

## RUPSubAdj

Version 5.20

### **Description**

This workbook proportionally adjusts subnational populations and components of change by age and sex from Rural-Urban Projection (RUP) program projections to be consistent with a national-level RUP projection.

### **Data Required**

- (1) National-level RUP file that has been run, and the location of the directory where the RUP and its output intermediate (.io1) files are stored.
- (2) Preliminary RUPs for subnational areas that cover the nation, and the location of the directory where the RUPs and their output intermediate (.io1) files are stored.
- (3) The location of a directory where output adjusted subnational projection files from RupSubAdj can be stored, as designated by the workbook user.

### **Assumptions**

The procedure assumes the national-level estimates and projections are more accurate than the summation of the subnational-level estimates and projections.

For population and each component of change, the procedure assumes equal levels of adjustment across all subnational areas for each variable, sex, age, and projection year.

### **Procedure**

The procedure upwardly and/or downwardly controls the subnational areas to the national total concurrently for all components of change—fertility, mortality, internal migration, and international migration—and population:

- (1) Controlling subnational population, births, and deaths. To control population, births, and deaths for each year, sex, and age at the subnational to the national level, the program sums the given component of change, calculates the ratio of the national-level population over the summation of the subnational populations (or births and deaths), and then multiplies this ratio by each subnational area population (or births and deaths). Ratios may differ across years, sex, and age, but within each year, sex, and age, they will be equal across all subnational areas. If rates rather than events are input into either a national or subnational RUP input file, the program will convert the rate to an event before controlling.
- (2) Controlling level of births by age of mother. For each single-year of age of females in their reproductive years, ages 10-54, subnational births are controlled upward and/or downward to the national-level births. The births by age of mother are then disaggregated by sex using the national-level sex ratio at birth as a control.
- (3) Allocating and controlling internal and international migrants. The surplus or deficit in migrants across regions (the deviation from zero) in proportion to region-specific

absolute number of net migrants is used to adjust internal migration, and to ensure net internal migrants of subnational areas sum to zero (Leete 1992). This standard method was modified using the “plus-minus” method (Smith, Tayman, and Swanson 2001) to allocate migrants by also accounting for the ratio of the total population of each subnational area to the national area for each year.

The formulas for the adjustment to variable V (population, deaths, or births) are as follows:

$$fV(y,s,a) = NV(y,s,a) / \sum_r V(r,y,s,a) \quad (\text{if } \sum_r > 0)$$

$$V'(r,y,s,a) = V(r,y,s,a) * fV(y,s,a)$$

The formulas for the adjustment to variable M (internal or international migration) are as follows:

$$fM(y,s,a) = \left[ \sum_r M(r,y,s,a) - NM(y,s,a) \right] / \sum_r P(r,y,s,a)$$

$$M'(r,y,s,a) = M(r,y,s,a) - fM(y,s,a) * P(r,y,s,a)$$

where:

a = age

s = sex

y = year

r = subnational area

fV(y,s,a) = adjustment factor for variable V, year y, sex s, and age a

NV(y,s,a) = national value for variable V

V(r,y,s,a) = preliminary value for variable V for subnational area r

V'(r,y,s,a) = adjusted value for variable V for subnational area r

fM(y,s,a) = adjustment factor for variable M

NM(y,s,a) = national value of migration variable M

M(r,y,s,a) = preliminary value of migration variable M for subnational area r

P(r,y,s,a) = value of population variable P for subnational area r

M'(r,y,s,a) = adjusted value of migration variable M

### **Advantages**

The workbook provides an efficient means of establishing consistency between national and subnational area estimates and projections. The algorithm tends to be especially useful in cases where internal migration is measured with rates since the application of these rates to each subnational area fail to generate a zero net migration total for the regions of a country.

## Limitations

- (1) The adjusted subnational area projections of population and components of change are not automatically displayed by the RUPSubAdj workbook. The projection outputs are only accessible using the Excel interface for RUP, RUPEX.xls, to open the output of the newly adjusted RUP files in the directory specified by the workbook user. In order to use the RUPSubAdj workbook, a moderate level of proficiency in accessing and running RUP files is required.
- (2) The procedure assumes that each subnational area contributes to an equal degree to the discrepancy between the national-level RUP and the summation of the subnational RUPs. The projection variables that undergo adjustment (population, deaths, births, international migrants, and, in some cases, internal migrants) are assumed to have the same level of discrepancy for each subnational area, and that consequently, equal proportional adjustments are appropriate to establish consistency with the national-level projections. This assumption may be violated where one or more areas has been subjected to unusual demographic change due to natural or human disaster. The accuracy of the estimates for subnational areas may also vary, but this method treats them all as equally accurate, so it may be, for example, increasing deaths in an area where the data are good but undercorrecting the deaths in an area with significant underreporting of mortality.
- (3) Using the RUPSubAdj spreadsheet alone may result in forcing extraneous adjustments on some (or all) subnational area variables, which would ultimately compromise the accuracy of the final set of subnational estimates and projections. This would occur when components of change are input as rates such as age-specific fertility rates (ASFRs), instead of events, such as births. In most cases, preliminary work to establish consistency between subnational and national RUPs should be conducted prior to use of RUPSubAdj. This preliminary work can be conducted with workbooks CTBL32, PROJE032, and PROJTFR032, which help establish agreement between subnational and national area population and other projection inputs.

## References

- Leete, Richard, 1992. **PEOPLE**. With Fong Cheng Hong, Cheng Fan Soon, and Geoff Simmons. Software and documentation distributed by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).
- Smith, Stanley, K., Jeff Tayman, and David A. Swanson. 2001. **State and Local Population Projections and Analysis**. Kluwer Academic/Plenum Publishers: New York.

## Note

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