# Vintage 2008 State and County Age-Sex Projection Methodology: Some Salient Points

*Prepared by:*
*David Egan-Robertson*
*Senior Demographer*
*Demographic Services Center*
*Wisconsin Dept. of Administration*
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## Introduction

Wisconsin's Demographic Services Center uses the well-known cohort-component method to develop its state and county age-sex population projections. In this method's most common variation, the initial population is carried forward in 5-year time steps by age and sex, with modifications to fertility, mortality and migration rates. We calculate and publish the projections in 5-year age groups by sex through age 95-99, with centenarians (ages 100 and over) constituting the ultimate age group.

While we would like to develop projections by race and Hispanic origin, the inconsistency in racial and ethnic categories between the 1990 and 2000 Censuses—the period from which we derived our base rates—prevented us from making reliable projections. In 1990, the Census allowed persons to self-identify as White, Black, American Indian or Alaskan Native, Asian and Pacific Islander, or Other Race. In 2000, the Census gave respondents the option of specifying two or more races. (Hispanic origin is a separate category; persons of any race may be Hispanic.) While various bridging techniques and reclassification schemes have been developed in academia and federal agencies, we did not feel that such recategorizations could produce valid base rates in Wisconsin's case. Hence, we have chosen to produce projections without regard to race or Hispanic origin.

This paper describes our procedure for estimating the population's age-sex structure at 2005 and the assumptions that we made and computational issues that we faced in developing the future fertility, mortality and migration scenarios. I do not detail the specific algorithms and formulas here; they are available in the documents listed in the "Citations" section at the end, which may be obtained upon request.

## Age-Sex Estimates of State and County Population at 2005

The year 2005—specifically, April 1, 2005—served as the base date for this vintage of projections. The prior projection series, referred to as vintage 2003 and published in early 2004, had the Census date of April 1, 2000 as its basis.

Lacking an enumeration at the mid-decadal reference date, Demographic Services interpolated its annual population estimates (which are referenced to January 1) to develop state and county total population estimates. The following three sections describe how we applied the 2000-05 projections and their underlying rates from vintage 2003 to estimate the age-sex distribution at the state. Similarly, later sections outline the county-level age-sex estimation.

### Estimated State Age-Sex Survival Rates, 2000-2005

Actual resident deaths by birth cohort (i.e., five-year age groups) and sex were obtained for April 2000 through March 2005 from the Department of Health Services' Vital Records section. The recorded state resident deaths numbered 232,041; we had projected 233,166 deaths. This difference of 0.5% indicated our projected age-sex specific survival rates might serve as a reasonable proxy for the 2000-2005 period. However, there were enough differences for particular age groups—an over-projection of deaths in ages 60-84 and under-projection in age 85-99—that a different approach should be pursued.

We apportioned the actual deaths by age and sex to persons who were resident in the state at 2000 and to migrants of the 2000-05 period, based on the proportions of such deaths as projected for the five years. Hence, the estimated deaths attributable to 2000 residents could be used to compute estimated five-year survival rates, centered at 2002.5 (i.e., October 1, 2002, the midpoint date). These rates were smoothed where needed to produce a reasonable pattern over the age cohorts for each sex.[1]

As a concluding test, we converted these survival rates to life table values and compared the resulting life expectancy at birth ($e_0$) to past values. At the 2000-05 midpoint, our estimated $e_0$ values were 75.86 for men and 80.97 for women. The table below illustrates the life expectancy pattern over recent decades:

**Life Expectancy at Birth , State of Wisconsin, 1970-2005**

| Year | Source[2] | Male $e_0$ | Female $e_0$ | Fem $e_0$ - Male $e_0$ | Change, Male $e_0$ | Change, Female $e_0$ |
|---|---|---|---|---|---|---|
| 1970 | NCHS | 69.2 | 76.0 | 6.8 | | |
| 1980 | NCHS | 71.9 | 78.8 | 6.9 | 2.7 | 2.8 |
| 1985 | DSC | 72.94 | 79.67 | 6.73 | 1.04 | 0.87 |
| 1990 | NCHS | 73.6 | 80.0 | 6.4 | 0.66 | 0.33 |
| 1995 | DSC | 74.51 | 80.35 | 5.84 | 0.91 | 0.35 |
| 2002.5 | DSC | 75.86 | 80.97 | 5.11 | 1.35 | 0.62 |

In parallel with national trends, Wisconsin's life expectancy has increased for both sexes, and it has increased more rapidly for men than for women. Life expectancy is discernibly higher in Wisconsin than for the nation as a whole: the most recent NCHS decennial life expectancy calculations for 2000 placed the U.S. $e_0$ values at 74.10 for males and 79.45 for females.

