Minnesota State Demographic Center
METHODOLOGY DOCUMENT

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METHODOLOGY FOR MINNESOTA COUNTY POPULATION PROJECTIONS BY AGE AND GENDER, 2015-2050

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This describes the methodology used to produce population projections for the 87 counties of Minnesota by age cohort and by gender for each five-year interval from 2015 to 2050. The method for projecting future population is outlined below. Each step is then discussed in more detail.

STEP 1: Project total population of each of Minnesota's 13 Economic Development Regions (EDR) as a historic share of state total

STEP 2: Project county total population as a historic share of respective EDR total

STEP 3: Apply the cohort-component method of population projections to each county

- **STEP 3A:** Group quarters analysis
- **STEP 3B:** Project births and deaths as rates of natural increase/decrease
- **STEP 3C:** Compute preliminary net-migration

STEP 4: Adjust net-migration figures

STEP 5: Control age/gender county totals to projected county totals as share of EDR

STEP 1: PROJECT EDR TOTAL POPULATION

The first step was to obtain a target annual population for each of MN's Economic Development Regions (EDR) based on each EDR's share of the state population. Regression techniques were used to obtain the yearly, predicted share of the population starting in 2015. Decennial Census counts,[1] Intercensal Estimates,[2] and the Minnesota State Demographic Center projections[3] were used as data inputs. The formula:

Log (EDR Population / MN Population)

was regressed on a constant, year, and year*year.

The model used data from 1990 to 2050. This regression analysis was conducted in Stata.

Generally, the regional shares outside of EDR 11 (Twin Cities Metro) have declined over time, while population has increased within EDR 11. This trend is projected to continue into the future. In 2010, 53.76% of MN's population lived in the Twin Cities region; by 2050 this is projected to decline to just over 60.46%.

For the period between 2015 and 2050, this projected share was then applied to the state population from the Minnesota State Demographic Center 2015 Series.[3] For the 2015 starting year, the Census Bureau's Intercensal Estimates by single year of age were used.

STEP 2: PROJECT COUNTY TOTAL POPULATION

The second step was to obtain a target annual county population based on each county's share of the respective EDR population. Regression techniques were used to obtain the yearly, predicted share of the population starting in 2015. Decennial Census counts,[4] Intercensal Estimates,[5] and the Minnesota State Demographic projections[6] were used as data inputs. The formula:

Log (County Population / EDR Population)

was regressed on a constant, year, and year*year.

The model used data from 1990 to 2050. This regression analysis was conducted in Stata. For the period between 2015 and 2050, this projected share was then applied to the EDR population outlined in Step 1.

STEP 3: APPLY COHORT-COMPONENT METHOD

The cohort-component method is an approach to demographic projections that accounts for age distribution in a given population. This method consists of segmenting the population into different subgroups that may be differentially exposed to the components of change, being births and deaths, by separately calculating the changes over time in each group.[7]

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[1] Decennial Census counts: http://www.census.gov/prod/www/decennial.html
[2] Intercensal Estimates: http://www.census.gov/popest/data/intercensal/state/state2010.html
[3] MN State Demographic Center projections: http://www.mn.gov/demography/projections.html
[4] Decennial Census counts: http://www.census.gov/prod/www/decennial.html
[5] Intercensal Estimates: http://www.census.gov/popest/data/intercensal/state/state2010.html
[6] MN State Demographic Center projections: http://www.mn.gov/demography/projections.html
[7] Preston, S.H., P. Hueveline, and M. Guilliot. 2001. *Demography: Measuring and Modeling Population Processes*. Malden, MA: Blackwell Publishing

A base population of July 1, 2014 was used because 2014 is the most recent year for which corresponding vital statistics are available from the Minnesota Department of Health. First, components of natural increase were calculated and applied as a projection. Next, for each subsequent year, the population of a given age group was advanced five years of age and the new age categories were updated using the projected survival rates for that year from the life tables created. A new birth cohort was then added to form the population under one year of age by applying the projected age-specific fertility rates to the average female population aged 10 to 54 years and updating the new cohort to the effects of mortality.

