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Municipal population projections, 1st January 2022-2042

This note illustrates the methodological contents underlying the municipal demographic projections for the period 2022-2042. The projections are broken down by age and sex. The forecast outcome is disseminated in three categories: population by sex and five-year age class, components of the population change and main demographic indicators. The municipalities considered in the study are 7,904, i.e. those existing as of January 1, 2022.

Istat periodically produces demographic projections as part of the line of activity "Population estimates and projections", in accordance with the provisions of the National Statistical Program, "Demographic projections" project (PSN code IST-01448). Municipal demographic projections are therefore based on internationally recognized methodological standards. In particular, the so-called cohort component model is used, according to which the population, taking into account the natural progression of age, changes from one year to the next based on the natural change (difference between births and deaths) and the migratory balance (difference between inflows and outflows).

The municipal projections derive the evolutionary assumptions regarding fertility, survival and migration from the Istat regional projections (base 2022) according to a top-down redistribution approach. The summary results of the municipal projections coincide with the regional ones. Although the link between the regional and municipal forecasting model ensures not only consistency of results but also a global reference framework for the demographic evolution of all municipalities, the data of this study, especially in the long term, should be treated with extreme caution. The demographic projections become, in fact, the more uncertain the further one moves away from the starting point, especially in small geographical realities such as those contemplated here[1].

Since the demographic assumptions of the municipal projections derive from the regional ones, developed on the basis of a probabilistic approach, the municipal projections are also probabilistic. In particular, we produced 3,000 simulations for each municipality, plus a median scenario that represents them. The latter is the only one to be released in the Istat database.

Population calculation procedure

Once the fundamental inputs of each demographic component have been prepared (for a description of which see the following paragraphs), the population calculation procedure for

[1] The smallest Italian municipality had just 31 residents as of 1 January 2022. Furthermore, it should be considered that 25% of the Municipalities have a population lower than 1,000 residents and that 31% have a population between 1,000 and 3,000.

every forecasting year can be ran. This procedure allows to obtain a generic population cohort P_{x+1}^{t+1} starting from the same cohort P_x^t a year before, where "x" represents age in completed years and "t" the calendar year. In notation, the time reference is always January 1st for stock data (population), the whole year for flow data (births, deaths, migrations).

The base population vector changes along time under the action of the three demographic components, whose parameters have been obtained separately. Each municipal vector is worked individually, while the vector for a Province is obtained by sum according to a bottom-up procedure. In notation, the type of variant is ignored since the calculation procedure is identical in each simulation.

The preliminary step is to determine the number of live births. With reference to a generic Italian municipality, if we define:

$\mathrm{P}_x^{t,F}$ female population of age x on 1 January year t;

$\mathrm{D}_x^{t,F}$ women who died at age x during year t[2];

$\mathrm{EC}_x^{t,F}$ emigrant women of age x during year t, with destination other municipalities in the region;

$\mathrm{ER}_x^{t,F}$ emigrant women of age x during year t, with destination municipalities of other regions;

$\mathrm{EW}_x^{t,F}$ emigrant women of age x during year t, with destination abroad;

$\mathrm{IC}_x^{t,F}$ immigrant women of age x during year t, from other municipalities in the region;

$\mathrm{IR}_x^{t,F}$ immigrant women of age x during year t, from municipalities of other regions;

$\mathrm{IW}_x^{t,F}$ immigrant women of age x during year t, coming from abroad;

we will have for x = 14, 15, ..., 50 (conventionally the age of the fertile period for a woman)

$$\mathrm{P}_{x+1}^{t+1,F} = \mathrm{P}_x^{t,F} - \mathrm{D}_x^{t,F} + \mathrm{IC}_x^{t,F} - \mathrm{EC}_x^{t,F} + \mathrm{IR}_x^{t,F} - \mathrm{ER}_x^{t,F} + \mathrm{IW}_x^{t,F} - \mathrm{EW}_x^{t,F} \qquad (1)$$

For the elaboration of the municipal input $\mathrm{D}_x^{t,F}$,$\mathrm{EC}_x^{t,F}$, $\mathrm{ER}_x^{t,F}$, $\mathrm{EW}_x^{t,F}$, $\mathrm{IC}_x^{t,F}$, $\mathrm{IR}_x^{t,F}$, $\mathrm{IW}_x^{t,F}$ please refer to the following paragraphs.