## Estimated State Age-Sex Migration Rates, 2000-2005

With actual birth and death data for the five-year period, the natural increase could be calculated for the state (and counties). Thus, total net migration, being the residual difference between estimated population change and natural increase, could be estimated.

At the state level, the net migration for 2000-05, estimated at 111,180, was very close to one-half of the 1990-2000 intercensal period (111,996). Furthermore, the estimated migration was approximately 27,000 higher than we projected for the quinennium (84,358). Rather than recalibrate the projected age-sex net migration rates for the five-year period, we substituted the base five-year rates, computed from the actual 1990-2000 intercensal experience for the vintage 2003 projections. This exchange resulted in a proxy total of 109,844 net migrants. The small difference (111,180-109,844 = 1,336) was apportioned to males and females according to Wisconsin's historic net migration patterns: 55% males, 45% females.

In order to "close the gap" between the base rates and those indicated by this difference in net migrants, we compute a quantity called the K factor.[3] In prior projection vintages, one K factor was computed for each sex, to be applied to all age cohorts. However, former DSC demographer Bal Kale and I had noted in preparations for the vintage 2003 projections that the shift in net migration rates, across broad age groups, vary. For example, in the 1990s—a decade of strong net in-migration to Wisconsin—the rise in migrants of the younger working-age population was much stronger, and that of older workers and retirees much weaker, than would be indicated by a single K factor. Conversely, in the 1980s—a decade of strong out-migration—the decline in net migrants and migration rates for younger working-age people was more pronounced than for those in later age cohorts.

[1] In general, after the transition from 0-4 to 5-9, the "first difference" of survival rates should be positive. That is, the survival rate for ages 5-9 should be higher than that for 10-14, that for ages 10-14 higher than 15-19, etc. Furthermore, female survival rates should be equal to or exceed male survival rates.
[2] NCHS = National Center for Health Statistics; DSC = Demographic Services Center
[3] The "K factor" is a numeric adjustment, equally applied to each age-specific migration rate within each age-sex grouping, that is simply the aggregate numeric migrant difference divided by aggregate surviving (or expected) population.

After testing a number of models, we settled upon a "two K" factor model for each sex, with the two broad age groups established at 0-54 and 55 and older.[4] Under this bifurcated model, the K factors of both sexes for ages 55 and over was slightly negative for 2000-05, and the factors of both sexes for ages 0-54 slightly positive. In contrast, a single-K calculation indicated a slight increase for both sexes.

## Estimated State Age-Specific Fertility Rates, 2000-2005

Actual resident births by sex of child were obtained for April 2000 through March 2005 from the Department of Health Services' Vital Records section. The recorded resident births numbered 347,023; we had projected 349,029 births. This difference of 0.6% indicated our projected age-specific fertility rates (ASFRs) for the 2000-05 period might serve as a reasonable proxy for the actual ASFRs.

The completion of survival and migration calculations allowed us to establish the endpoint (2005) population of "fertile females," those cohorts within which virtually all births occur, ages 10-49. The beginning and ending population for each five-year age group of women is averaged and then multiplied by the projected ASFRs from the vintage 2003 projections. This process generated an estimated number of births of more than 350,000. Iterating the estimated births to the actual total produced revised ASFRs and an aggregate total fertility rate (TFR) of 1.9087. This value corresponded well with the estimated TFRs for Wisconsin from the Dept. of Health Services (1.8969) and the National Center for Health Statistics (1.9059).

