau's V2019 county-level population estimates by age and sex.[3] This control measure leverages the post-2010 updates that the Census Bureau makes to each county's population based on actual and estimated county-level births, deaths, domestic migration, immigration, and reported changes in the group quarters populations since 2010. The resulting controlled estimates are, in turn, controlled to the Census Bureau's Census 2020 population counts of under-18 and 18-plus by MCD. By this method, the age/sex estimates in the UMDI Interim estimates will sum to the Census 2020 PL-94 totals for each city and town.

While the *level* of combined net migration[4], births, and deaths for each city and town is updated to reflect the Census 2020 count totals – or the change from 2010 to 2020 - in the UMDI Interim Estimates, our method assumed that:

- the *distribution* of combined net migration and deaths by age and sex in each city and town *relative to its county* is the same as was experienced between 2000 and 2010, and that
- the *distribution* of births, deaths, and net migration by five-year age and sex within each county is aligned with Census Bureau estimates by age, sex, and county through 2019.

For additional information on the UMDI Interim Estimates Methodology, contact Susan Strate at sstrate@donahue.umass.edu

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[1] For cohorts aged 0-9, Child-to-Women (CTW) ratios are used instead of Cohort-Change Ratios. children aged 0-4 are calculated as a ratio of the female population aged 20-44 and children aged 5-9 are calculated as a ratio of the population aged 30-49.

[2] For additional details on UMDI's modified cohort-change ratio method, see the Methodology section of: *Small Area Population Estimates for 2011 through 2020*, UMass Donahue Institute. October 2016.

[3] CC-EST2019-AGESEX-[ST-FIPS]: Annual County and Puerto Rico Municipio Resident Population Estimates by Selected Age Groups and Sex: April 1, 2010 to July 1, 2019, Source: U.S. Census Bureau, Population Division. Release Date: June 2020.

[4] "Net migration" in this summary refers to combined Net Domestic Migration and Immigration.