

Area tematica: 39 Modelli gerarchici e di superpopolazione

A way to solve the consistency question in a demographic multiregional cohort component model

Un modo per risolvere il problema della consistenza nelle previsioni demografiche multiregionali a componenti di coorte

Alessandro Valentini

Ricercatore Istat, alvalent@istat.it

Riassunto: Nella proiezione di popolazioni locali l'approccio più avanzato dal punto di vista metodologico è quello, a due livelli, multiregionale con componenti di coorte. Ai fini della programmazione territoriale è spesso opportuno garantire (attraverso un algoritmo di *consistenza*) che il cambiamento nella composizione delle aree di livello geografico più basso (ulteriori suddivisioni, accorpamenti, utilizzo di nuovi criteri funzionali) non modifichi i risultati aggregati (a livello di super popolazione).

Nella presente nota viene presentata una procedura generalizzata (sviluppata in VB) per la realizzazione di proiezioni con algoritmi di consistenza territoriali che tenga conto contestualmente della presenza di vincoli: a) nelle singole componenti del bilancio demografico; b) nella struttura per genere e per età.

Keywords: multiregional projections, consistency, constraints, equations of projection

The multiregional cohort component model (Willekens and Drewe, 1984) is the methodologically most advanced approach in projecting local populations. This approach is mostly used in many Countries of the world, especially in Europe and North America. The main reason of such a success is that all the areas are projected simultaneously. In such a way both the specific demographic rates of each sub-population and the point-to-point migrations are preserved. The method consists of a bi-level system in which the total at a higher level is calculated summing up the populations at a more concentrated geographical detail (second level). In the case of projections for the Italian regions, for instance, the national total is obtained summing up the regional figures.

The change in the composition of at least one area, the collapse of two areas or a further split of an area, give rise to alterations in the total results at the first level and for each single area at the second level, even in not altered areas. Despite differences in the results are technically attributable to heterogeneity, they are very difficult to understand for the users of projections. Therefore, in order to guarantee the (geographically) aggregated results of preceding projections based on a different geographical system, it is sometimes necessary to use particular procedures respecting some constraints considered valid on the technical or on the political point of view. The problem of respecting certain constraints coming from external sources is called, in literature, the problem of external consistency (Keilman N., 1985; Van imhoff, 1992).

The procedure is based on (continuous) changes in the *projection equations*, and may be applied to produce the first set of projections or, more often, subsequent releases. For instance, once calculated the national and regional forecasts (respectively

first and second level), in a further step it could be useful to predict the population of the provinces of a region (third level). In addition to this, the population of the region could be disaggregated using *new* third level areas (for instance socio-sanitary districts, local economic systems, and so on). The recalculation of the national projections based on new (second level) areas may constitute an important output. The degree of urbanisation, the coastal/ mountainous relief, the classes of demographic dimension are only some examples. An other application could be the aggregation of two or more regions on the basis of geographical, economical or functional new parameters.

In the above mentioned cases the aggregated (at various levels) total has to be constrained by the results of the original model. In the meanwhile the algorithm of projection should be robust and preserve the main characters of the multiregional system (with area-specific rates and point-to-point migrations). Despite the very practical interest of such applications international literature is very scarce about the methodologies to use in such cases (Simpson, 2004).

The main aim of the present paper is to introduce a generalised procedure to generate demographic forecasts under geographical consistency constraints. The procedure is perfectly integrated into each multiregional cohort component model and is able to take into account two kinds of external constraints for the super-population: a) the total amount of the various demographic components (births, deaths, immigrations and emigrations); b) the total population, for each group, by age and gender. The algorithm runs at the end of each year of projection. Firstly the consistency is imposed on the absolute figures of the demographic balance and subsequently on the age profiles of certain events (internal and international migrations). The algorithm minimises the changes in the transition rates. It can also be applied to adequate the flow data (and the concerned rates) for the first year of projection when birth, death or migration rates are available since the base year, but with insufficient detail to create an updated base year population. The software is developed in Visual Basic for Access. It is the result of the experience acquired realising multi-area demographic projections for Emilia Romagna (Bonaguidi et al., 2004).

References:

- Bonaguidi e al. (2004) Le previsioni demografiche, *Scritti di demografia, Regione Emilia Romagna*
- Keilman N. (1985) Internal and external consistency in multidimensional population projection models, *Environment and Planning A*. 17 (1985): pp. 1473-1498
- Kupiszewski and Kupiszewska (1998) Projection of Central and East European Populations – the model, the data and preliminary results, in: J. Fleischhacker and R. Münz (eds.), *Gesellschaft und Bevölkerung in Mittel- und Osteuropa im Umbruch*, Demographie Aktuell 13, Humboldt Universität, Berlin, 22–40.
- Rogers A. (1995) *Multiregional demography*, Wiley & sons ltd, New York
- van Imhoff E. (1992), A general characterization of consistency Algorithms in Multidimensional Demographic Projection Models, *Population studies* 46 (1992): pp. 159-169
- Simpson L. (2004) Integrating estimates within population forecasting, *Applied population and Policy* 1(2): 89-104
- Willekens F.J. and Drewe P. (1984) *Demographic Research and Spatial Policy*, Academic Press, London