However, when we looked at the state-level births by age of mother for the five-year period, it was clear that—following patterns of the prior 20 years—fewer births were occurring among young mothers (ages 15-29) and more births were occurring among older women. Thus, rather than using the iterated estimated births—which seemed to over-state births among younger mothers—we used the estimated births by age of mother to produce estimated ASFRs for the base quinennium.[5] The TFR remained the same.

## Projected State Age-Sex Survival Rates, 2005-2035

We used the same technique for projecting age-sex survival rates as we did in the vintage 2003 projections. First, for each age and sex cohort, we computed the ratio of our estimated 2000-05 survival rates to the corresponding national rates (from the National Center for Health Statistics), then multiplied these proportions by the Census Bureau's low series of projected survival rates from their 1999 projection series, the most recent set available.

Converting these projected survival values to the summary measure of life expectancies at birth, we found initially that the growth in male life expectancy for the first two five-year periods appeared to be low. As noted above, from 1980 through 2000, male life expectancy increased at a faster pace than that of females; it seemed unusual that we should project a much smaller increase for men than for women. We smoothed the male survival rate values so that the pattern of relationship with female values and the cycle-to-cycle change in life expectancy appeared more reasonable across the 30-year projection horizon.

**Life Expectancy at Birth, State Level, Estimated 2000-2005 and Projected 2005-2035[6]**

| | 2002.5 | 2007.5 | 2012.5 | 2017.5 | 2022.5 | 2027.5 | 2032.5 |
|---|---|---|---|---|---|---|---|
| Wisconsin Males | 75.86 | 76.38 | 76.69 | 77.15 | 77.68 | 78.25 | 78.86 |
| Wisconsin Females | 80.97 | 81.83 | 82.41 | 82.98 | 83.52 | 84.02 | 84.51 |
| Midpoint-to-Midpoint, Males | | 0.51 | 0.32 | 0.46 | 0.52 | 0.58 | 0.61 |
| Midpoint-to-Midpoint, Females | | 0.86 | 0.58 | 0.58 | 0.54 | 0.49 | 0.49 |
| Numeric Diff., Females - Males | 5.11 | 5.45 | 5.71 | 5.83 | 5.84 | 5.76 | 5.64 |

[4] For a more detailed discussion, see Kale, Egan-Robertson, Palit and Voss, "The Migration Component in a Population Projections Model." The full citation is at the end of this document.
[5] For births by age of mother, we did not have data for the specific 4/1/2000-3/31/2005 period, so we used ¾ of calendar year 2000 births plus the full calendar years 2002-2004 births plus ¼ of calendar year 2005 births.
[6] Survival rates are averaged mortality experiences across the five years, hence they are identified with the midpoint date.

## Projected State Age-Sex Migration and Rates, 2005-2035

As noted in the "Estimated State Migration Rates" section, migration appeared to remain quite strong through the first half of this decade, at a similar level to the 1990s. However, as we began preparing this vintage of projections in 2007, it was clear that the housing market, which had been growing rapidly through calendar year 2005, was slowing considerably. Indeed, given the spike in housing vacancies that began to be observed from 2005 forward, it is possible that our estimate at 2005 could be too high. Thus, we may have overstated net migration.

To account for the sluggish economy and to moderate for the likelihood of over-estimated migration for the first five years, we held the projection of net migrants to 60,000 for 2005-2010. In total, the estimated and projected net migrants for the 2000-2010 decade is approximately 172,000, which is lower than the 1990-2000 observed net migration by 55,000.

From 2010 through 2035, the impact of retiring workers born in the Baby Boom era of 1946-64 will potentially create a huge demographic shift in resident and migrant population. Wisconsin, like many other states in the northeastern and midwestern United States, will find it harder to draw domestic migrants because of increased competition among states. Across the 25 years from 2010 forward, we tapered the domestic net migration for each five-year period.

To help meet the needs of the state workforce, we expect that net international migration will increase to higher levels (11,000 to 12,000 per year) than observed in the late 1990s, from 2010 through 2025. As we advance beyond 2025, it may become the case that many of the international migrants who have taken up residence for their working careers in Wisconsin and the U.S. will return to their native countries after retiring. (For example, there is anecdotal evidence to this effect in the New York metropolitan area: elderly Poles are returning to Poland now that their homeland's economy is improving.) We forecast that the in-flow of international migration will continue to be steady, but the out-flow of retirees will reduce the net margin.

