Homework 4

Data

The data in 'mosquitofish.txt' represent the number of surviving mosquitofish y_i (for $i = 1, \ldots, n$) from $n = 32$ groups out of N_i initial fish in each group. For this homework assignment, we seek to construct a Binomial regression model to learn about covariates that may predict survival probability (θ_i). These covariates are standardized final mean length of surviving fish in group (L1), standardized duration in days of study (d), and also the product of the standardized L1 and d.

Questions

Prepare a written response to the following, using Overleaf. The assignment shouldn't be longer than 10 (double-spaced, excluding title page, references, and appendices). Due Thurs., March 23, at the beginning of the class period. Please submit the assignment as a PDF through CANVAS.

1. Using JAGS, develop the R code to fit the following Bayesian binomial regression model (just use the plain probit link, do not use the auxiliary variable probit approach):

$$y_i \sim \mathrm{Binom}(N_i, \theta_i) \text{ , for } i = 1, \ldots, n \text{ ,} \tag{1}$$

$$\mathrm{probit}(\theta_i) = \mathbf{x}_i'\boldsymbol{\beta} \text{ ,} \tag{2}$$

$$\boldsymbol{\beta} \sim \mathrm{N}(\boldsymbol{\mu}_\beta, \boldsymbol{\Sigma}_\beta) \text{ .} \tag{3}$$

2. Use JAGS to fit the binomial regression model above to the mosquitofish data set using $\mathbf{y}$ =N1 as the response variable, $\mathbf{N}$=N0, and the following combinations of the three covariates:

(a) intercept, standardized `L1`, standardized `d`, and a product of the two covariates (as an interaction term)

(b) intercept, standardized `L1`, standardized `d`

(c) intercept, standardized `L1`

(d) intercept, standardized `d`

(e) intercept only

3. Compare the DIC across model fits and make inference using the best scoring model according to DIC; include a violin plot for the regression coefficients.

References

- Soubeyand, S., R. Beaudouin, N. Desassis, and G. Monod. (2007). Model-based estimation of the link between the daily survival probability and a time-varying covariate, application to mosquitofish survival data. Mathematical Biosciences, 210: 508-522.