SALGST

Version 5.20

Description

This workbook projects the total populations of subnational areas using a logistic function and controls projected subnational populations to a national projected population series.[1] The resulting projections are consistent with the national totals.

Data Required

(1) Year, month, and day of first date of data available by subnational area (e.g., census date)

(2) Year, month, and day of second date of data available by subnational area (e.g., census date)

(3) Selected dates for projection: first date, last date, and year intervals between first and last date

(4) Total national population for each of the selected projection dates

(5) Total subnational populations for the first and second input dates

Assumptions

This workbook assumes that the proportional distribution of population by subnational areas over time can be represented by logistic curves.

Procedures

The projection calculation entails the following steps:

(1) For the first and second dates for which subnational area population data are available, proportions of the national population that the subnational areas constitute are calculated.

(2) The proportions calculated in Step 1, together with their reference dates and asymptotes (either default or user-defined) are used to calculate logistic growth rates, reflecting change in proportion between the first and second dates. For each subnational area i, the proportion (that the subnational population represents of the national population) at the second date is subtracted from the upper asymptote, and this difference is divided by the difference generated by subtracting the lower asymptote from the proportion at the second date.

(3) For each subnational area, the proportion (that the area represents of the nation) at the first date is subtracted from the upper asymptote, and this difference is divided by the difference generated by subtracting the lower asymptote from the proportion at the first date.

[1] Use of mathematical functions, including the logistic, for extrapolating population totals are discussed in Arriaga (1994) as well as by George et al. (2004). Arriaga developed the prototype for SALGST.xls.

(4) The quotient from Step 2 is divided by the quotient from Step 3, and the natural logarithm of the result is calculated.

(5) The result of Step 4 is divided by the interval between the first and second date.

Mathematically, for subnational area i the logistic growth rate is:

$$GR(i) = \ln(\{[U(i)-PR(t_2,i)]/[PR(t_2,i) - L(i)]\}/\{[U(i)- PR(t_1,i)]/[PR(t_1,i)-L(i)]\})/(t_1-t_2)$$

where:

GR(i) = logistic growth rate for subnational area i

U(i) = upper asymptote for subnational area i

PR(t,i) = proportion that subnational area i represents of the national population at time t

L(i) = lower asymptote for subnational area i

t_1 = first date for which data are available; also the first proportion date

t_2 = second date for which data are available; also the second proportion date

Projection of the subnational area proportions to one or more future dates uses the calculated logistic growth rates:

$$PR(t,i) = L(i) + [U(i) - L(i)] / (1 + \{[U(i) - PR(t_2,i)] / [PR(t_2,i) - L(i)]\} * \{Exp[-(t - t_2) * GR(i)]\})$$

where:

PR(t,i) = projected proportion of the national population in subnational area i at some future time t

$PR(t_2,i)$ = base proportion of subnational area i (to national population); this is the proportion at time t_2

GR(i) = logistic growth rate for subnational area i

t = future year for projected population

t_2 = year to which base proportion pertains

After proportions are projected for the subnational areas, they are adjusted so that their aggregate sums to 1 (or 100 percent):

$$APR(t,i) = PR(t,i)/\sum_i PR(t,i)$$

where:

PR(t,i) = proportion that subnational area i was projected to represent of the national population at time t

APR(t,i) = proportion that subnational area i was projected to comprise of the national population at time t, adjusted so that the summation of proportions of all subnational areas equals 1 (or 100 percent)

The last step in the projections process entails multiplying a projected national-level population total, for each projection year, by the subnational proportions controlled to 1 (or 100 percent).

$$P(t,i) = P(t)*APR(t,i)$$

where:

P(t,i) = population projected of subnational area i at time t

P(t) = projected population at the national level at time t

APR(t,i) = projected proportion of subnational area i at time t

Advantages

The workbook provides a means of establishing consistency between projected national and subnational area population trends and consistency across subnational area projected population trends.

Limitations

The method does not account for aberrant or dramatically shifting population growth patterns at the subnational level. Such growth often occurs in countries enduring periods of civil conflict or natural disasters, wherein large numbers of refugees and internally displaced persons move disproportionately into and out of select subnational areas.

References

Arriaga, Eduardo E. 1994. ***Population Analysis with Microcomputers***. With Peter D. Johnson and Ellen Jamison. Washington, D.C.: U.S. Bureau of the Census, U.S. Agency for International Development, and United Nations Population Fund. Volume 1, Chapter VIII.

George, M.V., Stanley K. Smith, David A. Swanson, and Jeff Tayman. 2004. "Population Projections," in David Swanson and Jacob S. Siegel, eds., ***The Methods and Materials of Demography***, 2nd Edition. San Diego: Elsevier, Inc., pp. 561-601.

Note

For access to all Subnational Projections Toolkit workbooks and documentation, go to: http://www.census.gov/population/international/software/sptoolkit/