Uncertain Population Forecasting: A Case for Practical Uses

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Keywords: forecast uncertainty, official statistics, population forecasting, use of forecasts

1. INTRODUCTION: PROBABILISTIC POPULATION FORECASTS REVISTED

In this paper we revisit the case for practical uses of the uncertainty assessments in official population forecasts, concerned with the future population size and structures.

Already in the 1970s a group of statistical demographers, uneasy with the deterministic ‘projections’, suggested the use of probability distributions to present the forecast uncertainty [1]. At the time, however, available technical resources were insufficient [2].

Since 1980s, statistical demography has been developing rapidly, especially in the area of stochastic population forecasting. Several authors have argued that probability distributions would allow the forecasts users to prepare appropriate contingency plans [3], and to make and analyse derived and conditional forecasts, when needed [4].

Despite methodological developments and recommendations, only in a few countries have probabilistic population forecasting methods been put in official statistical practice – the Netherlands and New Zealand. There have been hardly any policy applications of decision analysis or similar techniques, with an exception of [5].

In July 2014, the United Nations Population Division issued the first official probabilistic population projections for all countries, based on [6]. Much of the media coverage showed an understanding of the probabilities reported¹². In this context, we want to re-open the discussion on practical advantages and obstacles of probabilistic forecasting.

2. CHALLENGES AND OPEN QUESTIONS

The current practice in official population forecasting is inadequate, as deterministic forecasts are bound to fail. Probabilistic forecasts, with probability distributions of possible outcomes, contain warnings about the uncertainty, which itself is an ethical virtue. On the other hand, single-number forecasts are easier to grasp in cognitive terms.

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There is a need for an analytical framework for supporting decisions under uncertainty. Deterministic scenarios are problematic, and answer an incorrect question: what would happen under given assumptions – when the real question is: what will happen [1, 7].

Various reasons put forward in the past for a meagre uptake of probabilistic methods (see e.g. [8]) can now be largely addressed, thanks to advances in methodology and training. The four key contemporary challenges can be found elsewhere, as mentioned below.

The first challenge is the user attitude towards forecasting uncertainty and towards risk in general. Perception of uncertainty depends on the risk attitude of the users, and can be either seen as a lack of knowledge, or as added information that can help make decisions.

The second challenge results from the specificity of user needs and circumstances. The horizons for various forecasts and decisions differ, and so do their consequences. A few pre-defined variants are thus unlikely to correspond to specific user needs.

The third challenge is to deal with information, which may be incomplete, conflicting, or superfluous. Here, the role of expert judgement and appropriate elicitation becomes crucial [9], also with respect to the utility (loss) functions of the users. The perceptions of probability or utility (loss) are not uniform, and cognitive biases are likely to occur [10].

Finally, the fourth challenge is related to validation, calibration and testing of probabilistic forecasts, chiefly through comparing them with known outcomes [3]. Here, the aim could be to minimise the errors for a model with well-calibrated uncertainty [11].

3. WHERE NEXT? PRACTICAL RECOMMENDATIONS

To address these challenges, the discourse about uncertainty needs to change: from a lack of knowledge, to additional confidence, knowledge or information. Being explicit and transparent about uncertainty is also related to honesty, humility, and trust. This approach has proved successful in aviation, contributing to a substantial increase in safety levels.

To convince the users and producers of forecasts about the added value of uncertainty, the experience in other areas can be looked at. As population forecasts are a key input for many policy areas, they will also contribute to decisions regarding other policy variables.

Addressing the second challenge requires bespoke approaches, with forecasts tailored to the specific needs of different users [10], from high-level, strategic decision-making, to practical, operational planning, requiring quantitative input [12]. The appreciation of benefits of probabilistic forecasts can help justify the resources for their development.

Tailoring predictions, and eliciting the relevant information, requires interaction with users. The prerequisites here involve an open, two-way dialogue, with frequent exchange of information between forecasters and users, which would benefit from insights from cognitive science on statistical literacy, education and training.

As to validation, more methodological research is still needed, especially on calibrating the forecasts. Further work needs to acknowledge that time series of observations are likely not independent. In such cases, methods of risk management can be promising.

In order to achieve a paradigm shift in practical applications of probabilistic population forecasts, the focus should not be on methods, but on possible impacts and consequences of decisions. As a prerequisite, various sources of uncertainty need to be acknowledged, ideally within a joint and coherent framework, such as the one of the Bayesian statistics.
NOTES AND ACKNOWLEDGEMENTS

The full version of this paper will be forthcoming in Journal of Official Statistics in 2015. The paper originates from the workshop on “The use of probabilistic forecasts with focus on population applications”, London, 19 June 2014. The financial support of the ESRC and EPSRC is gratefully acknowledged. We also thank other workshop participants for stimulating discussions. The views expressed in the paper are exclusively those of the authors, and should not be attributed to any institution with which they are affiliated.

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