Arizona Sub-County Population Projections, 2023-2060: Methodology Report

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1. BACKGROUND

Arizona Sub-County Population Projections (2023 edition) are prepared in accordance with Executive Order 2011-04 signed by Governor Janice Brewer. Relevant sections are presented below:

> Section 1: The Arizona Department of Administration (ADOA) shall be the agency designated to produce the official population estimates and projections for the State of Arizona.
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> Section 4: ADOA shall produce the official population projections for each year for a minimum of the next 25-year period. The projections shall be dated as of July 1 and shall include projections for the State, its counties, its incorporated jurisdictions, and the unincorporated balance of each county.
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> Section 6: ADOA shall release the projections for the State's incorporated jurisdictions and the unincorporated balance of each county as soon as possible following the release of the State and county projections, but no later than nine months thereafter.

Executive Order 2011-04 also allows ADOA to incorporate sub-county projections made by Regional Councils of Governments (COGs):

> Section 8. … The Regional Councils of Governments shall submit population projection data for incorporated jurisdictions and the unincorporated balance of the counties to ADOA no later than six months after ADOA's release of State and county population projections in order to be included in ADOA's projections.

Central Arizona Governments (CAG), Maricopa Association of Governments (MAG), and Pima Association of Governments (PAG) made population projections for their respective member agencies in Maricopa, Pinal, and Pima counties. These projections are reviewed and adopted by ADOA and are released along with sub-county projections made by ADOA for places in the other 11 counties. MAG, and PAG each provided its own methodology statement. The methods described in this document apply to the projections made by ADOA.

Executive Order 2011-04 further directs the use of these projections:

> Section 10: Population estimates and projections produced by ADOA in accordance with this Executive Order shall be used by all State agencies for all purposes, including those required by federal law, which necessitates the development of population estimates or population projections.

Executive Order 2011-04 references ADOA because ADOA was the agency that housed the State Demographer's Office at the time the Executive Order was signed. In 2016, Arizona Revised Statutes established the Office of Economic Opportunity (OEO) (A.R.S. §41-5302) and moved the state's demographic research functions into OEO (A.R.S. §41-5402). The State

Demographer's Office is now a unit of OEO. All mentions of ADOA in Executive Order 2011-04 now apply to OEO.

2. METHODOLOGY

Development of the sub-county projections began with research into several different methods of population projection. Each method used different amounts of historical data and produced a wide range of results, some of which revealed inherent problems with their structures. The methods are briefly described below:

Constant Share Method:

$$P_{it} = (P_{il}/P_{jl})\ P_{jt}$$

where,

P_{it} is the population projection for small area *(i)* in the target year *(t)*;
P_{il} is the actual or estimated population for small area *(i)* in the launch year *(l)*;
P_{jt} is the population projection for larger area *(j)* in the target year *(t)*;
P_{jl} is the actual or estimated population for larger area *(j)* in the launch year *(l)*.

The Constant Share method assumes that the share of a place's population of a county remains constant over the projection horizon. This might not be a reasonable assumption for some places. The method forces places to grow at the same rate as the county, which may also be unreasonable in some areas.

Shift-Share Method:

$$P_{it} = (P_{jt})\ [(P_{il}/P_{jl}) + ((z/y)\ ((P_{il}/P_{jl}) - (P_{ib}/P_{jb})))]$$

where,

b denotes the base year;
z is the number of years in the projection horizon (between launch year and year *t*);
y is number of years in the base period.

The Shift-Share method accounts for changes in population shares over time. Over long projection horizons, it can lead to population losses for small areas that had declined or grew very slowly during the base period. It can result in a negative population.

Share-of-Growth Method:

$$P_{it} = P_{il} + [(P_{il} - P_{ib})/(P_{jl} - P_{jb})]\ (P_{jt} - P_{jl})$$

The Share-of-Growth method assumes that a place's share of county growth will be the same over the projection period as in the base period. This can result in a negative population. Also, when the direction of growth for a place is opposite that of the county, the method incorrectly distributes the growth.

Plus-Minus Distribution:

$$POSFACTOR = [ABSUM + (CNTRLCHG - SUM)]/ABSUM$$

$$NEGFACTOR = [ABSUM - (CNTRLCHG - SUM)]/ABSUM$$

where,

SUM is the sum of the population changes experienced by each place within the base period;
ABSUM is the sum of the absolute values of the population changes experienced by each place within the base period;
CNTRLCHG is the projected county population change between the launch year and the target year.

