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An Evaluation of Population Forecast Errors for Florida and Its Counties, 1980 – 2010

Stanley K. Smith, Population Program Director
Stefan Rayer, Research Demographer

Many decisions in both the public and private sectors are based on expectations of future population change. Planning for schools, hospitals, shopping centers, housing developments, electric power plants, and many other projects is strongly influenced by expected population growth or decline. The distribution of government funds and the granting of various types of licenses and permits may be affected as well. It is not surprising that population projections and forecasts are of so much interest to so many people.

A population projection can be defined as the numerical outcome of a specific set of assumptions regarding future population trends. It is non-judgmental in the sense that it makes no predictions regarding the likelihood that those assumptions will prove to be true. A population forecast, on the other hand, is the projection thought to be the most likely to provide an accurate prediction of future population change. It is explicitly judgmental. Given this distinction, all forecasts are projections but not all projections are forecasts.

The Bureau of Economic and Business Research (BEBR) has been making three sets of population projections (low, medium, and high) for Florida and its counties for many years. These projections – especially the medium projections – are often interpreted as forecasts. It is therefore essential to evaluate the accuracy of those projections. In this report, we investigate the accuracy of several sets of state and county population projections published by BEBR over the last 30 years. We focus primarily on the medium projections but also investigate the performance of the low and high projections as indicators of the likely range of future population growth. By providing information on the performance of previous projections, this analysis will help data users evaluate the potential reliability of current and future projections.

METHODOLOGY

BEBR uses two different approaches to construct population projections. At the state level, we base our projections on a cohort-component methodology in which births, deaths, and migration are projected separately for each age-sex cohort in the population. Three different sets of migration and fertility assumptions are used, providing three sets of projections (low, medium, and high). The medium projection is the one we believe is most likely to provide an accurate forecast of the future population.

County projections are based on a variety of statistical techniques that extrapolate historical population trends into the future. In most years, the medium projections for counties are calculated as the average of several individual projections and are controlled to add to the state population projection. The low and high projections are based on the distribution of errors from previous sets of projections. Again, the medium projections are those expected to provide the most accurate forecasts. A detailed description of the methodology used in our most recent set of state and county projections is provided in the Appendix.

The following terminology is used to describe population projections:

1) **Base year**: the year of the earliest observed population size used to make a projection.

2) **Launch year**: the year of the latest observed population size used to make a projection.

3) **Target year**: the year for which population size is projected.

4) **Base period**: the interval between the base year and launch year.

5) **Projection horizon**: the interval between the launch year and target year.

For example, if data from 1990 and 2000 were used to project the population in 2010, then 1990 would be the base year, 2000 would be the launch year, 2010 would be the target year, 1990–2000 would be the base period, and 2000–2010 would be the projection horizon.

In this report, we evaluate the forecast accuracy of state and county projections for launch years 1980, 1985, 1990, 1995, 2000, and 2005. Using the medium series, we compare projections covering several different horizons with census counts or mid-decade estimates and calculate the percent differences for each target year. We refer to these differences as forecast errors; that is, we treat the medium projections as if they were indeed forecasts of the future population. It should be noted that errors calculated in this manner may have been caused by enumeration or estimation errors as well as by errors in the forecasts themselves.

FORECAST ACCURACY

State Projections

Results for the medium state-level projections are shown in Table 1. There was not a perfectly monotonic relationship between forecast errors and length of horizon, but errors generally increased (ignoring the direction of error) as the horizon became longer. Averaged across all launch years, errors were approximately 3% for 5-year horizons, 4% for 10-year horizons, 6% for 15-year horizons, 9% for 20-year horizons, 11% for 25-year horizons, and 16% for 30-year horizons.

