Activity 6: key

Week 5 Recap: Binomial Probability Exact Analysis

- Bayes Rule with data
- "Calculus"
- Bayesian Data Analysis with binary data

Week 6 Overview: Bayesian Analysis with MCMC

- jags
- Bayesian Analysis with MCMC

Steps of Bayesian Data Analysis

Recall that for a Bayesian analysis we will follow these steps:

1. **Identify the data relevant to the research questions.** What are the measurement scales of the data? Which data variables are to be predicted, and which data variables are supposed to act as predictors?
2. **Define a descriptive model for the relevant data.** The mathematical form and its parameters should be meaningful and appropriate to the theoretical purposes of the analysis.
3. **Specify a prior distribution on the parameters.** The prior must pass muster with the audience of the analysis, such as skeptical scientists.
4. **Use Bayesian inference to re-allocate credibility across parameter values.** Interpret the posterior distribution with respect to theoretically meaningful issues (assuming that the model is a reasonable description of the data; see next step).
5. **Check that the posterior predictions mimic the data with reasonable accuracy (i.e., conduct a 'posterior predictive check').** If not, then consider a different descriptive model.

JAGS code modification

Recall the code form the weekly module.

```
model_string <- "model{
  # Likelihood
  z ~ dbinom(theta, N)

  # Prior
  theta ~ dbeta(alpha, beta)
  alpha <- 1 # prior successes
  beta <- 1 # prior failures
}"
```

Rewrite this in a way that alpha and beta can be inputed as data elements. Then re run the analyses. Recall that `z = 392` and `N = 869` when estimating the probability of a house in Seattle having more than two bedrooms.

JAGS Code object

Following the previous question, use the posterior samples `posterior_sample[[1]]` to create a density plot of the posterior distribution and overlay the true posterior density.

Synthetic Data

a.

Simulate data from a normal process (mean .75, sd = 10) for 1000 trials.

b.

State priors for μ and σ

c.

Given this data and priors, run jags code to estimate posterior distributions for μ and σ

```
model_normal<- "model{
  # Likelihood
  for (i in 1:n){
    y[i] ~ dnorm(mu, 1/sigma^2)
  }

  # Prior
  mu ~ dnorm(mu0, 1/sigma0^2)
  sigma ~ dgamma(a, b)
}"
```

d.

Compare your results from part c with what you'd expect.

Regression

Assume we will use the Seattle housing dataset, but will now focus on housing price and use `sqft_living` as a predictor in a regression model.

a. Identify a descriptive statistical model for the relevant data. Then interpret the statistical parameters in that model.

b. Specify a prior distribution for all parameters in the model.