The Plus-Minus method distributes the county population change to places based on the change occurring within the base period. POSFACTOR and NEGFACTOR are applied to a place's growth since the launch year based on the direction of that growth. This takes into account that some places experienced growth in the opposite direction of their county. However, places with zero population may not receive any adjustment, and results can be negative.

The methods described above are collectively referred to as "ratio methods."

GIS Boundary Matching

Although most incorporated places have existed for many decades, some Census Designed Places (CDPs) that existed in 2020 did not in previous decennial censuses. Even if a CDP of the same name had existed for the previous censuses, it may have covered a much smaller or much larger area. Utilizing 2020 place boundaries and block-level census data and maps from 1990, 2000, and 2010 censuses, we created historical data for each place. These data were used as alternative base data for the ratio methods we researched. If the historical data were correct, we would see a more accurate picture of where growth occurred in the CDPs. However, we suspect that this method did not work correctly in some counties due to inaccurate maps or block-level population data, especially for 1990. Instead of being used as inputs to create draft projections, these data were ultimately employed as a tool for discussion with the jurisdictions to better understand areas on a case-by-case basis.

Forecast Model:

Intercensal estimates for 1980-2019 and postcensal estimates for 2020-2022 were used as input to the SPSS 26 forecasting procedure for each incorporated place and unincorporated balance of county. The optimal forecast model (ARIMA, Holt, Brown, or Simple exponential smoothing

model) for each place was chosen algorithmically by SPSS and used to forecast population from 2023 to 2060.

None of the methods reviewed were appropriate for all places. In some cases, the results of the ratio methods projected negative population, or an unreasonable rate or direction of population change for smaller places. The forecast models[1] were chosen to produce the preliminary population projections for incorporated places and the unincorporated balance of counties because they were based on many more historical data points than the ratio methods and produced a higher percentage of feasible projections. These results were first adjusted to pass through the official OEO population estimate for 2022 and then adjusted proportionately to achieve agreement with the official published population projection for each county. The population for each CDP was then created by distributing the adjusted balance of county estimates according to the Census 2020 share of the balance of county population (constant share method).

Regional councils of governments (COGs) and several jurisdictions reviewed the preliminary projections. Their local knowledge about planned economic development, resource constraints, and demographic patterns in specific areas guided adjustments to the preliminary projections. Several rounds of consultation were conducted before the sub-county projections were finalized.

3. LOCAL KNOWLEDGE AND ADJUSTMENTS

Adjustments to the preliminary sub-county projections were made on a case-by-case basis to create a reasonable picture of population change within each county. Whenever possible, the most recent general plans for incorporated places were reviewed and used as a "reasonableness check" on the preliminary and revised population projections. The description of adjustments is provided below. Final projections for places that are not addressed in the sections below are equivalent to the preliminary numbers.

Apache County:
No changes were made to the preliminary projections.

Cochise County:
All incorporated places and the unincorporated balance of county underwent adjustment because their forecast models appear to carry past trends of growth or decline to extreme levels through the projection horizon. Much of Douglas' recent population decline was due to a reduction in prison population which had an outsize influence on the forecast. Instead of using the forecasted population decline, the population was held constant from 2022 onward. For all other places, the projected value for 2040 was reassigned to 2060. The populations for 2023-2059 were then obtained by linear interpolation. This technique prevented the forecast

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[1] Model statistics are available upon request for all incorporated places and the balances of county.

model from carrying a trend too far and too fast into the future (it was also used for several other jurisdictions in other counties for the same rationale). All places were then proportionately adjusted to preserve consistency with the county population.

Coconino County:
No changes were made to incorporated places. However, several CDPs were identified as growth areas with planned development to be considered, many of which did not exist on Census Day 2010. The area plan for Bellemont specified a build out of 1,020 residential units. This implied an additional 567 housing units will be added to the Census 2020 housing stock. Satellite imagery showed that most of these units will be RVs. Build out was assumed by 2030 with a persons per household attributed to RV residents based on a study about RVers[2]. Occupancy rate of RV lots was assumed to be 75 percent. This added about 787 persons to the CDP, and the population was held constant going forward.

Based on the area plan for Doney Park, Mountain View Ranches, and Timberline-Fernwood and feedback from local partners, an additional 380 housing units were assigned to reach build out by 2040. The housing units were distributed proportionately to each CDP with additional populations calculated using Census 2020 persons per household and occupancy rates. The build out populations were assigned to 2040 and held constant until 2060.