Table 1. Forecast Errors for State Projections, Launch Years 1980–2005

	Launch Year							
Horizon	1980	1985	1990	1995	2000	2005	Ave. 1	Ave. 2
5 Years	-2.1	-2.6	0.8	-3.6	-2.3	6.0	2.9	-0.9
10 Years	-5.1	-4.1	-1.6	-6.5	-0.1	—	3.5	-3.5
15 Years	-7.3	-7.6	-4.7	-5.2	—	—	6.2	-6.2
20 Years	-10.8	-11.4	-3.7	—	—	—	8.6	-8.6
25 Years	-11.2	-11.2	—	—	—	—	11.2	-11.2
30 Years	-16.3	—	—	—	—	—	16.3	-16.3

Ave. 1: Average ignoring the direction of error
Ave. 2: Average accounting for the direction of error

How do these errors compare with those found in other studies? Several studies have evaluated forecast accuracy for states, using a variety of time periods and projection techniques (e.g., Kale et al., 1981; Smith and Sincich, 1988, 1992; White, 1954). These studies have reported average errors (ignoring the direction of error) ranging between 5% and 8% for 10-year horizons and between 10% and 15% for 20-year horizons. Errors for the Florida projections have thus been somewhat smaller than those reported in other studies of state population projections.

Although errors in the state-level projections increased with the length of the projection horizon for every launch year, the errors themselves varied considerably from one launch year to another. For 5-year horizons, the projection for launch year 1995 had an error of -3.6% whereas the projection for launch year 2005 had an error of 6.0%. For 10-year horizons, the projection for launch year 1995 had an error of -6.5% whereas the projection for launch year 2000 had an error of only -0.1%. The 20-year projection for launch year 1985 had an error of -11.4% whereas the 20-year projection for launch year 1990 had an error of only -3.7%. These differences illustrate the lack of predictability regarding the accuracy of projections for a single place, such as the state of Florida. As we show in the next section, there is substantially more predictability when focusing on averages for a number of places (e.g., counties).

Most of the errors reported in Table 1 had negative signs, indicating that the projections were lower than the populations counted or estimated for the target years. Does this mean that the cohort-component method has an inherent downward bias and that current and future projections of the Florida population will also tend to be low? No, it doesn't. A study of state projections from 1900 to 1980 found that projections tended to be predominantly high during some time periods and predominantly low during others (Smith and Sincich, 1988). The positive and negative errors largely offset each other over time, indicating that there was no general tendency toward either an upward or downward bias. Also, we note that the 2010 Florida projection for launch year 2005 turned out to be substantially too high. We believe BEBR's current and future projections of Florida's population are as likely to be too high as too low.

County Projections

We used several measures of error to evaluate the forecast accuracy of BEBR's medium county projections. Mean absolute percent error (MAPE) is the average when the direction of the error is ignored. The 67th percentile error (67PE) is the error that is larger than two-thirds of all county errors (ignoring direction of errors). These are measures of precision, or how close the projections were to subsequent census counts or mid-decade estimates, regardless of whether they were too high or too low.

Mean algebraic percent error (MALPE) is the average error when the direction of the error is accounted for; that is, positive and negative errors are allowed to offset each other. This is a measure of bias: a positive MALPE reflects a tendency for projections to be too high and a negative MALPE reflects a tendency for projections to be too low. We use the proportion of positive errors (%POS) as another measure of bias because a few large errors can disproportionately influence the size and sign of the MALPE.

Tables 2–5 summarize the precision and bias of county projections with launch years 1980, 1985, 1990, 1995, 2000, and 2005. As shown in Table 2, MAPEs averaged approximately 5% for 5-year horizons, 8% for 10-year horizons, 11% for 15-year horizons, and 15% for 20-year horizons. Although there was some variation from one launch year to another, there was considerably more stability over time in average errors for counties than there was in errors for the state as a whole.

For each launch year, mean errors increased approximately linearly with the length of the projection horizon. Similar results have been reported in many previous studies (e.g., Rayer, 2008; Smith, 1987; Smith and Sincich, 1992; Tayman, 1996; White, 1954). There was some indication that errors have become smaller over time, at least for launch years 1980 through 2000. This may have been caused by changes in county size and growth-rate characteristics; we return to this possibility later in the report. For launch year 2005, however, the MAPE for a 5-year horizon was larger than in any previous launch year.

Table 2. MAPEs for County Projections, Launch Years 1980–2005

	Launch Year						
Horizon	1980	1985	1990	1995	2000	2005	Average
5 Years	5.0	5.8	4.2	4.7	4.1	5.9	4.9
10 Years	9.8	7.2	8.2	7.6	6.1	—	7.8
15 Years	11.5	10.8	11.7	9.4	—	—	10.9
20 Years	15.5	14.3	14.3	—	—	—	14.7

Table 3 shows the results for the 67th percentile errors. Again, errors increased in an approximately linear manner with the length of the horizon.

