

A Possible Reconstruction of L'Aquila Population by Age Structure from 1810 to 1859: an Application and a Comparison between Two Methods

*Un Tentativo di Ricostruzione per Età della Popolazione dell'Aquila dal
1810 al 1859: Applicazione e Confronto tra Due Metodi*

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Riassunto: Obiettivo del lavoro è ricostruire la struttura per età della popolazione dell'Aquila per il periodo 1810-1859. Al fine di sopperire alla mancanza di fonti statistico-demografiche per lo studio di popolazioni storiche, sono state utilizzate due tecniche di Proiezione Stocastica Inversa: l'*Inverse Projection Differenziata* (IPD, Rosina 1993) e l'*Inverse Projection Stocastica in Avanti* (SIPAV, Bertino S., Sonnino E., 1995). Per mostrare le analogie e le differenze tra le due metodologie sono stati analizzati alcuni dei principali indicatori demografici (speranza di vita alla nascita, tasso di fecondità totale) che permettono di osservare una sostanziale congruenza degli scenari forniti.

Keywords: Inverse Projection, Age Structures, Historic Demography

1. Introduction

The situations' heterogeneity in terms of sources availability and quality moved to a very huge number of innovations in the field of the demography applied to historic populations in the last decades. These progresses allowed to create and improve some historic data analysis methods in which became very important the Inverse Projection ones. These methods enable to estimate a population age structure and main demographic indicators, using births and deaths historical series, same population age structure at a fixed initial time and model life tables. This paper shows a comparison between the results obtained by the IPD, developed by Rosina in 1993, and by SIPAV, developed by Bertino and Sonnino in 1995, used to reconstruct L'Aquila ⁽¹⁾ population age structure from 1810 to 1859 in order to show analogies and differences.

2. Differentiated Inverse Projection (IPD): method and data

Since XIX century with the availability of deaths historical series and their by age distribution information, IPD method proposed by Rosina (1993) - extended and modified version of Lee (1974) Inverse Projection, aggregative, not nominative,

⁽¹⁾ L'Aquila in XV and XVI Centuries was the 2nd important city of the South of Italy but a reliable estimate of its population started in 1810, 7323 inhabitants, with *Stati di Popolazione* and Civil State registers. These documents give a very specific demographic balance yearly but the age structure it's available only for few years and too large age classes.

population reconstruction system - allows to overcome the limit, pointed out by Lee himself, of mortality constant variations by age and to provide improvement of survival total estimates and, moreover, to obtain information on mortality patterns. Variations of mortality curves level as well as their shape are allowed. Even if deaths basic data are not much precise it is always possible to obtain a young people as well as an adult people death class. In this way two mortality levels are applied to the initial population allowing to catch the young age possible behavior in comparison with the adult one. This method enables to estimate mortality and fertility main measures starting from births and deaths series, utilizing mortality, fertility and net migrations patterns and pointing out a strong preciseness not only in the initial population estimate but also in the migrations dealing. The available data, utilized for the age structure of L'Aquila population reconstruction, are:

- total population historical series from 1810 to 1859 (drawn from L'Aquila *Stati di Popolazione*);
- age structure (on five-year period classes) estimated from the near municipalities of Cerchio in 1811 and Avezzano in 1813 age structures;
- births and deaths series from 1810 to 1859, drawn from L'Aquila *Stati di Popolazione*; missing data from 1831 to 1838 are drawn from *Civil State* records (Natale S., 1999) and for five-year period 1835-40 an estimation has been provided;
- Coale and Demeny model life tables, by sex, relative to initial and final period (south model, respectively 5 and 7 levels).

3. Inverse Forward Stochastic Projection (SIPAV): method and data

The Inverse Projections methods use macro simulation procedures, which give only one possible population reconstruction dependent of mortality and fertility chosen parameters. To avoid the unique scenario problem, Bertino and Sonnino developed a stochastic procedure that, using different micro simulations obtained with the same mortality and fertility models, gives some probable scenarios coherent with the historic contest. According to modality of estimating the probability distribution of age at death, it's possible to distinguish two different techniques of Inverse Stochastic Projection: SIPAV and SIPIN (Inverse Backward Stochastic Projection)⁽²⁾. In our analysis, starting with population amount and structure at time t , with the events happened in a fixed period and assuming specific trends for mortality and fertility, SIPAV enables to determine a population reconstruction for a definite period. The population time series are products of a stochastic process where births and deaths are the events. Therefore, if the age-sex structure is known at the start of the time t , it's possible to determine the structure for the following year using the births and deaths series. Simulating the age-sex births and deaths structure it's possible to create different population structures and to estimate the demographic indicators (T.F.R., life expectancy, etc.). Results are the average of the 27 simulations performed. The data used are:

- population time series by sex, from 1810 to 1857 (drawn from L'Aquila *Stati di Popolazione*);

