

A second order 2-dimensional Intrinsic Gaussian Markov Random Fields in blood pressure data

Maria Zafeiria Spyropoulou¹ and James Bentham¹

¹ *School of Mathematics, Statistics and Actuarial Science, University of Kent, UK*

Abstract

Raised blood pressure is a key risk factor for non-communicable diseases, and is estimated to affect 1.13 billion people worldwide. The focus is on estimating trends in systolic (SBP) and diastolic (DBP) blood pressure but with an emphasis on their interaction (INT).

We separate the globe into groups of countries, and apply a Bayesian hierarchical model. Each country is a member of a region and super-region, in which there is a smaller and a larger group of countries respectively. This structure allows us to borrow strength across regions and super-regions when there is not adequate information from the countries' own data. Within each country, data are correlated temporally and within each region and super-region data have temporal and between-countries correlation [2].

We begin with a linear model over time. Three separate linear models for DBP, SBP and INT are created, with each taking advantage of the hierarchical structure and borrowing information. To allow the temporal correlation we add a non-linear model over time. A two-dimensional Intrinsic Gaussian Markov Random Field (IGMRF) is implemented for the model. By using the IGMRF of two dimensions for DBP and SBP, the INT is included implicitly [1]. At last, we introduce an age model using B-splines, and fixed effects for covariates such as diet types, urbanization and studies' coverage, which help the model fitting for DBP, SBP and INT.

Applying these methods has shown that IGMRF approximations can be used for estimating the correlations and for facilitating MCMC algorithms. For the computational process of the model, we use canonical parametrisation for the Metropolis' updates, Cholesky factorisation for the Gibbs' sampler updates and parallel computing for accelerating the code. By using the aforementioned methodology, our model is mixing well and converges, hence is able to estimate the variation of the interaction between SBP and DBP across countries, over time in different age groups and gender.

Keywords

MCMC, Intrinsic Gaussian Markov Random Fields, 2nd order 2-Dimensional Random Walk

Acknowledgements

The author was supported by the University of Kent.

References

- [1] H. Rue and L. Held.(2005). *Gaussian Markov Random Fields: Theory and Applications. Vol. 104. Monographs on Statistics and Applied Probability* London: Chapman & Hall
- [2] Danaei G, Finucane MM, Lin JK, et al.(2011).*National, regional, and global trends in systolic blood pressure since 1980:systematic analysis of health examination surveys and epidemiological studies with786 country-years and 5.4 million participants.* Lancet.