**Net Migrants, State Level, Estimated 2000-2005 and Projected 2005-2035**

| Source | 2000-2005 | 2005-2010 | 2010-2015 | 2015-2020 | 2020-2025 | 2025-2030 | 2030-2035 |
|---|---|---|---|---|---|---|---|
| Domestic | n/a | 10,000 | 35,000 | 30,000 | 25,000 | 20,000 | 15,000 |
| International | n/a | 50,000 | 55,000 | 60,000 | 55,000 | 47,500 | 40,000 |
| TOTAL | 110,350 | 60,000 | 90,000 | 90,000 | 80,000 | 67,500 | 55,000 |

With the target net migrants for each five-year period established, we could adjust age-sex migration rates using the two-K factor method, as described in the "Estimated State Migration Rates" section. After parceling out the projected migrants to males and females (55% and 45%, as observed historically), we further apportioned the sexes to the 1990-2000 observed percentages for ages 0 through 54 (93.3% male, 88.8% female) and 55 and over (6.7% male, 11.2% female). In essence, this procedure produces a two-by-two matrix of four net migrant "targets." The difference of the four values from the corresponding values of the previous five-year cycle produced four K factors, which were added to the appropriate net migration rate values of the previous cycle to generate the NMRs for the current projection cycle.

We made proportional adjustments to control the calculated net migrants to the target net migrants, and a further smoothing step was performed between the transition age groups of 50-54 and 55-59 to make the cohort change across the 30-year projections horizon more reasonable.

## Projected State Age-Specific Fertility Rates, 2005-2035

Initially, we employed the same method as used in the vintage 2003 projections: basing the projected age-specific fertility rates for Wisconsin on the rate of change in the middle series of national fertility rates developed by the Census Bureau in their 1999 projections.

While this process seemed reasonable, we noted a couple of issues once we made an initial run of the projections. First, the number of births rose rapidly across the 30-year projections horizon, compared to the change from 1995-2000 to 2000-2005. Second, by using the ratio method involving the Census Bureau's projected rates—which adjust all ages gradually upward—the number of births to teenage mothers increased substantially. However, the pattern since 1995 has shown that teen birth rates and number of teen births has been dropping, probably due to the emphasis on teen pregnancy prevention. In addition, the rates and number of births for ages 30-34 through 40-44 have been rising fairly steadily since 1990.

We first attempted to extend the ASFRs into the future using linear regression, employing the annual estimated rates computed by the Department of Health Services for 1990 through 2005. These time series demonstrate a strong linear relationship. However, the projected rates for ages 15-19 fell severely (and reduced the number of births in 2030-35 to one-seventh of the 2000-2005 experience) and for ages 30-34 rose sharply (and increased the number of births to 160 percent of the base period).

In order to develop more reasonable rates and births by age of mother, we delayed the projected 2020 ASFRs for ages 15-19 and 30-34 to 2035 and interpolated for the intervening years. The rates across time bore more resemblance to the pattern we had observed for 1990-1995, 1995-2000 and 2000-2005.