The expression (1) represents the female population of childbearing age on 1 January t+1. Now, taking into account the specific fertility rates by age of the mother it is possible to determine the number of expected live births:

$$\mathrm{N}^t = 0{,}5 \cdot \sum_x \left(\mathrm{P}_x^{t,F} + \mathrm{P}_x^{t+1,F}\right) \cdot \mathrm{f}_x^t \qquad (2)$$

For the determination of specific municipal fertility rates by age of the mother, f_x^t , please refer to the relevant paragraph. The expression (2) gives the number of live births in each municipality during the year t. This amount is then broken down by sex on the basis of the constant

[2] For all flow components, age x is understood to be in completed years on 1 January of the year, and not at the time of the occurred event, that is, adopting what is usually defined as a cohort approach.

composition of 515 males and 485 females for every 1,000 births. The two quantities NM^t and NF^t , respectively born of male and female sex, are then placed in the first row of the vectors of the male and female population[3].

After determining the births, the iterative calculation can then fully start to obtain the population on 1 January of the year t+1; since the procedure is identical for both sexes, the population is indicated in notation with the symbol P. To obtain the population vector P_{x+1}^{t+1}, starting from the initial vector P_x^t, a procedure similar to that described in expression (1) is used, expanded to all age groups and both sexes.

Base population

The base population is the one from the census as of January 1, 2022 by age, sex and municipality, adjusted for the registry revision operations implemented in the municipalities during 2022[4]. Therefore, in order to avoid taking these fictitious subjects into consideration in the future iterative count, steps were taken to remove them from the population at the end of 2022.

Determination of municipal inputs: general considerations

In order to guarantee an overall coherence framework, especially considering the imponderability of the demographic events being forecasted in territorial areas of minimal size, the more general scenario assumptions contained in the latest Istat regional projections were used (base 1 January 2022). To obtain the municipal input vectors, top-down procedures for each demographic component have been constructed. The detailed methodology is illustrated below.

Nevertheless, considering the assumptions of the regional projections as a support for the municipal ones is not sufficient to prepare the model in its entirety. In fact, the regional projections do not support the modelling of migratory movements within each region, the discussion of which is shown in the last paragraph.

Fertility in the municipalities

Regardless of the type of simulation (median or its variant) in notation, for the determination of the vectors f_x^t we proceeded as follows. First, the average fertility rates of the Region (R) to which

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[3] Each vector therefore contains 112 elements. The first identifies the live births, the last the open age group (110 and over). The remaining elements represents single ages from 0 to 109 years.

[4] So-called registry registrations and de-registrations for other reason (cfr.: Istat, la dinamica demografica – anno 2022, https://www.istat.it).

each municipality belongs, relating to the five-year period 2016-2019 and 2021, were applied to the average female population of childbearing age of the Municipality (c) in the year 2021. The year 2020 has been censored in order to avoid the introduction of biased effects due to the pandemics in the calculation of the indicators. That is,

$$\widehat{\mathrm{N}}_c = \sum_x \mathrm{E}\left(\mathrm{f}_{R,x}^{16-19,21}\right) \cdot \mathrm{E}\left(\mathrm{P}_{c,x}^{21} + \mathrm{P}_{c,x}^{22}\right)$$

The quantity $\widehat{\mathrm{N}}_c$ represents the amount of theoretical births in the Municipality if in 2021 there was a fertility identical to that recorded on average in the last valid five years in the whole of the Region to which it belongs. At this point, we can build the ratio:

$$\mathrm{kn}_c = \mathrm{N}_c / \widehat{\mathrm{N}}_c$$

where the quantity N_c represents the real amount of births on average observed in the five-year valid period 2016-2019 and 2021 in the Municipality. This ratio therefore represents an estimate of the distance between the Municipality and its Region in reproductive terms. It can be used as a correction ratio in order to scale the assumptions relating to the Region on the intensity of fertility expressed by the Municipality:

$$\mathrm{f}_{c,x}^t = \mathrm{kn}_c \cdot \mathrm{f}_{R,x}^t \quad \text{with } t=2022, \dots, 2041$$

By operating in this way, for each year of forecast we get a municipal vector of age specific fertility rates commensurate with the distance between the propensity for fertility of the municipality and that relating to the entire region. The model assumes that the correction ratio never changes during the forecasting exercise, so that the relative distance between a municipality and its region remains proportionally constant[5].

