

EUROPOP2026: A Revised Methodology for Projecting the EU's Regional Populations at NUTS3-Level

1. Introduction and Background

Europe's regions exhibit demographic heterogeneity, with significant spatial differences in mortality (Sauerberg et al., 2024), varying fertility patterns (Campisi et al., 2020), and diverse migration patterns (Newsham & Rowe, 2024). Analysing and projecting these subnational demographic dynamics is important for academic research and evidence-based policymaking. Within the European Union regional population projections underpin socioeconomic assessments, infrastructure planning, fund allocation, and cohesion policy analysis (Cilek et al., 2024). The European Commission last regional population projections were published in 2019.

Recognising the need for methodological advancement and sustainability, the European Commission is undertaking a comprehensive revision for the next regional projection round to be published in 2026. This paper presents this ongoing work, detailing an updated framework designed to be more robust, transparent, and linked explicitly to the forthcoming national-level population projections from Eurostat (scheduled for spring 2026). This ensures a coherent demographic outlook across EU geographical scales.

The revision addresses limitations in the previous approach (Lanzieri, 2021) and makes use of new demographic techniques suited to data consistently available from Eurostat (primarily population and vital statistics by sex and 5-year age group at NUTS3 level). Major updates include a revised model structure, enhanced treatment of migration acknowledging its complexity and uncertainty (Bijak, 2024a), and an expanded range of scenarios designed to explore policy-relevant questions about regional futures (Bijak, 2024b), including divergence/convergence dynamics relevant to EU policy discussions.

2. The Revised Projection Model Framework

2.1. Structure and Data Inputs

The revised model implements a bi-regional cohort-component model within a population accounts framework (Rees, 1984; Wilson et al., 2025a), ensuring all demographic components balance. We change to projection framework to a 5x5 model (5-year age groups, 5-year projection intervals), replacing the previous 1x1 structure. This aligns better with the robustness and availability of Eurostat regional data, significantly reducing the need for extensive estimation and smoothing of single-year inputs, particularly for smaller NUTS3 regions, hoping to improve model quality and sustainability.

Fertility age patterns are derived from available data (often 5-year groups) and smoothed using techniques such as calibrated splines (Schmertmann, 2012) if necessary. Mortality patterns are estimated using life table methods, potentially borrowing strength from higher NUTS levels or national data where regional data is sparse, and projected using approaches like the mortality surface method, chosen for its ability to handle small area data robustly (Orwat-Acedańska, 2023; Wilson, 2018).

2.2. Constraining to National Projections

Consistency with Eurostat's national projections is a main concern for the regional projections. An iterative calculation scheme within each projection step ensures that preliminary regional projections of births, deaths, and international migration flows (disaggregated by intra-EU and extra-EU) are proportionally scaled. For each sex and 5-year period-cohort, the sum across all NUTS3 regions is

constrained for each demographic component to match the corresponding national total from the official Eurostat national projection scenario being. This guarantees coherence between national and regional demographic outputs.

3. Innovation in Migration Modelling: The Synthetic Approach

Modelling migration consistently and adequately across all NUTS3 regions is challenging due to the lack of harmonised, detailed origin-destination flow data. The revised JRC model addresses this by employing a synthetic migration approach (based on Wilson, 2022; Wilson et al., 2025a). This method is designed to work across all NUTS3 regions using primarily commonly available data from Eurostat: population estimates by age and sex, and vital statistics by age (of mother) and sex. It generates plausible, region-specific, age- and sex-structured *directional* migration flows—important for demographic modelling (Raymer et al., 2025)—without requiring direct observation of these flows. The model explicitly distinguishes three migration types (Internal, Intra-EU International, Extra-EU International), resulting in six flows per region (inflows and outflows for each type).

The synthetic estimation process applies the following key steps consistently across all NUTS3 regions for each sex and 5-year age cohort:

