STA 122 ASSIGNMENT 5

Due April 15, 2009

1. Refer to the data in Chapter 6 of Lee 10. For interpretation convert weights to pounds and subtract 40 from weeks, and consider a linear regresion model to predict weight based on gestational age:

$$W_i = \alpha + \beta(A_i - 40) + \epsilon_i$$

where the y-intercept is the expected weight of a female baby born at 40 weeks.

   (a) Fit a linear regression and examine the residuals – do there appear to be any violations of assumptions (normality, constant variance) that suggest that we need to transform the data or worry about outliers?

   (b) Fit the linear regression using WinBugs using proper priors that approximate the usual reference prior $p(\alpha, \beta, \phi) \propto 1/\phi$ where $\phi = 1/\sigma^2$ and ϵ_i are iid $N(0, \sigma^2)$.

   Plot posterior distributions and construct 95% HPD intervals for α, β, σ. Using this model, find the posterior probability that a female born at 36 weeks will be less than 4 pounds 4 ounces (this was the weight of my smallest twin). Provide a brief paragraph interpreting the results.

   (c) Based on my siblings weights, I have come up with an informative prior:

$$\begin{aligned} \alpha \mid \phi &\sim N(8, 1.5/\phi) \\ \beta \mid \phi &\sim N(1.7, .05/\phi) \\ \phi &\sim G(1/2, 22.5/2) \end{aligned}$$

   Repeat (b) using the informative prior. Do the results change in any significant way?

2. For the stackloss data used previously, use Winbugs to fit a robust regression using t errors. Use 9 degrees of freedom and the approximate reference prior for the coefficients and precision.

   (a) Fit the model using the two stage error model:

$$\begin{aligned} \epsilon_i \mid \sigma^2, \lambda_i &\sim N(0, \sigma^2/\lambda_i) \\ \lambda_i \mid G(\delta/2, \delta/2) & \end{aligned}$$

   (b) Create side-by-side boxplots of the distribution of λ for each case. Which points appear to be "down-weighted"?

   (c) Create HPD intervals for all of the regression coefficients – how do the estimates compare to the estimates and intervals under normality?

   (d) Has the estimate of σ changed significantly from the normal model? Explain.

   (To contrast results either use the OLS estimates and CI or refit the model in Winbugs using normal errors.