The last step is purely computational. It consists in balancing the expected births at the municipal level with the amount of regional births. This is obtained simply by pro-rating the total expected births as sum of the births for all the municipalities to births from the regional projections.

Mortality in the municipalities

For the elaboration of the municipal inputs of mortality, the scheme is conceptually identical to that described for fertility. Leaving aside once again in notation the type of simulation (median or its variant) and the sex, for the determination of the vectors q_x^t, giving the (projection-)

[5] For example, if from the observed data it results that Municipalities A and B express, respectively, a fertility equal to 90% and 120% of the regional one, these ratios are left unchanged during the forecast period, even if theoretically it would be possible to model some variation of the ratios over time. For example, by introducing the hypothesis of convergence between the Municipalities, it would be possible to hypothesize that the Municipality A moves from a ratio equal to 90% towards one equal to 100%. However, given the shortness of the time horizon (10 years), it was preferred to avoid this further possibility which would have made the model less parsimonious in the face of insignificant advantages in terms of results. The same considerations apply to the demographic components (mortality, migration) described in the following paragraphs.

probabilities of death, we proceeded as follows. First, the average probabilities of death of the Region for the last valid five-year period 2016-2019 and 2021 were applied to the municipal population as of 1 January 2021. The year 2020 has been censored in order to avoid the introduction of biased effects due to the pandemics in the calculation of the indicators:

$$\widehat{\mathrm{D}}_c = \sum_x \widehat{\mathrm{D}}_{c,x} = \sum_x \mathrm{P}_{c,x}^{21} \cdot \mathrm{E}\left(q_{R,x}^{16-19,21}\right)$$

The quantity $\widehat{\mathrm{D}}_c$ represents the amount of theoretical deaths, according to the assumption that in the Municipality were recorded the same risks of death of the Region to which it belongs. At this point the ratio:

$$\mathrm{kd}_c = \mathrm{D}_c / \widehat{\mathrm{D}}_c$$

where the quantity D_c represents the amount of deaths on average observed in the five-year period 2016-2019 and 2021 in the Municipality, it is used to pro-rate the theoretical deaths by age to the total deaths actually observed.

Contrary to the case of births, where the constant application of the correction factor in all forecasting years is sufficient to calibrate the fertility of individual municipalities on the regional projections, in the case of deaths the procedure is more complex. First, we define an estimate of the distribution by age of municipal deaths by applying the expression:

$$\mathrm{D}_{c,x} = \widehat{\mathrm{D}}_{c,x} \cdot \mathrm{kd}_c$$

then with the expression

$$\mathrm{q}_{c,x}^{16-19,21} = \frac{\mathrm{D}_{c,x}}{\mathrm{P}_{c,x}^{21}}$$

we obtain an estimate of the probabilities of death of the Municipality, whose distribution by age is derived from the regional mortality structure but whose overall death intensity is calibrated on the levels recorded by the Municipality.

Having derived by approximation a mortality curve representative of the Municipality allows at this point to relate the Municipality and the Region to which it belongs with a logit regression model of the following type:

$$logit(\mathrm{q}_{c,x}) = \alpha_c + \beta_c \cdot logit(\mathrm{q}_{R,x}) \qquad (3)$$

remembering that $z = logit(Y) = \log\frac{Y}{1-Y}$, while its inverse is $Y = \frac{\exp(z)}{1+\exp(z)}$

The determination of the alpha and beta parameters defines, in practice, a linear relationship between the mortality of the Municipality and that of its Region. The latter is used to scale the regional assumptions on the specific mortality intensity of each municipality. This is done by applying the expression (3) with t = 2022, ..., 2041. Finally, at the end of the iterative process, the deaths obtained at the municipal level are pro-rated to the amount of deaths from the regional projections. This, as mentioned, allows to ensure consistency of results between municipal and regional projections.

Municipal migratory flows with other regions and abroad

The migratory flows beyond the regional border, by single municipality, year of forecast, sex and age were determined by resorting, once again, to the regional projections. In particular, we apply a top-down procedure in order to redistribute in each Municipality what had been foreseen for the Region as a whole in terms of registrations and cancellations for change of residence from / to other regions and from / to abroad.

