Systems, Nowcasting, and Statistical Demography

Thursday 4 September, 9am

Online Obituaries for Mortality Monitoring in Canada
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In this research, we investigate whether online obituaries can be used to track the seasonality of mortality in the Canadian provinces of Quebec and Ontario, between 2017 and 2024. Using the We employed a locally hosted Large Language Model (LLM) fine-tuned on French and English obituary texts to extract key demographic variables—such as age at death, gender, and date of death, marital status, and family ties—from a corpus of over 750,000 obituaries collected from 500 funeral homes across Canada.

We analyzed the temporal distribution of deaths by epidemiological week and explored whether obituary data could serve as a tool for nowcasting mortality—offering near real-time estimates that precede official statistics, which in Canada are often delayed by several months. By aligning obituary-based counts with environmental indicators (temperature, precipitation, wind) and public health records (COVID-19 cases and deaths), we assessed the responsiveness of this data source to both seasonal variation and external shocks.

Our findings show that obituary data captures clear seasonal mortality trends and aligns well with ground-truth data. While anomalies during the COVID-19 pandemic introduced limitations, the potential for nowcasting weekly mortality using obituaries remains strong. This work reinforces the value of digital trace data in population monitoring and contributes to the expanding use of AI-driven methods and novel data sources in computation/digital demography.

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Reading Survival Gain through “Halfway Age”: A New Outlook on Aging
Devikrishna N B, Rahul Mondal, Udaya S Mishra - International Institute for Population Sciences

The relationship between a life table's mean age a and halfway age a (i.e., age at which life expectancy equals the age) is crucial to understanding survival gain and the evolution of lifespan distribution. We design a framework to examine the monotonicity in mean and halfway ages and their dynamics with entropy over time through Bayesian optimization.

We derive an objective function to explore boundary conditions of entropy conditional on mean and halfway ages. We formulate this via a Bayesian Optimization using Hamilton Monte Carlo Sampling. This framework identifies the conditions under which entropy reaches its extrema, revealing how lifespan distributions converge/diverge across time and populations. We apply this framework using mortality data from the United Nations World Population Prospects 2024, over 1950–2100 for 237 countries/areas. We estimate mean age, halfway age, and entropy for period and cohort life tables and the simulated Logistic-Makeham and Siler-Makeham mortality distributions.

From Bayesian optimisation, we find that the global entropy maxima are achieved when the mean and halfway age converge. Supporting this result, we find monotonically increasing empirical trends of halfway and mean ages with a corresponding reduction in entropy, indicating a global convergence toward longer, more predictable lifespans in around 94 percent of the countries, including Japan, France, and India. Our study highlights the demographic relevance of Bayesian optimization, which offers a new way to capture the stochastic nature of mortality processes and new insights into the dynamics of aging, survival gains, and lifetime equality.

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Coherent Forecasting of Fertility Rates by Age and Education: The case of Colombia
Felipe Sanchez-Segura, Arkadiusz Wiśniowski - University of Manchester

Accurate fertility forecasting is essential for effective demographic planning, with direct implications for education systems, labour markets, and social protection frameworks. In Colombia, marked disparities in fertility behaviour by educational attainment reflect broader socioeconomic inequalities and evolving reproductive norms. However, widely used forecasting models often fail to account for these differences, limiting their policy relevance and predictive accuracy. This paper proposes a coherent Bayesian hierarchical framework to forecast fertility rates disaggregated by age and education level. Three modelling strategies are assessed: a non-coherent model treating educational groups independently; a partially coherent model aligning age-specific fertility trajectories across groups; and a fully coherent model that additionally harmonizes period trends. Using reconstructed national fertility rates from 1998 until 2018, the analysis demonstrates that coherent modelling approaches yield more stable and policy-informative projections. Moreover, the Bayesian framework enhances predictive performance by explicitly incorporating uncertainty. The results underscore the critical importance of integrating educational gradients in fertility forecasting and provide a robust methodological tool for supporting evidence-based policy formulation.

Modelling and measuring migrant fertility: using hazard models and dynamic microsimulation to account for multiple clocks.
Karel Neels - University of Antwerp

Conventional fertility measures such as the period total fertility rate have repeatedly been shown to severely overestimate fertility of first generation migrant women as a result of unidimensional standardization for age while fertility patterns of migrant women are shaped by a larger number of factors and clocks such as age at migration, parity at migration, duration since migration, as well as duration since index birth. The bias is particularly articulated – with parity-specific fertility indicators often exceeding unity - in periods characterized by a strong influx of age heterogenous migrants. Using longitudinal microdata for Belgium for the period 1985-2023, we estimate discrete-time hazard models of entry into parenthood and parity progression that incorporate multiple baselines and an individual-level frailty for migrant women originating from different regions in Europe, Turkey, Maghreb countries and other non-European countries. Subsequently, the parameter estimates of the hazard models serve as input for dynamic microsimulations to emulate completed fertility levels for a synthetic cohort of migrant women while correctly keeping track of multiple clocks and unobserved heterogeneity over their simulated life courses in the destination country. By avoiding inadmissible values, the period fertility levels implied by the hazard-based microsimulation models are considerably lower than those suggested by conventional fertility indicators, particularly for groups where family formation is an important migration motive. Our results suggest that hazard-based microsimulation models provide a superior approach over conventional indicators to measure migrant fertility and quantify the impact of migration and unfolding diversity by migration background on fertility trends in receiving countries.

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Population Nowcasting in the Digital Age: A Research Manifesto for Impactful Demographic Science
Andrea Aparicio-Castro - University of Oxford, Jakub Bijak - University of Southampton, Gianluca Boo - WorldPop, Carmen Cabrera-Arnau - University of Liverpool, Edith Darin - University of Oxford, Nicholas Irons - University of Oxford, Ridhi Kashyap - University of Oxford, Douglas Leasure – University of Oxford

Demographic data are essential for public policy but are often hampered by delays and low temporal resolution, limiting their utility in fast-changing contexts such as crises, displacement, and migration surges. This manifesto outlines the emerging field of population nowcasting defined as the practice of producing timely, near real-time estimates of population size and distribution by integrating traditional and digital trace data sources such as mobile phone records, social media, and satellite imagery. We identify three key application domains for nowcasting: immediate operational response in crises, adaptive tactical planning during recovery phases, and strategic institutional use for official statistics. Each domain presents distinct data needs, methodological challenges, and ethical considerations. Despite advances in computational methods and data availability, current approaches remain fragmented and ad hoc, lacking standardisation, reproducibility, and systematic validation. This paper calls for a structured, modular framework grounded in transparency, ethical data governance, and collaborative partnerships to produce reliable, validated, and

scalable nowcasting systems. We emphasise the importance of balancing methodological rigor with operational feasibility and underscore the critical role of openness, reproducibility, and responsible data sharing. By advancing population nowcasting, demographic science can significantly enhance policy relevance, improve crisis response, and modernise official statistics for the digital age.