**Midpoint Age-Specific Fertility Rates, State Level, Estimated 2000-2005 and Projected 2005-2035**

| Age Group | 2002.5 | 2007.5 | 2012.5 | 2017.5 | 2022.5 | 2027.5 | 2032.5 |
|---|---|---|---|---|---|---|---|
| 10-14 | 0.000473 | 0.000461 | 0.000449 | 0.000437 | 0.000426 | 0.000414 | 0.000402 |
| 15-19 | 0.031915 | 0.027381 | 0.022848 | 0.020014 | 0.018880 | 0.017747 | 0.016614 |
| 20-24 | 0.085598 | 0.080919 | 0.076240 | 0.071561 | 0.066881 | 0.062202 | 0.057523 |
| 25-29 | 0.117549 | 0.117444 | 0.117338 | 0.117233 | 0.117127 | 0.117022 | 0.116917 |
| 30-34 | 0.100302 | 0.109279 | 0.118255 | 0.123865 | 0.126109 | 0.128353 | 0.130597 |
| 35-39 | 0.038673 | 0.043747 | 0.048821 | 0.053895 | 0.058969 | 0.064043 | 0.069117 |
| 40-44 | 0.006891 | 0.007878 | 0.008864 | 0.009851 | 0.010838 | 0.011824 | 0.012811 |
| 45-49 | 0.000347 | 0.000368 | 0.000389 | 0.000410 | 0.000431 | 0.000452 | 0.000473 |
| **Total** | **0.381749** | **0.387477** | **0.393205** | **0.397266** | **0.399662** | **0.402058** | **0.404453** |
| **WI TFR** | **1.9087** | **1.9374** | **1.9660** | **1.9863** | **1.9983** | **2.0103** | **2.0223** |
| *U.S. CB TFR* | *2.0733* | *2.1066* | *2.1374* | *2.1661* | *2.1936* | *2.2098* | *2.2133* |

The projected fertility scenario appears reasonable on the basis of: (a) the observed upward tendency in fertility in the 1990s and early 2000s in Wisconsin, (b) the likely increase in the proportion of minorities in the state over time, and (c) the expected future higher fertility rate at the national level that continues the recent trend and conforms to the expressed intentions of women interviewed in national surveys.

Note that the state’s total fertility rate (TFR) indicated by these ASFRs begins about .17 below the national level and is approximately .19 below it at 2030-2035. Wisconsin’s total fertility rate has maintained a similar gap for several decades, so it is reasonable to assume that this difference will remain relatively constant into the future.

## Estimated County Age-Sex Survival Rates, 2000-2005

The calculation of county age-sex survival rates is fraught with peril because of the vagaries introduced by small numbers. Our methodology divides the population into 42 age and sex categories (21 age cohorts, ages 0-4 through 100 and over, for each sex). In counties with less than 30,000 population—thirty-one of Wisconsin's seventy-two counties were below this size in 2000—age-sex cohorts may contain a few hundred people; at the older age categories, perhaps only a few dozen. Random variation in the occurrence of deaths can produce an inconsistent pattern of survival rates as we advance through a county's age cohorts. The goal, then, of developing county-level survival rates, and corresponding life expectancies, is not to hold rigidly to the observed events of the past, but to produce a reasonable and justifiable set of rates that provide a solid basis for projecting into the future.

Similar to initial state-level survival rate estimations for our base period, we apportioned the actual county deaths by age and sex to persons who were resident in each county at 2000 and to migrants of the 2000-05 period, based on the proportions of such deaths as projected for the five years. In addition, we controlled the county-level surviving (expected) population by age and sex to the state-level values, then calculated revised estimated county age-sex survival rates. Given the previous paragraph's discussion, not surprisingly, an initial computation of age-sex resident deaths using these revised rates indicated some categories where the ratios of resident deaths to all deaths were unacceptable.

We tested several techniques to produce more reasonable patterns of survival rates and life expectancies. In particular, we wanted our life expectancies to be consistent with those calculated for the vintage 2003 projections. These values were based on the ten-year, 1990-2000 survival experience; our current values were based on only five years' experience. We found that, within age groups across all counties, the survival rates' variance from the mean becomes quite wide in older age groups (again, due to the variation of small numbers). We established a limit of the mean plus or minus 1.5 standard deviations for survival rates in the sex-specific age categories of 75-79 and older, drawing in the outliers to these bounds. Additional smoothing of the rates to adhere to our two parameters (positive first differences, female rates higher than males') produced life expectancies that were more logical than those generated without these strictures.

Base estimated life expectancies at birth ranged, for men, from 61.8 years in Menominee County to 78.5 years in Ozaukee County and, for women, from 71.5 years in Menominee County to 83.0 years in Dunn County.[7]

## Estimated County Age-Sex Migration Rates, 2000-2005

An important element of net migration at the county level is to control for large changes in group quarters populations. During the 1990s and early 2000s, Wisconsin opened at least a half-dozen correctional institutions, mostly in smaller-sized counties. In addition, a federal facility in a rural county expanded its population in the past fifteen years and, after 2000, at least two counties built new jails with vastly increased capacity, largely with the intent of housing state prisoners and/or federal detainees. These sudden upsurges in population, generally male and concentrated in a few five-year age groups, would produce inaccurate base migration rates that should not be carried into the future.