1. Estimate Residual Net Migration (RNM): Using the demographic balancing equation principle, the net effect of all migration for a cohort over the base period is calculated indirectly. This is done by taking the observed population change for the cohort and adjusting it for the estimated number of deaths (derived from available mortality data, often using NUTS2 life tables). This step provides a target net migration figure for each cohort based on reliable population and mortality data.
2. Generate Initial Directional Flows: Preliminary age-sex specific estimates for each of the six migration flow types are created. This uses standard *model migration schedules* (representing typical age patterns of migration) applied to the relevant regional population-at-risk for each flow (e.g., using origin population for outflows like emigration and internal out-migration, and destination population or population outside the region for inflows like immigration and internal in-migration, consistent with demographic practice). These initial flows capture general age patterns but not the specific regional intensity or net balance.
3. Scale to Aggregate Totals (Optional): Where reliable estimates for the *total* volume (summed across ages/sexes) of certain migration types are available (e.g., from national statistics), the initial age-sex specific flows from Step 2 are proportionally adjusted to match these totals. This anchors the overall magnitude of specific flows if external information exists.
4. Calculate Cohort-Specific Scaling Factors: This core step reconciles the initial flow estimates with the observed population dynamics. For each age-sex cohort, the total preliminary inflow (sum of internal, intra-EU, extra-EU inflows from Step 3 or 2) and total preliminary outflow are calculated. A mathematical scaling factor is then determined (as outlined in Wilson, 2022) to adjust these preliminary flows so that their difference (inflow - outflow) precisely matches the Residual Net Migration calculated for that cohort in Step 1.
5. Adjust Type-Specific Directional Flows: The calculated cohort-specific scaling factor is applied to the preliminary flows for *each* of the six migration types (from Step 3 or 2). Inward flows (internal in, intra-EU in, extra-EU in) are multiplied by the factor, while outward flows (internal out, intra-EU out, extra-EU out) are divided by it. This ensures the relative contribution of each migration type is maintained, while the *total net effect* across all types perfectly aligns with

the net migration derived from observed population change (RNM) for that specific cohort. This yields the final set of six synthetic, directional, age-sex specific migration flows for the base period.

This systematic process generates a complete set of directional migration flows for every region and cohort, consistent with the net migration implicitly observed through population changes and vital statistics. When the quality of the population estimates is good, it provides a robust and data-parsimonious method suitable for the NUTS3 level across the EU, relying primarily on population structure information. For the projection period, assumptions are made about the future evolution of these synthetic base-period rates and flows, often involving gradual convergence towards national or EU-level trends.

4. Expanded Scenarios for Policy Analysis

Migration futures are deeply uncertain (Bijak, 2024a). To address this and enhance policy relevance, the revised framework produces a wider array of scenarios than previously available. These explore alternative demographic pathways by combining different assumptions on the future trajectories of fertility, mortality, and the six migration components, informed by narrative logics (e.g., varying speeds of convergence) and constrained by corresponding national-level scenarios from Eurostat.

Planned regional scenarios include:

- **Baseline (BSL):** Assumes partial convergence of regional demographic rates towards long-run national trends, constrained to the Eurostat baseline national projection.
- **No Migration (NoMig):** Illustrates regional dynamics under natural change only, constrained nationally. The variant has two sub-variants: No regional migration with only regional migration set to zero, and no intra-EU migration with only intra-EU migration set to zero.
- **Component Variants:** Scenarios focusing on alternative fertility (e.g., LowFert) or migration (e.g., HighMig) levels, linked to Eurostat's national variants.
- **Delayed Convergence:** Explores slower reduction in regional differentials compared to the baseline with regional difference constant in relative terms until 2050 before starting to converge.

This expanded set aims to provide a richer toolkit for sensitivity analysis and exploring policy-relevant "what-if" questions regarding regional demographic futures.

5. Relevance and Conclusion

The revised JRC methodology for NUTS3 population projections aims to offer a robust, sustainable, and transparent approach, methodologically consistent across all EU regions and aligned with available Eurostat data. Major changes to previous methodology include the use of a population accounts framework, the 5x5 structure suited to regional data realities, and particularly the use of the synthetic migration model which addresses data gaps and comparability issues using primarily standard population data available from Eurostat.

Regional EU projections are frequently used by the European research community, underpinning many studies on regional development, social equity, environmental pressures, labour markets, and ageing. A clear and transparent understanding of the production method, especially the migration component, can improve the subsequent application and interpretation by researchers.

Moreover, the projections and the expanded scenarios serve as basis for policy formulation and evaluation at EU, national, and regional levels (Bijak, 2024b). The scenario approach allows policymakers to incorporate uncertainty, assess the range of potential demographic futures, and test the sensitivity of outcomes to different drivers.

However, the approach involves trade-offs. The 5x5 framework, while enhancing robustness and feasibility across all NUTS3 regions, reduces the temporal and age detail compared to a 1x1 model, potentially limiting applications focused on very short-term dynamics or specific single-year age groups. Furthermore, achieving a methodologically consistent approach applicable to all EU member states inevitably requires compromises that might not capture the full depth achievable in projections tailored specifically to a single country with richer data. While the synthetic migration model is a powerful tool for consistency in data-sparse environments, a full multi-regional model incorporating observed origin-destination migration data remains the theoretical gold standard where such data exist reliably.

The authors aim to have a detailed evaluation of the synthetic approach and further exploration of mixed-use of synthetic approach and modelled migration estimates ready as part of the conference presentation.

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