Table 3. 67th Percentile Errors for County Projections, Launch Years 1980–2005

	Launch Year						
Horizon	1980	1985	1990	1995	2000	2005	Average
5 Years	5.2	6.6	5.0	5.5	4.2	7.2	5.6
10 Years	10.6	8.8	9.0	8.5	7.3	—	8.8
15 Years	12.4	12.4	12.7	10.3	—	—	12.0
20 Years	17.4	15.8	16.9	—	—	—	16.7

Table 4 shows the results for MALPEs. All the errors through launch year 2000 had negative signs and generally became larger as the horizon became longer. The projections for launch year 2005, however, had a strong upward bias. This illustrates the unpredictability in the likelihood that a given set of projections will tend to be too high or too low.

Table 4. MALPEs for County Projections, Launch Years 1980–2005

	Launch Year						
Horizon	1980	1985	1990	1995	2000	2005	Average
5 Years	-2.6	-1.5	-1.3	-1.4	-1.9	5.0	-0.6
10 Years	-5.3	-4.2	-4.6	-4.2	-1.0	—	-3.9
15 Years	-9.0	-7.9	-8.2	-3.6	—	—	-7.2
20 Years	-12.9	-11.6	-8.4	—	—	—	-11.0

Table 5 shows the results for the proportion of positive errors. All but two showed a tendency for the projections to be too low. The 10-year projections for launch year 2000 had a slight majority of positive errors and the 5-year projections for launch year 2005 had a large majority of positive errors. The results shown in Tables 4 and 5 are consistent with those shown in Table 1 for the state as a whole. This is not surprising, of course, because the county projections were adjusted to add to the state projections.

Table 5. Proportion of Positive Errors for County Projections, Launch Years 1980–2005

	Launch Year						
Horizon	1980	1985	1990	1995	2000	2005	Average
5 Years	37.3	35.8	43.3	37.3	35.8	85.1	45.6
10 Years	31.3	26.9	28.4	29.9	55.2	—	34.3
15 Years	20.9	25.4	20.9	37.3	—	—	26.1
20 Years	19.4	20.9	25.4	—	—	—	21.9

How do the errors reported here compare with those found in other studies? A study of 2,971 counties in the United States found MAPEs of 12–15% for 10-year horizons and 25–35% for 20-year horizons (Smith, 1987). A similar study of 2,482 counties found MAPEs of approximately 10% for 10-year horizons and 20% for 20-year horizons (Rayer, 2008). A study of 1,579 townships in Illinois found MAPEs of approximately 12% for 10-year horizons (Isserman, 1977). A study of 1,837 minor civil divisions in Wisconsin found MAPEs of approximately 10–11% for 10-year projections (Chi, 2009). With respect to precision, then, errors for the Florida county projections have been as small as or smaller than those reported in previous studies of population forecast accuracy for sub-state areas.

What about bias? Few studies have addressed this question, but those that have done so have found no predictable biases in most population projection techniques (Smith and Sincich, 1988, 1992). For most techniques, some sets of projections turn out to have an upward bias and others turn out to have a downward bias, but there is no way to know in advance which tendency will characterize any given set of projections. We believe the medium county projections published by BEBR have equal probabilities of being too high or too low.

What impact do differences in population size and growth rate have on forecast accuracy? To answer this question, we aggregated errors across all launch years, giving results for six sets of 5-year projections, five sets of 10-year projections, four sets of 15-year projections, and three sets of 20-year projections. For each county, population size was measured in the launch year and growth rate was measured over the ten years immediately preceding the launch year.

As shown in Table 6, precision generally increased with increases in population size. Similar results have been reported in many other studies (e.g., Isserman, 1977; Rayer, 2008; Smith, 1987; Tayman, 1996; White, 1954). Furthermore, the impact of differences in population size on MAPEs and 67th percentile errors appeared to increase with the length of the horizon. For 5-year horizons, errors for the smallest counties were 35–40% larger than errors for the largest counties, but for 20-year horizons they were almost twice as large.