In other words, given the vectors $\mathrm{ER}_{R,x}^{t}$, $\mathrm{EW}_{R,x}^{t}$, $\mathrm{IR}_{R,x}^{t}$, $\mathrm{IW}_{R,x}^{t}$, respectively emigrants to other regions, emigrants to abroad, immigrants from other regions and immigrants from abroad, by individual age and year of forecast (and regardless of the type of variant and sex in notation) relating to the Region, the same quantities were calculated on a municipal basis based on to the following expressions:

$\mathrm{ER}_{c,x}^{t}=\alpha_{cER} \cdot \mathrm{ER}_{R,x}^{t}$

$\mathrm{EW}_{c,x}^{t}=\alpha_{cEW} \cdot \mathrm{EW}_{R,x}^{t}$

$\mathrm{IR}_{c,x}^{t}=\alpha_{cIR} \cdot \mathrm{IR}_{R,x}^{t}$

$\mathrm{IW}_{c,x}^{t}=\alpha_{cIW} \cdot \mathrm{IW}_{R,x}^{t}$

with $\sum_{c\in R} \alpha_{cER} = 1;\ \sum_{c\in R} \alpha_{cEW} = 1;\ \sum_{c\in R} \alpha_{cIR} = 1; \sum_{c\in R} \alpha_{cIW} = 1;$

The values α_{cER} , α_{cEW} , α_{cIR} , α_{cIW} are therefore distributions of constant weights with which to divide the overall migratory flows of the Region among its Municipalities. We get their evaluation, over the valid five-year period 2016-2019 and 2021. The year 2020 has been censored in order to avoid the introduction of biased effects due to the pandemics in the calculation of the indicators.

Municipal migratory flows within the Region

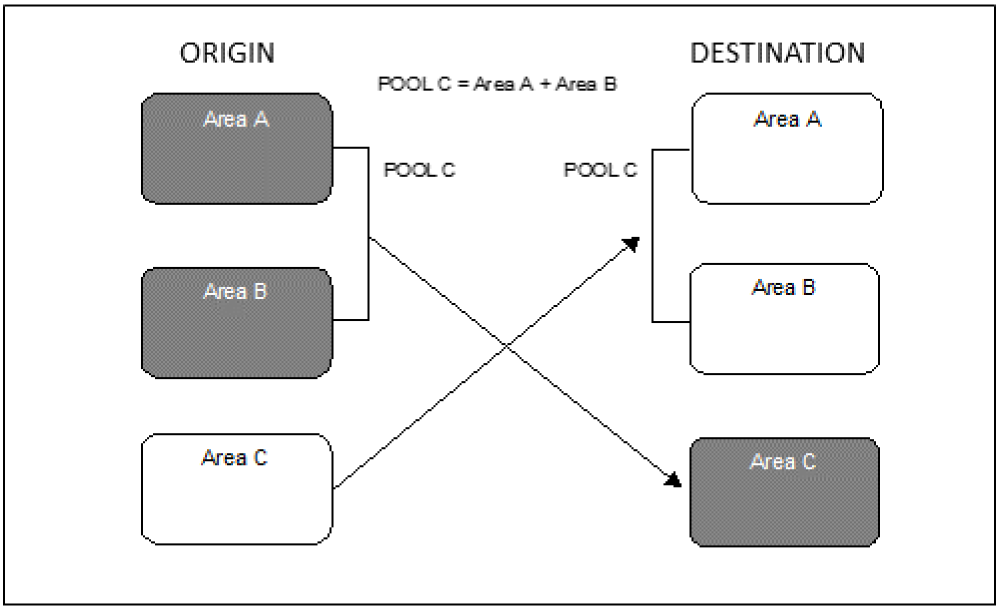
The use of the regional projections for the distribution of demographic events among the various Municipalities, as described in the previous paragraphs, is not sufficient to complete the picture of the assumptions about the future demographic trend in the Municipalities. In fact, it is also necessary to determine the annual amount of migratory flows within each Region, by sex, age and forecast year.

The basic data used are those from the administrative survey on registrations and cancellations due to change of residence. The model bases its main assumption on the maintenance throughout the time horizon of the propensities to mobility that have been recorded in the last valid five years (2016-2019 and 2021). The year 2020 has been censored in order to avoid the introduction of biased effects due to the pandemics in the calculation of the indicators. Actually, excluding the year 2020, the recent evolution of the phenomenon shows limited variations in the total amount of intra-regional residence transfers. It was therefore decided to leave the intra-regional probabilities of the Municipalities unchanged, so that the inter-municipal flows (of the same region) change over time only because of the variations in the amount and in the age structure of the resident population.