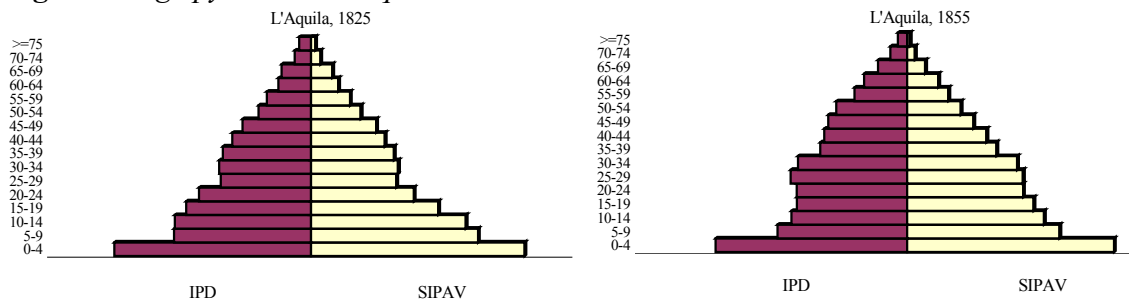
⁽²⁾ The difference between the procedures "forward" and "backward" lies in the determination of the probability distribution of the Age of Death (X). While in SIPAV the population structure is known before the event, in SIPIN we determine the distribution *a posteriori*.

- yearly age structure distinguished by sex at the initial year; it is estimated from the near municipalities of Cerchio in 1811 and Avezzano in 1813 structures;
- births and deaths series from 1810 till 1857, drawn from the L'Aquila *Stati di Popolazione*; missing data in 1827 and 1854 and in the period 1831-1838 are drawn from the Civil State registers (Natale S., 1999);
- by age specific fertility rates (15-49), related to the total fertility rate (TFR), are kept constant through all period;
- Coale and Demeny model life tables, distinguished by sex, related to initial and final period (South model, respectively 5 and 7 level);
- standard migratory curve distinguished by age (0-59).

4. The results comparison

In order to simplify the results analysis and, mostly, the comparison between the two methods, the age pyramids are built with regard to two different years of the study. Using these pyramids it's possible to compare the age structure, for both sex ⁽³⁾, coming out from the two methods (figure 1). Even if the results are almost the same and show a population becoming always younger, the phenomenon results wider in case of the SIPAV method. As a matter of fact it's possible to observe a young people larger proportion and an old people lesser percentage in the right part of the pyramid; these differences are stronger as time goes by.

Figure 1: Age pyramids, L'Aquila, 1825 and 1855

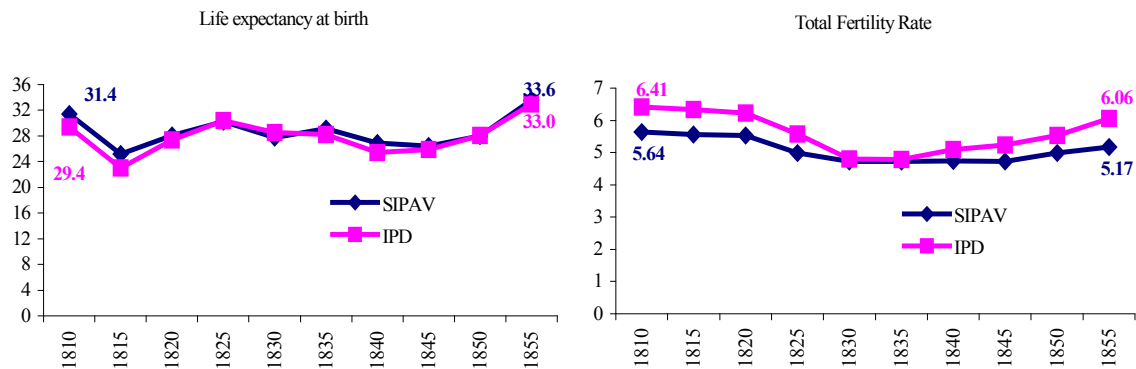


Taking into consideration the life expectancy at birth in the observed period by the SIPAV and IPD methods, a huge decrease is shown in the first five years for both techniques because of the louse-borne typhus of the 1817. The results are coherent with the historic events. With the exception of the first five years the curves are almost similar and trend to converge in the last period (figure 2). As far as total fertility rate is concerned, it's possible to observe a decrease from 1810 to 1830-1835 and, then, an inversion until it reaches the value 6.06 for IPD and 5.17 for SIPAV ⁽⁴⁾. Differences between the two methods reach the major gap in the inspected initial and final year. Higher IPD values shown through all the period due to the fact that IPD estimates have been carried out at joined sex level.

⁽³⁾ The sex distinction is available only in the SIPAV method.

⁽⁴⁾ SIPAV also yields standard deviations. The highest standard deviation is 0,13 reached in 1815 while the lowest one is 0,05 of 1810.

Figure 2: Life expectancy at birth and total fertility rate, L'Aquila, 1810-1857



5. Conclusion

In this analysis IPD and SIPAV methods have been used in order to reconstruct L'Aquila population structure in the period 1810-1859 through all the difficulties due to the programs bounds. Results, obtained by the main demographic indicators estimate, have shown and confirmed a specific situation, partly deduced from the historic and demographic events. One of the most interesting aspects of these applications is the substantial similarity of the results. These methods enable to estimate the population age structure otherwise very difficult to obtain.

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