Table 6. Forecast Errors for County Projections, by Population Size and Length of Horizon

	MAPE			
Population Size	5 Years	10 Years	15 Years	20 Years
< 15,000	8.8	8.8	12.6	18.3
15,000 to 49,999	8.9	8.9	12.5	16.6
50,000 to 199,999	8.0	8.0	11.0	14.2
> 200,000	5.5	5.5	7.2	9.7
	67 PE			
Population Size	5 Years	10 Years	15 Years	20 Years
< 15,000	6.8	9.9	15.5	22.4
15,000 to 49,999	5.9	9.1	12.4	16.9
50,000 to 199,999	5.8	10.2	13.0	17.9
> 200,000	4.9	6.7	7.6	12.4
	MALPE			
Population Size	5 Years	10 Years	15 Years	20 Years
< 15,000	-1.1	-5.3	-10.4	-17.2
15,000 to 49,999	-0.6	-4.5	-9.7	-13.8
50,000 to 199,999	-1.0	-3.6	-5.1	-8.0
> 200,000	0.1	-2.5	-4.1	-5.7
	% POS			
Population Size	5 Years	10 Years	15 Years	20 Years
< 15,000	42.9	27.4	23.5	7.5
15,000 to 49,999	51.8	36.6	19.7	16.1
50,000 to 199,999	42.1	35.1	32.9	32.8
> 200,000	45.3	36.1	27.4	27.3

Measures of bias displayed no clear relationship with population size. The proportion of positive errors sometimes increased with population size and sometimes declined. Although MALPEs generally declined with increases in population size, this was due to the relationship between population size and the size of the error, independent of its direction. We believe that when differences in growth rates are accounted for, differences in population size have no systematic impact on the tendency for projections to be too high or too low; several other studies have drawn similar conclusions (Murdock et al., 1984; Rayer, 2008; Smith and Sincich, 1988).

Table 7 shows the results for population growth rates over the ten years immediately preceding the launch year. Measures of precision displayed a u-shaped relationship between errors and growth rates. For both MAPEs and 67th percentile errors, errors were smallest for counties with 10–25% growth rates and became larger as growth rates deviated in either direction from this moderate growth level. Similar results have been reported in several previous studies (Isserman, 1977; Rayer, 2008; Smith, 1987; Tayman 1996).

Table 7. Forecast Errors for County Projections, by Growth Rate and Length of Horizon

	MAPE			
Growth Rate	5 Years	10 Years	15 Years	20 Years
< 10 %	6.6	8.8	12.5	15.3
10 - 25 %	4.2	6.1	9.3	12.3
25 - 50 %	4.4	7.5	10.2	13.7
> 50 %	6.4	9.9	12.8	17.2
	67 PE			
Growth Rate	5 Years	10 Years	15 Years	20 Years
< 10 %	7.5	9.0	13.3	17.6
10 - 25 %	4.5	7.5	10.5	13.3
25 - 50 %	5.3	9.4	12.0	16.7
> 50 %	6.0	10.9	14.2	20.8
	MALPE			
Growth Rate	5 Years	10 Years	15 Years	20 Years
< 10 %	1.1	-4.4	-9.4	-13.3
10 - 25 %	0.7	-2.2	-3.4	-6.9
25 - 50 %	-1.1	-3.5	-7.3	-9.9
> 50 %	-2.5	-6.3	-9.4	-14.0
	% POS			
Growth Rate	5 Years	10 Years	15 Years	20 Years
< 10 %	56.4	30.0	16.0	9.5
10 - 25 %	50.8	38.6	32.8	27.0
25 - 50 %	44.2	33.6	25.6	27.2
> 50 %	36.3	32.9	25.0	16.1

Measures of bias showed no clear relationship with differences in growth rates. The proportion of positive errors sometimes increased as the growth rate increased and sometimes declined. This result is different than that reported in a number of previous studies, which have found a tendency for places with slowly growing or declining populations to be under-projected and places with rapidly growing populations to be over-projected (Rayer, 2008; Smith 1987; Smith and Sincich 1988; Tayman, 1996). We are not sure why the results found in the present study differ from those found previously. This may have been caused by the relatively small sample size, the lack of diversity in growth rates (few Florida counties have lost population and many have grown rapidly), or the aggregation of results over a number of different launch years.