After analyzing the controlled GQ population from the vintage 2003 projections (growth during the 1990s) and the changes from 2000 to 2005, we set aside—based on Census 2000 block or block group data, and age distribution estimates for new institutions—male population in Adams, Chippewa, Dodge, Grant, Jackson, Juneau, Waushara and Winnebago counties. These set-asides created an unusual demographic scenario: a segment of the population removed from the beginning population, held at the same age distribution, not subjected to mortality and migration rates for their respective age cohorts, then added to the resulting endpoint population. In actuality, prisoners are entering these facilities by "in-migrating" from other counties or states, aging and facing mortality risk, and then "out-migrating" somewhere else at the conclusion of their terms. Conversely, non-institutional counties are "senders," and eventual "receivers," of these inmates. However, developing a migration model to incorporate this complexity would be arduous. This set-aside process is an acceptable compromise.

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[7] For a more detailed discussion of the development of county life expectancies, see Kale, Egan-Robertson, Palit and Voss, "County-Specific Life Tables." The full citation is at the end of this document.

The revised estimated county age-sex survival rates and estimated county 2005 total populations (excluding the aforementioned group quarters populations) allowed us to make a first estimate of total net migrants. The expected populations by age and sex were calculated and aggregated across all counties. These forty-two preliminary totals were then compared to corresponding state age-sex values to produce ratios, which were multiplied by all county values. Thus, the sum of the counties' expected populations by age and sex now equaled the matching state age-sex values.

The adjusted county expected populations were aggregated and subtracted from the 2005 county estimates to establish an initial pool of net migrants, without regard to age and sex. Using the aggregated (county) projected male and female net migrants from the vintage 2003 projections, we could calculate K factors based on the numeric difference, in order to adjust the vintage 2003 projected net migration rates to generate estimated net migration rates for the base period.

With the expected populations and net migrants by age and sex finished, the total county age-sex population at 2005 could be assembled. (In addition, the excluded group quarters population was returned at this point.) In order to assure exact matches between the aggregation of county population and the state values, I conducted a two-way iteration to eliminate any marginal differences. Finally, because of wide variability in the net migration rates among the oldest three age groups—90-94, 95-99 and 100 and over—we equalized the male and female rates within each county by dividing the sum of net male and female migrants by the sum of male and female expected populations within each age cohort.

### Estimated County General Fertility Rates, 2000-2005

The small number of births in some age-of-mother cohorts at the county level impedes the use of age-specific fertility rates. Instead, we computed county-specific general fertility rates (GFRs), which relate all births to the female population ages 15 through 44. For this vintage's five-year base period, we used data on actual births for the five years and the midpoint, or averaged, estimate of female residents. Hence, the base rates were centered on October 1, 2002.

While the distribution of GFRs among Wisconsin's counties are grouped relatively tightly and display a fairly normal distribution, there are outliers because of the presence of certain populations. Setting upper and lower bounds at 1.5 standard deviations from the mean estimated GFR for all counties, we found that four counties—Clark, Menominee, Monroe and Vernon—exceeded the higher limit and two—Florence and Iron—were below the lesser. In the former group, Menominee County is largely an Indian reservation, and Clark, Monroe and Vernon counties have Amish population. Florence and Iron counties are far northern, sparsely populated counties adjacent to Michigan's upper peninsula. Their public school enrollments through 8$^{th}$ grade—numerically the lowest of all counties—have declined by 48 and 24 percent, respectively, this decade, indicating a dearth of births, and families of childbearing age, from 1995 forward. In projections mode, we will treat these outlier counties differently from the others.