The assumptions for the components of change were based on a time-series analysis of historical trends. The next section provides details about the methods used to project fertility rates, mortality rates, and levels of net-migration.

STEP 3A: GROUP QUARTERS ANALYSIS

Group quarters population include, but are not limited to, educational, correctional, and medical facilities. The total group quarters population by county is taken from the 2010 Decennial Census. Since the number of people residing in group quarters remains fairly stable from year to year, the population residing in group quarters for each age-cohort and gender was removed from the existing population prior to application of the cohort-component method. The group quarters population was then added back in after the cohort-component method was computed and held constant for each year of the dataset. If the removal of group quarters population created unrealistic natural change within a cohort, it was assumed that at least a share of the 2010 group quarters population should remain to participate in demographic change within the geography.

STEP 3B: PROJECT BIRTHS AND DEATHS

Births were projected using fertility rates by five-year age-cohort among women of childbearing age. Age-specific fertility rates from 2012, 2013, and 2014 were averaged and the birth sex ratio was controlled to 1.05.

Deaths are projected using survival rates by five-year age-cohort and gender. Age-specific fertility rates from 2012, 2013, and 2014 were averaged and survival rates were obtained from county-specific life table.

It can be difficult to obtain stable measures of mortality for small population. Because of this, Greater Minnesota age-specific mortality rates were averaged together and used for all Greater Minnesota counties.

STEP 3C: COMPUTE PRELIMINARY NET-MIGRATION

Historic net-migration rates were observed from 1990 to 2014 using the following formula:

$$P_{x+1} = P_x + (B - D) + M$$

where:

P_x is the population of any given year
B is births occurring during P_x
D is deaths occurring during P_x
M is net-migration during P_x

By solving for M, the following formula is left as a residual:

$$M = P_{x+1} - (P_x + (B - D))$$

The residual of M is considered as net-migration for the given year. This process was continued through the projection time frame where the difference between the product of the cohort-component and the desired state level population achieved from steps 1 and 2 results in net-migration. If there are more people than expected, there was net-in-migration. If there were fewer people than expected, there was net-out-migration.

STEP 4: ADJUST NET-MIGRATION FIGURES

In this step, the total number of net-migrants across all age/gender groups from the preliminary migration calculations in step 3c was compared to the historical migration trends also calculated in step 3c. The preliminary numbers were then adjusted to equal the target value.

STEP 5: CONTROL AGE/GENDER TOTALS TO ANNUAL COUNTY TOTALS

The final step involves rounding and making minor adjustments to the existing population in age groups. Fertility rates, mortality rates, and net-migration rates, when applied to a total population, will yield a decimal that cannot exist in a dataset expressing total population. This is the formula used to make these adjustments

$$ {}_nP_x * (P_t / \Sigma_n P_x) $$

where for any given year:

- ${}_nP_x$ is the total population in a single sex/age group
- P_t is the total population
- $\Sigma_n P_x$ is the sum of all single sex/age groups

POTENTIAL SOURCES OF ERROR IN PROJECTIONS

There are many potential sources of error in demographic projections. These include:

1. The estimates used for the base population may be inaccurate. The further estimates are from the Census year, the less accurate they are likely to be.
2. The national projections could be in error.
3. The state projections could be in error.
4. The predicted trend in the Economic Development Region share of the state population could change in an unexpected way.
5. The predicted trend in the county share of the Economic Development Region population could change in an unexpected way.
6. Fertility rates may change in a pattern other than that assumed by this model.
7. Mortality rates could change in a pattern other than that assumed by this model.
8. Future migration trends could shift depending upon economic trends, immigration law changes, climate change and many other factors.

For more information regarding the methodology described here, please contact Megan Dayton at megan.dayton@state.mn.us.