Another way to evaluate forecast accuracy is to compare projections with the naive alternative to making projections; namely, the assumption that no population change will occur. In most instances, using a no-change assumption led to errors that were two to three times larger than those shown in Table 2. Furthermore, the naive assumption had a tremendous downward bias because almost all Florida counties experienced population growth in recent decades. Although BEBR's projections do not provide perfect forecasts of population change, they clearly provide better forecasts than the naive assumption that no change will occur.

BEBR's county projections are based on simple techniques that extrapolate historical trends into the future. Could forecast accuracy be improved by using more complex techniques that account for changes in the components of population growth (births, deaths, and migration) or factors such as changing economic conditions, density constraints, or zoning restrictions? The evidence strongly suggests that more complex techniques cannot produce more accurate forecasts of total population than can be achieved using simple extrapolation techniques (e.g., Chi, 2009; Murdock et al., 1984; Rayer, 2008; Smith and Sincich, 1992; White 1954).

We do not believe that applying more complex techniques would lead to any systematic improvement in forecast accuracy for the county projections. There is a certain irreducible level of uncertainty regarding future population growth. It appears that the relatively small amount of historical information contained in simple extrapolation techniques provides as much guidance to this uncertain future as the much larger amount of information contained in more complex techniques. In the next section, we describe BEBR's approach to dealing with this uncertainty.

ACCOUNTING FOR UNCERTAINTY

The preceding analysis focused on the medium projections. These are the projections most commonly used as forecasts of the future population. However, as the analysis has shown, population forecasts virtually never provide perfect predictions of future population growth. Rather, some prove to be very accurate while others turn out to be quite inaccurate. How can this uncertainty be dealt with?

The producers of population projections often deal with uncertainty by producing a range of projections. This is typically done using one of two distinct approaches: 1) applying several alternative assumptions regarding fertility, mortality, or migration rates, or 2) developing prediction intervals based on statistical models. BEBR uses the first approach for its state projections and the second for its county projections.

State Projections

We produce a range of projections for the state as a whole by applying alternative assumptions regarding future migration and fertility rates. These alternative assumptions are based on evaluations of historical migration and fertility trends in Florida and our expectations regarding future changes in those trends. The medium projections are based on the trends we believe are most likely to occur. The low and high projections are based on potential changes in those trends. Although the low and high projections do not represent absolute limits to population growth, they do reflect substantial changes from recent trends. Applying alternative assumptions regarding fertility, mortality, or migration rates is the approach most commonly used for developing a range of population projections.

How did the low and high projections of Florida's population compare with the growth that actually occurred over the projection horizon? For launch year 1980, the high projection was above the actual population in 1985 but below it in 1990 and all subsequent target years. For launch year 2005, the low projection for the state was above the above the actual population in 2010. For all other launch years and target years, the high and low projections encompassed the actual populations occurring over time. That is, actual population growth fell between the low and high scenarios in four of the six sets of state projections analyzed in this study. We believe the low and high state projections produce a range wide enough to provide a reasonable indication of uncertainty but narrow enough to provide useful scenarios for planning purposes.

County Projections

Since launch year 1985, BEBR's low and high projections for counties have been based on an analysis of population forecast errors for a large sample of counties in the United States, broken down by population size and growth rate and covering a large number of launch years and projection horizons. The low and high projections can be interpreted as empirical prediction intervals showing the range in which approximately two-thirds of future county populations would fall if the future distribution of forecast errors in Florida were similar to the past distribution in the United States.

Using the low and high projections for launch years since 1985, we tabulated the number of counties in which the actual populations in subsequent years fell within the projected range. The results are shown in Table 8. If the prediction intervals were reasonably accurate, approximately 45 of Florida's 67 counties would have populations falling between the low and high projections.

Except for the five-year horizon for launch year 1985, too many county populations fell within the projected range. That is, the width of the range overstated the degree of uncertainty. The tendency to overstate uncertainty grew with the length of projection horizon and was greater for more recent launch years than earlier launch years.

