GLAINTELLIGENCE

Update 2017-05

Annex to Trend Projection Methodology

Updates for the 2015-based projections

February 2017

Introduction

This annex details changes made to the GLA's trend methodology[1] for the interim 2015-based projections.

1. Age specific fertility rates used within the model are now smoothed before use in the model.
2. The model now includes the option of directly including unattributable population change as a component in the projections.

The first change was in response to the recommendations of the review undertaken by the ESRC Centre for Population Change at the University of Southampton. This final report from this review is available on the London Datastore[2].

The methodology is otherwise unchanged from that used to produce the 2015 round of projections published in July 2016.

Smoothing age-specific fertility rates

Base age specific fertility rates (ASFR) are derived from the detailed components of change for the most recent set of ONS subnational population projections (SNPP). For the 2015 round projections, these rates were used without smoothing.

For the 2015-based projection, a smoothing process has been integrated into the model to reduce random fluctuations in the data. The approach used is to use a function to fit double-peaked Hadwiger mixture curves (Chandola *et al*. 1999)[3] to the age-specific fertility rates.

The double-peak Hadwiger curve is given by the expression:

$$f(x) = am\left(\frac{b_1}{c_1}\right)\left(\frac{c_1}{x}\right)^{3/2}\exp\left\{-b_1^2\left(\frac{c_1}{x}+\frac{x}{c_1}-2\right)\right\} + (1-m)\left(\frac{b_2}{c_2}\right)\left(\frac{c_2}{x}\right)^{3/2}\exp\left\{-b_2^2\left(\frac{c_2}{x}+\frac{x}{c_2}-2\right)\right\}$$

[1] https://files.datapress.com/london/dataset/2015-round-population-projections/2016-07-04T14:15:19/GLA%20trend%20projection%20methodology.pdf

[2] Hilton, J., Bijak, J., Forster, J. (2016) Independent review of population projection methodology of the Greater London Authority

[3] Chandola, T., Coleman, D.A., Horns, R.W. (1999) Recent European fertility patterns: fitting curves to 'distorted' distributions. Population Studies, 53, 3:317-329.

Where:
x is age of the mother at birth

(x) is the fertility rate at age x f

m is a mixture parameter that determines the relative sizes of the two component distributions

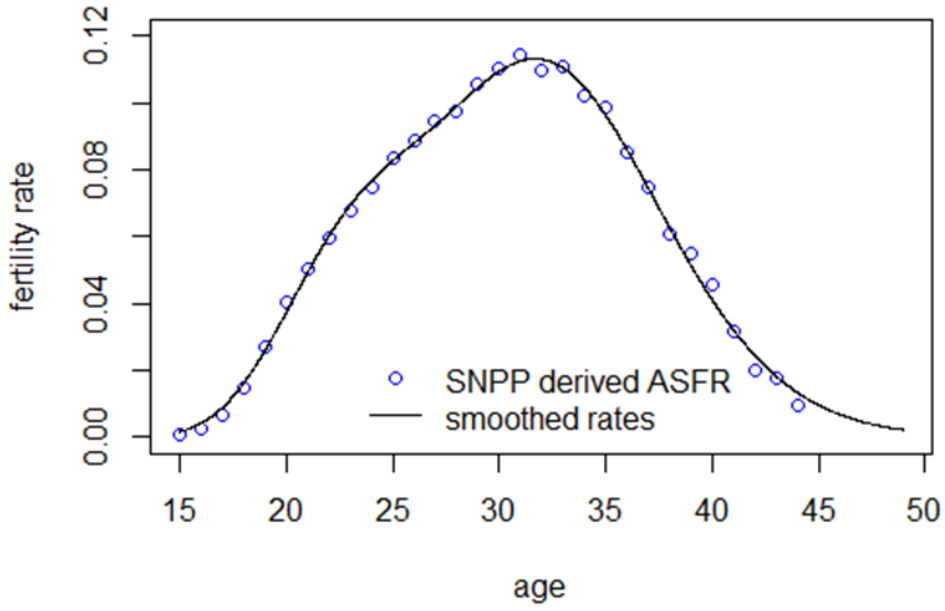
a, b_1, c_1, b_2, c_2 are other model parameters related to total fertility and the level and trend of the mean ages of fertility in the two component distributions.

The input data to the function is a set of ASFR for each local authority for ages 15 to 44 (the range for which ONS outputs births by single of age of mother from the SNPP). The output is a set of smoothed rates for ages 15 to 49, with ages 45 to 49 calculated by extrapolation of the fitted curve (see Figure 1).

