

## **Bayesian Population Projections with Model Uncertainty**

Arkadiusz Wiśniowski\* email: [A.Wisniowski@soton.ac.uk](mailto:A.Wisniowski@soton.ac.uk)

Peter W.F. Smith,

Jakub Bijak,

James Raymer

ESRC Centre for Population Change, University of Southampton

Since the 1990s, there has been an increasing need to move away from deterministic and variant-based projections to probabilistic projections. The probabilistic approach allows for a direct specification of the chances or probability that a future population will fall within a certain set of intervals, as well as for including many types of uncertainties. However, national statistical offices often lack the expertise to develop probabilistic models or to extend their current models to include probabilities. Also, probabilistic models should be usable at a detailed demographic level, and capable of incorporating expert knowledge of demographic experts.

In this presentation we will describe a Bayesian population projection model that is capable of producing forecasts by age and sex and incorporates model uncertainty. First, we argue that the Bayesian approach is a more natural framework for incorporating various forms of uncertainty in probabilistic projections. Second, we demonstrate the differences that arise from choosing different specifications of models (e.g., extensions of the Lee-Carter model) for fertility, mortality, immigration and emigration in terms of forecasted age patterns and their associated measures of uncertainty. Third, we incorporate this information into a cohort component projection model and use Bayesian model averaging techniques to produce a model-averaged population forecast for the United Kingdom by age and sex. Finally, we discuss the merits and flexibility of a Bayesian cohort component projection model and highlight some areas where this work could be extended.

**Key Words:** Population projections, Modelling population components, Bayesian model averaging