The framework for the intra-regional migratory model is based on a model known in literature as "*variable pool-model*". This term refers to a migration model that defines two entities for each territorial unit of the system, the single unit itself and all the others as a whole. More precisely, the pool is a container of possible destinations and origins that allows the representation of measures of migratory events in which the numerator is a quantity generated by the population at the denominator.

For example, in a closed system consisting of three areas, called A, B and C, the pool of each area corresponds to the set of the other two. Therefore, the pool of A is the set B∪C, the pool of B corresponds to the set A∪C and finally, the pool of C corresponds to A∪B. Following this approach, it will therefore be possible to build both measures that describe the propensity to leave a certain area of the system, such as from C towards A∪B, and measures that describe the propensity to enter C, in the form of a propensity to exit any of the other areas of the system to move to C (Figure 1).

Figure 1 - Representation of a variable pool migratory model



A particular advantage of the pool model is implicit in its definition: once a certain territorial unit has been set, the aggregation of all the others in a single container allows to greatly simplifying the reality, thus facilitating the data processing.

A further simplification of this specific model consists to deal with profiles of intra-regional mobility, by sex and age, similar among all the Municipalities belonging to a given Region. This is because, given the need to represent the migrations of even small and very small municipalities, it would not be sufficient to resort to municipal statistics alone, given that in these cases there is often a low volume of transfers.

Therefore, the <u>first step</u> consisted in determining a similar migratory profile by age (and sex) within each region by measuring:

$$m_{R,x} = \frac{\mathrm{E}\left(\mathrm{EC}_{R,x}^{16-19,21}\right)}{\mathrm{P}_{R,x}^{21} \cdot \left(1 - \frac{\mathrm{q}_{R,x}^{21}}{2}\right)}$$

where the numerator contains the last valid five-year average of inter-municipal cancellations due to intra-regional transfer of residence, classified by age. The denominator, on the other hand, contains the exposure at risk of migrating in 2021, i.e. the population by sex, age and region, purified from the perturbing effect of mortality through the expression in parentheses[6]. The measure thus obtained expresses the average probability of making an intra-regional migration in 2021, assuming that what was detected in the previous valid four years is similar to what happened in that year.

The <u>second step</u> is to impose the passage between the raw values of the *Rogers function*, thus obtaining the distribution of the smoothed values:

$$\left.\begin{aligned} \widehat{m}_{R,x} = {} & a_1\ exp\left(-\alpha_1\ x\right) + \\ & a_2\ exp\left\{-\alpha_2\ \left(x-\mu_2\ \right) - exp\left[-\gamma_2\ \left(x-\mu_2\ \right)\right]\right\} + \\ & a_3\ exp\left\{-\alpha_3\ \left(x-\mu_3\ \right) - exp\left[-\gamma_3\ \left(x-\mu_3\ \right)\right]\right\} + \\ & c \end{aligned}\right\}$$

a function that, given the characteristic profile of migratory movements by age, almost always characterized by recurring regularities regardless of the intensity of the phenomenon, allows to appropriately summarize the trend. In particular, the function is characterized by four components:

1) a negative exponential curve of pre-working ages, with descent rate α_1 ;

2) a left asymmetric unimodal curve of working ages, centered on an average age μ_2 , with ascent rate γ_2 and descent rate α_2 ;

3) an almost normal curve of the post-working ages, centered on an average age μ_3 , with ascent rate γ_3 and descent rate α_3 ;

4) a constant "c" to improve the adaptation of the function, which represents the minimal level

[6] This effect is treated by assuming that death and migration events are independent and uniformly distributed throughout the year, so that in 50% of cases death will precede migration, while in the remaining 50% migration will precede death.

of propensity to migrate.

The full model therefore contains 11 parameters. Seven of them $\{\alpha_1, \alpha_2, \alpha_3, \mu_2, \mu_3, \gamma_2, \gamma_3\}$ define the age-profile, while the remaining four measure the total intensity of migration. In summary, the μ type parameters position the curve on the x age axis, the γ and α type parameters measure the slopes of the ascending and descending part of the curve, respectively. Finally, the type “a” parameters measure the level of migrations and the relative weight of the three component curves.