All CDPs were then proportionately adjusted to preserve consistency with the projected population of the unincorporated balance of county.

Greenlee County:
No changes were made to the preliminary projections.

Graham County:
No changes were made to the preliminary projections.

Gila County:
The projected values for 2040 were reassigned to 2060 in Hayden and Miami. The populations for 2023-2059 were then obtained by linear interpolation. All places were then proportionately adjusted to preserve consistency with the county population.

La Paz County:
The population of Quartzsite was held constant. All places were then proportionately adjusted to preserve consistency with the county population.

Maricopa County:
Official sub-county projections for this county were produced by Maricopa Association of Governments (MAG). They were reviewed and adopted by OEO. The MAG methodology can be

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[2] https://escapees.com/census-results-are-in-who-are-rvers

found at
https://azmag.gov/Programs/Maps-and-Data/Population-Housing/socioeconomic-Projections.

Mohave County:
No changes were made to the preliminary projections.

Navajo County:
All incorporated places and the unincorporated balance of county underwent adjustment. Completion of 400 residential units in Winslow was assigned to 2040; Census 2020 persons per household and occupancy rate were used to calculate population which was then held constant to 2060.

Feedback from NACOG suggested that Pinetop-Lakeside is experiencing a large influx of people who can work remotely. The feedback also pointed to recent housing construction and suggested that this is a growth area. A review of historical data showed that Pinetop-Lakeside grew rapidly between the mid-1980s and the mid-2000s but shifted to gradual decline in the last 15 years. Although there might have been a recent influx of people working from home, with many companies instituting return to office policies, more remote workers are not expected. Persons per household have declined significantly since 2010 and will likely continue to decline. Given the low occupancy rates from recent decennial censuses, much of the current construction of residential units is most likely to be vacation or second homes. For these reasons, and against the background of decline in projected county population, the population was held constant from 2022-2060. The same adjustment was made for Pinetop Country Club.

For the remaining incorporated places and unincorporated balance of county, the projected values for 2040 were reassigned to 2060, and populations for 2023-2059 were obtained by linear interpolation. All places were then proportionately adjusted to preserve consistency with the county population.

Pima County:
Official sub-county projections for this county were produced by Pima Association of Governments (PAG) in cooperation with OEO. They were reviewed and adopted by OEO. The PAG methodology can be found at
https://pagregion.com/wp-content/docs/pag/2023/08/2022-Sub-county-Population-Projection-Method_20230825-Final.pdf

Pinal County:
Official sub-county projections for this county were produced by Maricopa Association of Governments (MAG). They were reviewed and adopted by OEO. The MAG methodology and projections can be found at
https://azmag.gov/Programs/Maps-and-Data/Population-Housing/socioeconomic-Projections.

Santa Cruz County:
For all incorporated places and the unincorporated balance of county, the projected values for 2040 were reassigned to 2060, and populations for 2023-2059 were obtained by linear interpolation. All places were then proportionately adjusted to preserve consistency with the county population.

Yavapai County:
The projected values for 2040 were reassigned to 2060 in Camp Verde and Clarkdale. The populations for 2023-2059 were then obtained by linear interpolation. Projections for Dewey-Humboldt were developed using an average of the share of growth method and the forecast model. Jerome, which only gained 30 people between Census 2010 and Census 2020, had its population held constant from 2022- 2060. All places were then proportionately adjusted to preserve consistency with the county population, except for Wickenburg which was projected by MAG.

Yuma County:
One incorporated place and one CDP were adjusted in Yuma County. Somerton was set to experience the same annual growth as Yuma for the entire projection horizon. Since it is primarily a vacation community, Martinez Lake (not published due to its small population size) was expected to regain its Census 2010 number of occupied units with the Census 2020 persons per household by 2030. The population was held constant going forward. All places were then proportionately adjusted to preserve consistency with the county population.

4. INCLUSION OF PLACES

MAG and PAG each made their own decision as to what places to include in sub-county projections. OEO accepted those choices after determining that they meet the minimum requirement of Executive Order 2011-04. Working with Central Arizona Governments (CAG), Northern Arizona Council of Governments (NACOG), Southeastern Arizona Governments (SEAGO), and Western Arizona Council of Governments (WACOG), OEO decided to produce population projections for all incorporated places, the unincorporated balance of counties, all CDPs, and the small balance of counties in 12 counties. Due to the high degree of variability and uncertainty, it was decided that CDPs with a Census 2020 population of less than 500 be excluded in the final publication of sub-county population projections.