Bayesian Statistics short course – week 2 (amended version)

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Homework

Task 1

(*Linear regression*)

The data enclosed in the `data.txt` file contain information on GDP per capita (in Euros, at current prices), as well as on annual immigration counts, for Germany and the United Kingdom since the early 1990s, as reported by Eurostat and the ONS.

Using WinBUGS, estimate simple linear regression models for immigration counts in both countries, using GDP per capita as the explanatory variable. Assume vague prior distributions for model parameters. Compare the prior and posterior distributions, and comment on the posterior density for the regression coefficient.

Hints: You can use normal distributions for the constants and regression coefficients, remembering that in Winbugs, the parameters of the `dnorm` functions are the mean and the precision (inverse variance). For the inverse variance of the random term, you can use a gamma distribution for example with small parameters (see the WinBUGS manual for detailed parameterisation), or any other sensible distribution that takes only positive values).

Task 2

(*Prediction – time series model*)

With the same data as in Task 1, predict immigration counts for Germany and the UK, $m(t)$, assuming an autoregressive model AR(1): $m(t) = c + \phi\, m(t-1) + \varepsilon(t)$, where $\varepsilon(t) \sim N(0, \sigma^2)$. In WinBUGS, carry out predictions until 2020. For ϕ, assume a prior distribution that: (i) restricts the values of ϕ to the interval $[-1, 1]$, and (ii) does not impose such a restriction, and compare the results.

Hint: For the autoregression parameters ϕ, you can experiment with different distributions, for example normal (with different precision), uniform, beta, etc.

Task 3*

(*R interface*)

Carry out the analysis from either Task 1 or Task 2 in R by using an interface package of your choice. Comment on similarity of results to those obtained with WinBUGS, and on the speed of calculations.