The method chosen to fit the model to each regional series is a fit procedure for nonlinear functions in the parameters, known as the *Levenberg-Marquardt*[7] algorithm. The model also made use of least square estimators to give greater weight to the age groups with a low level of migration.

The <u>third step</u> consists in dimensioning the theoretical regional migration probabilities on the specific intensity of each single Municipality. This result is determined using the following correction factor:

$$km_c = \frac{\mathrm{E}\left(\mathrm{EC}_c^{16-19,21}\right)}{\sum_x \mathrm{P}_{c,x}^{21} \cdot \left(1 - \frac{\mathrm{q}_{c,x}^{21}}{2}\right) \cdot \widehat{\mathrm{m}}_{R,x}}$$

where the numerator shows the last valid five-year average of migrations towards other municipalities of the same Region. The denominator is an estimate resulting from the application of the theoretical migration probabilities on the population of the Municipality concerned (net of those not exposed to risk to undergo the migratory event) in the year 2021.

The correction factors calculated in this way are then used to obtain an estimate of the municipal migration probabilities by sex and single year of age:

$$m_{c,x} = km_c \cdot \widehat{\mathrm{m}}_{R,x}$$

The resulting vector of probabilities, $m_{c,x}$, is then ready to be applied to the municipal population in the context of the cohort component method. Note that the probabilities $m_{c,x}$ are kept constant along the time horizon. Furthermore, the formulation is replicated for each simulation. Therefore, the results obtained in terms of migratory flows from the Municipality to other Municipalities of the Region structurally depend on the intensity of the probability of migrating at various ages but also on the population exposed to the risk of migrating at the various forecast years.

The <u>fourth and last step</u> of the procedure acts within the cohort component method and consists

[7] Cfr.: Levenberg K., 1944, A method for the solution of certain nonlinear problems in least squares, Quarterly of Apllied Mathematics, n.2; Marquardt D.W., 1963, An algorithm for least squares estimation of nonlinear parameters. SIAM, Journal of Numerical Analysis, n.11.

in redistributing the emigrants to other municipalities, i.e. the quantity

$\mathrm{EC}_{c,x}^{t}=\mathrm{P}_{c,x}^{t}\cdot\left(1-\mathrm{q}_{c,x}^{t}\right)\cdot\mathrm{m}_{c,x}$ for t=2022, … , 2041

to be transformed in immigrants in other municipalities, namely the application of the pool model which guarantees consistency at the level of each covariate for the expression: $\sum_{c\in R}\mathrm{EC}_{c,x}^{t}=\sum_{c\in R}\mathrm{IC}_{c,x}^{t}$

ensuring that the total number of intra-regional emigrations is identical, by definition, to the number of immigrations of the same type.

At single Municipality level, the quantity $\mathrm{IC}_{c,x}^{t}$, that is the number of immigrants from other Municipalities of the Region, is determined on the basis of the expression:

$$\mathrm{IC}_{c,x}^{t}=\varphi_c\cdot\sum_{k\in R,k\neq c}\mathrm{EC}_{k,x}^{t}$$

where

$$\varphi_c=\frac{\mathrm{IC}_{c}^{16-19,21}}{\sum_{k\in R}\mathrm{IC}_{k}^{16-19,21}}$$

corresponds to the relative weight of intra-regional immigration of the Municipality on the total intra-regional immigration, as it was in the last valid five-year period 2016-2019 and 2021. The assumption, therefore, is that the relative distribution of intra-regional immigration among municipalities is invariant with respect to age and that this can be kept constant over the time horizon of the projections, looking at what observed in the last five years.

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Glossary

Age specific fertility (rate): the ratio of the number of live births to women between the ages of x and x + 1 and the average number of women of that age in a given year.

Average number of children per woman: the number of children a woman would have if she was subjected to the fertility calendar (in the form of age-specific fertility rates) of a given calendar year during her reproductive life span.

Birth (rate): ratio between the number of live births in the year and the average amount of the resident population, multiplied by 1,000.

Cohort component (model): the continuous calculation algorithm that in iterative mode simulates the evolution of the fundamental population equation by age group, allowing to determine the demographic flows and to obtain the surviving population at the end of each year.

Death: the cessation of any sign of life at any time after the vital birth.

