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## Regional probabilistic fertility forecasting by modeling between-country correlations

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### Abstract

**Background:** The United Nations (UN) Population Division constructs probabilistic projections for the total fertility rate (TFR) using the Bayesian hierarchical model of Alkema et al. (2011), which produces predictive distributions of the TFR for individual countries. The UN is interested in publishing probabilistic projections for aggregates of countries, such as regions and trading blocs. This requires joint probabilistic projections of future countryspecific TFRs, taking account of the correlations between them.

**Objective:** We propose an extension of the Bayesian hierarchical model that allows for probabilistic projection of aggregate TFR for any set of countries.

**Methods:** We model the correlation between country forecast errors as a linear function of time invariant covariates, namely whether the countries are contiguous, whether they had a common colonizer after 1945, and whether they are in the same UN region. The resulting correlation model is incorporated into the Bayesian hierarchical model's error distribution.

**Results:** We produce predictive distributions of TFR for 1990-2010 for each of the UN's primary regions. We find that the proportions of the observed values that fall within the prediction intervals from our method are closer to their nominal levels than those produced by the current model.

**Conclusions:** Our results suggest that a substantial proportion of the correlation between forecast errors for TFR in different countries is due to the countries' geographic proximity to one another, and that if this correlation is accounted for, the quality of probabilistic projections of TFR for regions and other aggregates is improved.

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