What happened? Why did the two-thirds prediction intervals contain more than two-thirds of the county populations? There are several possible explanations. The distribution of errors for counties in Florida may differ in some unmeasured way from the distribution of errors for counties in other states. The increase in the

Table 8. Number of Counties with Populations Falling Below the Low Projection, Above the High Projection, or Within the Projected Range

	Length of Horizon			
Launch Year	5 Years	10 Years	15 Years	20 Years
1985				
Below Low	11	2	0	0
In Range	41	53	55	53
Above High	15	12	12	14
1990				
Below Low	1	1	1	1
In Range	56	59	58	61
Above High	10	7	8	5
1995				
Below Low	3	1	1	—
In Range	59	62	63	—
Above High	5	4	3	—
2000				
Below Low	1	0	—	—
In Range	63	65	—	—
Above High	3	2	—	—
2005				
Below Low	6	—	—	—
In Range	61	—	—	—
Above High	0	—	—	—

number of large counties and the decline in the number of small counties in Florida – combined with a slowdown in population growth rates – may have reduced uncertainty over the last few decades. Perhaps these results simply reflect an unusual period of stability, as Florida's population has grown by approximately 3 million in each of the last four decades. Whatever the explanation, the development of reliable prediction intervals is a topic requiring further study.

CONCLUSION

Florida is a dynamic, diverse, and rapidly growing state, but BEBR's population projections have turned out to be reasonably accurate in many instances. As shown in this report, state-level forecast errors have averaged 3% for 5-year horizons, 4% for 10-year horizons, 6% for 15-year horizons, and 9% for 20-year horizons (ignoring the direction of errors). County-level forecast errors have averaged 5%, 8%, 11%, and 15% for those horizons, respectively Based on comparisons with other studies, we believe this is a good record of forecast accuracy.

Can we expect the same level of accuracy for current and future projections? For the state as a whole, we cannot be sure. As an individual place, it is subject to a substantial amount of potential variability, both in terms of the size and the direction of future errors. Previous errors have varied considerably from one launch year to another, but it is likely that future errors for any given length of projection horizon will fall somewhere in the range of errors shown in Table 1.

We can be more confident in the results for counties, but only when those results are aggregated. Average errors are much more predictable than individual errors. With respect to precision, then, we believe MAPEs and 67^{th} percentile errors for current and future county projections are likely to be similar to those shown in Tables 2 and 3. With respect to bias, however, we cannot make any predictions. There is simply no way to know in advance whether a given set of projections will turn out to be predominantly too high or too low.

Results for individual counties, of course, are much less predictable than results based on averages. Given this uncertainty, data users should consider several possible alternatives rather than a single scenario when using county-specific projections for decision-making purposes. Population projections provide valuable tools, but they must always be accompanied by a careful analysis of historical trends and a thoughtful evaluation of alternative scenarios when planning for the future.

REFERENCES

Chi, Guangqing (2009). "Can Knowledge Improve Population Forecasts at Subcounty Levels?" *Demography* 46: 405–427.

Isserman, Andrew (1977). "The Accuracy of Population Projections for Subcounty Areas," *Journal of the American Institute of Planners* 43: 247–259.

Kale, Balkrishna, Paul Voss, Charles Palit and Henry Krebs (1981). "On the Question of Errors in Population Projections", paper presented at the annual meeting of the Population Association of America, Washington, DC.

Murdock, Steve H., F. Larry Leistritz, Rita R. Hamm, Sean-Shong Hwang, and Banoo Parpia (1984). "An Assessment of the Accuracy of a Regional Economic-Demographic Projection Model," *Demography* 21: 383–404.

Rayer, Stefan (2008). "Population Forecast Errors: A Primer for Planners," *Journal of Planning Education and Research* 27: 417–430.

Smith, Stanley K. (1987). "Tests of Forecast Accuracy and Bias for County Population Projections," *Journal of the American Statistical Association* 82: 991–1003.

Smith, Stanley K. and Terry Sincich (1988). "Stability Over Time in the Distribution of Population Forecast Errors," *Demography* 25: 461–474.