Demographic projection: elaboration that shows the future development of a population when certain assumptions are made regarding the future course of mortality, fertility and migration.

Deterministic demographic projection: elaboration on the future development of a population, summarized in a single series of values obtained from a single set of demographic assumptions, which does not report any measure regarding the uncertainty usually associated with the results.

Dependency ratio: ratio between the population of inactive age (0-14 years and 65 years and over) and the population of active age (15-64 years), multiplied by 100.

Elderly dependency ratio: ratio between the population aged 65 and over and the population aged 15-64, multiplied by 100.

Emigration for abroad (rate): the ratio between the number of emigrations to abroad and the average amount of the resident population, multiplied by 1,000.

Immigration from abroad (rate): the ratio between the number of immigrations from abroad and the average amount of the resident population, multiplied by 1,000.

Internal emigration (rate): the ratio between the number of internal emigrations and the average amount of the resident population, multiplied by 1,000.

Internal immigration (rate): the ratio between the number of internal immigrations and the average amount of the resident population, multiplied by 1,000.

Internal migration balance: difference between the number of registrations for change of residence from another Municipality and the number of de-registrations for change of residence to another Municipality.

Internal net migration (rate): the difference between the internal immigration rate and the internal emigration rate.

Life expectancy at age "x": the average number of years that a person of completed age "x" can count to survive in the hypothesis that, in the course of his subsequent life, he was subjected to the risks of mortality by age (from age "x" up) of the year of observation.

Life expectancy at birth: the average number of years that a person can count to live from birth in the hypothesis that, in the course of his existence, he was subjected to mortality risks by age of the year of observation.

Live birth: the product of conception which, once expelled or completely extracted from the maternal body, regardless of the duration of gestation, breathes or manifests other signs of life.

Mean age: mean age of the population at a certain date expressed in years and tenths of a year.

Mean age at birth: the mean age at birth of mothers expressed in years and tenths of a year, calculated considering only live births.

Migratory balance with abroad: difference between the number of registrations for change of residence from abroad and the number of de-registrations for change of residence to abroad.

Mortality (rate of): ratio between the number of deaths in the year and the average amount of the resident population, multiplied by 1,000.

Natural balance: difference between the number of births and the number of deaths.

Natural growth (rate): the difference between the birth rate and the death rate.

Net migration with abroad (rate): the difference between the immigration rate from abroad and the emigration rate with abroad.

Old age (index): ratio between the population aged 65 and over and the population aged 0-14, multiplied by 100.

Predictive (or confidence) interval: an interval associated with a random variable yet to be observed, with a specific probability that the random variable falls within it.

Probabilistic demographic projection: elaboration on the future development of a population, summarized in a set of values or in a probability distribution, in which the variables used are of a random nature that cannot be predicted with certainty and in which not all assumptions are equally probable.

Probability of death: the probability that an individual of precise age x will die before the birthday x + 1.

Projection: development expected in the future.

Projection probability of death: the probability that an individual of age x (in years completed on 1st January) will not survive within the year.

Projection probability of interregional migration: the probability that an individual of age x (in years completed on January 1st) moves residence between two regions before the end of the year.

Range: measure of the variability of a quantitative phenomenon defined by the difference between its maximum and the minimum value.

Registration and de-registration for transfer of residence: registration concerns people who have moved to a Municipality from other Municipalities or from abroad; the de-registration concerns people who have moved to another municipality or abroad.

Resident population: constituted in each Municipality (and similarly for other territorial divisions) of people with habitual residence in the Municipality itself. Persons temporarily residing in another Municipality or abroad, for the exercise of seasonal occupations or for reasons of limited duration, do not cease to belong to the resident population.

Scenario approach: the description of the context, even conceptual, in which the population is projected. In a deterministic approach it usually refers to the main or central assumption. In a stochastic it can refer to the assumption identified as mean or median.

Simulation: the quantitative implementation of a single set of demographic assumptions to be launched in the cohort-component model in order to obtain a single set of demographic projections.

Total balance: sum of the natural balance and the total migratory balance.

Total growth (rate of): the sum of the total net migration rate and the natural growth rate.

Total migratory balance: the sum of the migration balance with abroad and the internal migration balance.

Total net migration (rate): the sum of the net internal migration rate and the net migration rate with abroad.

For technical and methodological information

Marco Marsili

marsili@istat.it