A Levenberg-Marquardt Nonlinear Least-Squares algorithm is used to fit a curve to each set of data, with starting points chosen based on previously fitted curves from 2011, and convergence tests as described here: https://cran.r-project.org/web/packages/minpack.lm/minpack.lm.pdf using the package defaults for convergence conditions. The parameters of the fitted curve are then used to calculate new rates for each age.

If convergence does not happen within 200 iterations, a grid search method is used to run the Levenberg-Marquardt Nonlinear Least-Squares algorithm with a range of starting values in order to find the best fit. If no fit is found then the data for that local authority is left unchanged.

Figure 1: Raw and smoothed fertility rates for Brent



Incorporating Unattributable Population Change

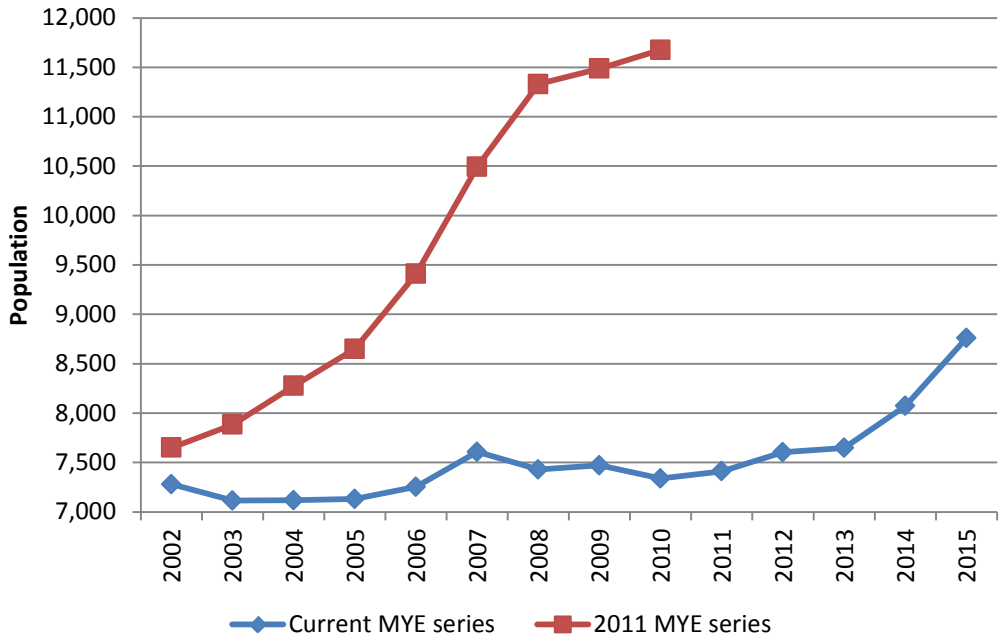
The 2015 round methodology projected forward using the standard components of population change: fertility, mortality and migration. The ONS revised mid-year estimate series for 2001 to 2011 accounted for differences in the populations that cannot be reliably attributed to specific gross migration flows or error in the start or end population estimates by adding a component labelled *Unattributable Population Change* (UPC) into the estimate series.

The GLA has previously avoided having to include UPC explicitly in its projections by producing its own estimates backseries and assigning all population change to standard components. Together with improvements in the quality of ONS's international inflow estimates following the Migration Statistics Improvement Programme, this has been judged sufficient to avoid the need to directly consider UPC.

The decision to include a facility to explicitly include UPC components in the projections was made largely to address issues with projections for the City of London. It was felt that official estimates for the City since 2011 gave unrealistically high population growth, which were reflected in subsequent projection results.

Overestimates of growth in City were an issue throughout the last decade when official data suggested growth of over four thousand (Figure 2). The 2011 census showed that City had actually experienced a negligible increase in population over the period. In the revised mid-year estimate series produced in 2013, ONS reconciled census population and annual migration estimates by including an annual outflow of 400 persons through UPC.

Figure 2: Comparison of current and pre-census population estimates for City of London



Though a judgment was made by the GLA regarding the scale of adjustment that would be appropriate, it was not clear how it should be distributed between the gross migration components of change. It was deemed that the simplest and most transparent approach was to apply an adjustment to the projected population within the model.

Currently the adjustment is applied only to the City of London. This takes the form of a fixed 'outflow' from the population made after all other components have been applied.

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