Smith, Stanley K. and Terry Sincich (1992). "Evaluating the Forecast Accuracy and Bias of Alternative Population Projections for States," *International Journal of Forecasting* 8: 495–508.

Tayman, Jeff (1996). "The Accuracy of Small-Area Population Forecasts Based on a Spatial Interaction Land-Use Modeling System," *Journal of the American Planning Association* 62: 85–98.

White, Helen (1954). "Empirical Study of the Accuracy of Selected Methods of Projecting State Population," *Journal of the American Statistical Association* 49: 480–498.

Appendix: BEBR Methodology for 2011 Population Projections

State projections

The starting point for the most recent set of state-level projections was the 2010 Census count of the total population, as reported by the U.S. Census Bureau. Because detailed census data on the age, sex, race, and ethnic composition of the population are not yet available we estimated these characteristics by updating data from the 2000 Census through the use of mortality, fertility, and migration rates.

Projections of the future population were made using a cohort-component methodology in which births, deaths, and migration are projected separately for each age-sex group, by race (white, nonwhite) and ethnicity (Hispanic, non-Hispanic). Survival rates were applied to each age-sex-race-ethnicity group to project future deaths in the population. These rates were based on Florida Life Tables for 2004–2006, calculated by the Bureau of Economic and Business Research using mortality data published by the Office of Vital Statistics in the Florida Department of Health. The survival rates were adjusted upward in 2010, 2015, 2020, 2025, 2030, and 2035 to account for projected increases in life expectancy.

Domestic migration rates by age, sex, race, and ethnicity were based on migration data for 1995–2000 as reported in the 2000 Census. Domestic in-migration rates were calculated by dividing the number of persons moving to Florida from other states by the mid-decade population of the United States (minus Florida). Domestic out-migration rates were calculated by dividing the number of persons leaving Florida by Florida's mid-decade population. In both instances, rates were calculated separately for males and females by race and ethnicity for each five-year age group up to 85+.

These in- and out-migration rates were weighted to account for changes in migration patterns and to provide alternative scenarios of future population growth. For each of the three series, projections of domestic in-migration were made by applying weighted in-migration rates to the projected population of the United States (minus Florida), using the most recent set of national projections produced by the U.S. Census Bureau. Projections of out-migration were made by applying weighted out-migration rates to the Florida population.

Projections of foreign immigration were also based on data from the 2000 Census. For the high series, foreign immigration was projected to exceed the 1995–2000 level by 10% in 2010–2015 and by 25% during each five-year interval thereafter. For the medium series, foreign immigration was projected to remain at the 1995–2000 level in 2010–2015 and to exceed that level by 10% during each five-year interval thereafter. For the low series, foreign immigration was projected to be 10% less than the 1995–2000 level for each five-year interval after 2010. Foreign emigration was assumed to equal 22.5% of foreign immigration for each series of projections. The distribution of foreign immigrants by age, sex, race, and ethnicity was based on the patterns observed between 1995 and 2000.

Projections were made in five-year intervals, with each projection serving as the base for the following projection. Projected in-migration for each five-year interval was added to the survived Florida population at the end of the interval and projected out-migration was subtracted, giving a projection of the population age five and older. Births were projected by applying age-specific birth rates (adjusted for child mortality) to the projected female population of each race/ethnicity group. These birth rates were based on Florida birth data for 2004–2006 and imply a total fertility rate of approximately 1.8 births per woman for non-Hispanic whites, 2.3 for non-Hispanic nonwhites, and 2.4 for Hispanics. In the low and medium series, birth rates were projected to remain constant at 2004–2006 levels for non-Hispanic whites and to decline gradually over time for Hispanics and non-Hispanic nonwhites. In the high series, birth rates were projected to remain constant at 2004–2006 levels for all three race/ethnicity groups.

As a final step, projections for non-Hispanic whites, non-Hispanic nonwhites, and Hispanics were added together to provide projections of the total population. The medium projection of total population in 2015 was adjusted to be consistent with the most recent state population forecast produced by the State of Florida's Demographic Estimating Conference. None of the projections after 2015 had any further adjustments.

