Course: Bayesian Modeling Using WinBUGS

LAB 1 – Introduction to WinBUGS

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ACTIVITY #1

Consider the following data from two independent groups:

Y	Group	Y	Group
1.50	1	0.80	2
0.54	1	0.03	2
0.85	1	-0.37	2
2.04	1	0.67	2
-0.49	1	0.76	2
-0.65	1	2.47	2
0.98	1	1.36	2
-0.63	1	2.29	2
-1.72	1	2.26	2
-0.06	1	2.71	2
0.60	1	-0.28	2
1.25	1	1.70	2
-0.72	1	1.88	2
0.66	1	-0.35	2
-0.39	1	1.90	2

a) Use the Normal distribution to model those data assuming that the parameters (mean and standard deviation) for each group are different. Write the code in WinBUGS, using non-informative prior distributions for the unknown parameters. Run the MCMC for 5000 iterations plus 1000 burn-in iterations.

b) Estimate the posterior distributions for the means and the standard deviations in each group. Compare the posterior distributions of the two means and the posterior distributions of the two standard deviations with box plots. Produce summary statistics, trace plots, density and autocorrelation plots for each parameter of interest.

c) Estimate the posterior distributions for $\mu = \mu_1 - \mu_2$ and $\sigma = \sigma_1 / \sigma_2$, where μ_j and σ_j are the mean and the standard deviation respectively for the j = 1, 2 group. Use the posterior sample to infer for the equality of the means and the standard deviations of the two groups. Produce summary statistics, trace plots, density and autocorrelation plots for μ and σ.

d) Calculate the DIC value of the above model.

e) Change your model assuming that the standard deviations are equal in each group. Write the new code in WinBUGS, using again non-informative prior distributions for the unknown parameters. Run the MCMC for 5000 iterations plus 1000 burn-in iterations.

f) Estimate the posterior distributions for the means in each group and the common standard deviation. Compare the posterior distributions for the two means with box plots. Produce summary statistics, trace plots, density and autocorrelation plots for each parameter of interest. Estimate the posterior distribution of $\mu = \mu_1 - \mu_2$ and use the posterior sample to infer for the equality of the means of the two groups. Produce summary statistics, trace plots, density and autocorrelation plots for μ.

g) Calculate the DIC value of the new model and compare it with the DIC value of the model with different standard deviations of the two groups.

ACTIVITY #2 (Homework)

Consider the following data:

0.4 0.01 0.2 0.1 2.1 0.1 0.9 2.4 0.1 0.2

(a) Use the exponential distribution $Y_i \sim Exp(\theta)$ to model these data and impose a prior on $\log\theta$.

- Define the data in WinBUGS using both rectangular and list formats. Use $\theta=1$ as initial value.
- Write the model code.
- Compile the model and obtain a sample of 1000 iterations after discarding initial 500 iterations as burnin.
- Monitor the convergence graphically using trace and autocorrelations plots.
- Calculate Monte Carlo errors using WinBUGS.
- Obtain posterior summaries and density plots for θ, $1/\theta$, and $\log\theta$.
- Export MCMC values using the CODA option. Import them in another statistical package and obtain the ergodic mean plot.

(b) Use the gamma and the log-normal distributions to model the data. (perform similar analysis as in a)

(c) Use the normal distribution for the logarithms of the original values to model the data. (perform similar analysis as in a)

(d) Compare the results obtained under all models above. Use DIC to decide which model is more appropriate.