### Projected County Age-Sex Survival Rates, 2005-2035

We used the same technique of projecting county age-sex survival rates as used in the vintage 2003 projections: we assumed that the change in survival rates within each county age-sex group would be proportional to the projected change in the corresponding state age-sex group. However, we instituted two parameters to make the time series pattern more reasonable:

1) We set an upper bound on survival rates of .9995 (a limit of 5 deaths per 10,000 people). In many small-population counties, it is not unusual to have zero deaths in an age-sex group in five years; in fact, there were even some "no-death" cohorts in the 1990-2000 period. Projecting over a 30-year horizon, it is unlikely that a cohort that experienced no deaths in the base period will maintain that pattern.
2) Our ratio method to project survival rates led to some of them increasing well out of range of the state rates and that of all counties for specific age-sex groups. Similar to our work on the base period rates, we created a pair of bounds—mean plus or minus 1.5 standard deviations—for age groups 75-79 and higher.

After these procedures, we also smoothed some rates to ensure each county's survival rates, by sex, followed the expected first-difference pattern. Our final panels of survival rates were converted to life expectancies as a check for reasonableness.

### Projected County Net Migrants and Age-Sex Migration Rates, 2005-2035

In our base five-year period, we estimated that six counties had net out-migration, the remaining sixty-six had in-migration. As we move forward through each five-year projections cycle, we anticipate total net migration will rise and fall in each county parallel with the change in predicted state-level migration. In addition, a similar parallel process will occur within each age and sex cohort: the number of migrants in counties' age-sex cohorts will move up and down in correspondence to the state-level values.

For each five-year projection period, we apportioned the numeric change in total state migrants to each county based on its proportion of absolute value in the prior five-year period, then added this number to the calculated value in the prior five-year period. Subsequently, we apportioned each counties' net migrants to males and females based on the proportional values observed for net migrants in the 1990-2000 period.[8] Finally, having established male and female county migrant targets, we computed K factors and projected age-sex migration rates for each cycle.[9]

Age-sex net migrants at the county level encompass greater difficulty because migration at a county level may be moving in the opposite direction from the corresponding cohort at the state level. For illustrative purposes, the possible outcomes of "gainers" and "losers" may be summarized in a matrix:

| State \ County | **in-migration** | **out-migration** |
|---|---|---|
| **in-migration** | gain-gain | gain-loss |
| **out-migration** | loss-gain | loss-loss |

The presumption is that, if the state will gain and a county will gain in a specific age-sex cohort, the county will draw migrants from other counties that are losing in that cohort, plus draw on gains from interstate migration.

### Projected General Fertility Rates, 2005-2035

Our general assumption is that the fertility rate in individual counties will tend toward a projected state rate at some distant point in time. For our purposes, we set the target point of conjunction at 50 years for those counties whose GFRs fell within the mean plus or minus 1.5 standard deviation calculations from the base period. For the six statistically outlying counties (described in the "Estimated County General Fertility Rates" section), we assume their GFRs will tend toward the state's rate at a slower pace, placing the point of conjunction at 75 years.

As discussed in the state calculations, with expected populations and net migrants computed for all county age-sex categories, the endpoint "fertile female" county populations could be constructed. We then multiplied the projected GFRs by the averaged, or midpoint, female population ages 15-44 to generate an initial projection of county-specific births. These preliminary numbers were controlled proportionally to the state projected births for the five-year period to generate final county projected births.

[8] For counties in which, in the 1990s, the male migrants or female migrants numbered fewer than 100, or if one sex was positive and the other negative, the proportions were controlled to the mean proportion of all counties plus/minus 1.5 standard deviations.
[9] We used the "one K" method for the counties, even though we used the two K factors at the state level. At the county level, we could not create the iterative calculation that would allow us to compute and apply two Ks for ages 0-54 and 55 and over. However, because we controlled net migrants to the state age-sex specific totals, the two-K method was utilized indirectly.

### Iteration to County and Age-Sex Population Targets

After completion of all of the above steps in a projections cycle, small differences remained from our state-level age-sex targets and county targets. (The county totals tended to vary somewhat more than the age-sex ones.) We executed a two-way iteration so that the sums of county age-sex populations equaled the 72 desired county totals and the aggregated age-sex populations equaled the 42 desired state age-sex marginals. The need to round to whole persons may have caused the final results to differ slightly from the targets.

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