County projections

The cohort-component method is a good way to make population projections at the state level, but is not necessarily the best way to make projections at the county level. Many counties in Florida are so small that the number of persons in each age-sex-race-ethnicity category is inadequate for making reliable cohort-component projections. Even more important, county growth patterns are so volatile that a single technique based on data from a single time period may provide misleading results. We believe more useful projections of total population can be made by using several different techniques and historical base periods.

For counties, we started with the 2010 total population counts reported by the U.S. Census Bureau. For years after 2010, we made projections in five-year intervals for each county using five different techniques and three historical base periods (2005–2010, 2000–2010, and 1995–2010). The five techniques were:

1. Linear – the population will change by the same number of persons in each future year as the average annual change during the base period.

2. Exponential – the population will change at the same percentage rate in each future year as the average annual rate during the base period.

3. Share-of-growth – each county's share of state population growth in the future will be the same as its share during the base period.

4. Shift-share – each county's share of the state population will change by the same annual amount in the future as the average annual change during the base period.

5, Constant population – each county's population will remain constant at its 2010 value.

For the linear and share-of-growth techniques we used base periods of five, ten, and fifteen years, yielding three sets of projections for each technique. For the exponential and shift-share techniques we used a single base period of ten years, yielding one set of projections for each technique. The constant population technique was based on data for a single year (2010).

This methodology produced nine projections for each county for each projection year (2015, 2020, 2025, 2030, 2035, and 2040). From these we calculated three averages: one using all nine projections, one that excluded the highest and the lowest projection, and one that excluded the two highest and the two lowest projections. In 62 counties the medium projection was based on the average in which the two highest and the two lowest projections were excluded. In Escambia and Okaloosa counties we used an average of projections made with the share-of-growth technique and base periods of 10 and 15 years; in Franklin County we used the share-of-growth technique and a base period of 10 years; in Monroe County we used an average of projections made with the constant population technique and the share-of-growth technique with a base period of 15 years; and in Pinellas County we used an average of projections made with the constant population technique and the share-of-growth technique with a base period of 10 years. In all counties, the projections were adjusted to be consistent with the total population change implied by the state projections.

We also made adjustments in several counties to account for changes in institutional populations such as university students and prison inmates. Adjustments were made only in counties in which institutional populations account for a large proportion of total population or where changes in the institutional population have been substantially different than changes in the rest of the population. In the present set of projections, adjustments were made for Alachua, Baker, Bradford, Calhoun, Columbia, DeSoto, Dixie, Franklin, Gadsden, Gilchrist, Glades, Gulf, Hamilton, Hardee, Hendry, Holmes, Jackson, Jefferson, Lafayette, Leon, Liberty, Madison, Okeechobee, Santa Rosa, Sumter, Suwannee, Taylor, Union, Wakulla, Walton, and Washington counties.

Range of projections

The techniques described above were used to produce the medium series of county projections. This is the series we believe will generally provide the most accurate forecasts of future population change. We also produced a series of low and high projections to provide an indication of the uncertainty surrounding the medium county projections. The low and high projections were based on analyses of past population forecast errors for counties throughout the United States, broken down by population size and growth rate. They indicate the range into which approximately half of future county populations will fall, if the future distribution of forecast errors in Florida is similar to the past distribution in the United States.

The range between the low and high projections varies according to a county's population size in 2010 (less than 25,000; 25,000 or more), rate of population growth between 2000 and 2010 (less than 15%; 15–29%; 30–49%; and 50% or more), and the length of the projection horizon (mean absolute percent errors grow about linearly with the length of the projection horizon). For any given county, of course, the actual future population could be above the high projection or below the low projection.

For the medium series of projections, the sum of the county projections equals the state projection for each year (except for slight differences due to rounding). For the low and high series, however, the sum of the county projections does not equal the state projection. The sum of the low projections for counties is lower than the state's low projection and the sum of the high projections for counties is higher than the state's high projection. This occurs because potential variation around the medium projection is greater for counties than for the state as a whole.

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UF | Bureau of Economic and Business Research
Warrington College of Business Administration
UNIVERSITY *of* FLORIDA

221 Matherly Hall
P.O. Box 117145
Gainesville, Florida 32611-7145
phone: 352-392-0171
fax: 352-392-4739
info@bebr.ufl.edu
www.bebr.ufl.edu

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