Geog 509: Bayesian Data Analysis
Chapter 4 Problem Set

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4E1

$$y_i \sim \text{Normal}(\mu, \sigma)$$

4E2

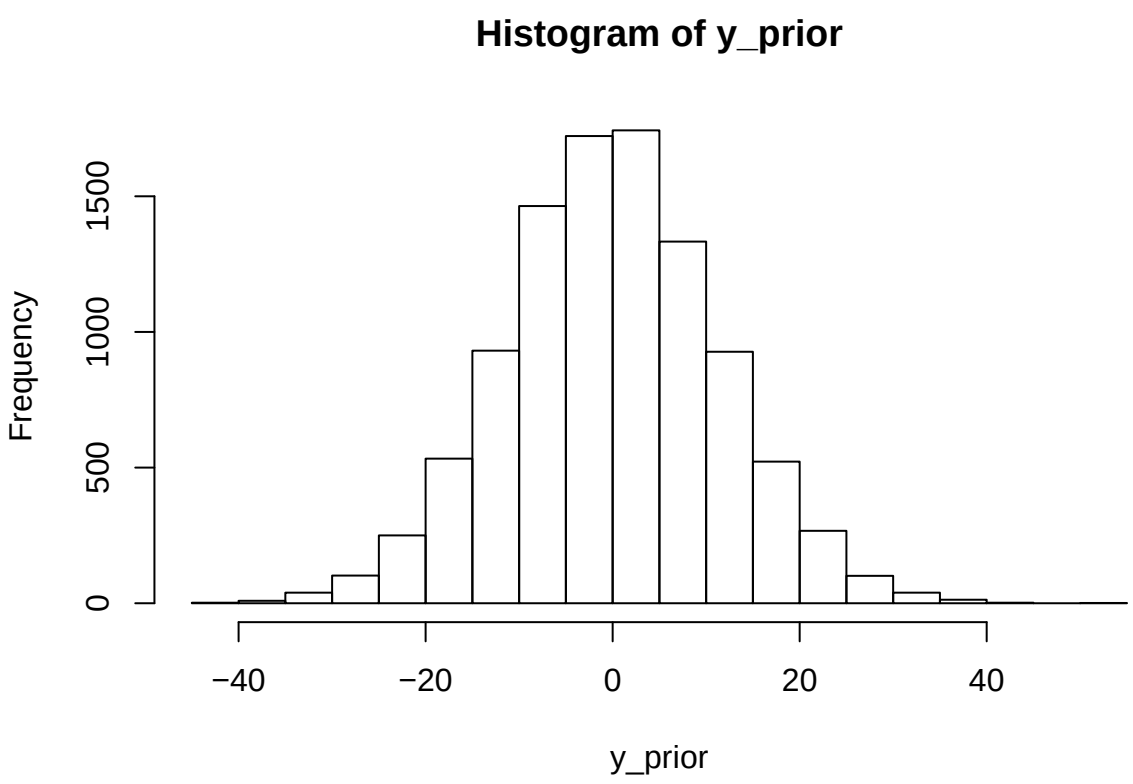
There are two parameters μ and σ

4E3

$$\Pr(\mu, \sigma | y_i) = \frac{\prod_i \text{Normal}(y_i|\mu, \sigma)\text{Normal}(\mu|0, 10)\text{Uniform}(\sigma|0, 10)}{\int\int \prod_i \text{Normal}(h_i|\mu, \sigma)\text{Normal}(\mu|0, 10)\text{Uniform}(\sigma|0, 10)d\mu d\sigma}$$

4M1

```
n <- 10000
mu <- rnorm(n, 0, 10)
sigma <- runif(n, 0, 10)
y_prior <- rnorm(n, mu, sigma)
hist(y_prior)
```



4M4

$$h_i \sim \text{Normal}(\mu, \sigma) \mu_i = \alpha + \beta t_i \alpha \sim \text{Normal}(160, 50) \beta \sim \text{Normal}(0, 10) \sigma \sim \text{Uniform}(0, 50)$$

4M5

$$h_i \sim \text{Normal}(\mu, \sigma) \mu_i = \alpha + \beta t_i \alpha \sim \text{Normal}(120, 50) \beta \sim \text{Uniform}(0, 30) \sigma \sim \text{Uniform}(0, 50)$$

Changed the mean for average height and also changed the distribution of of β to be uniform to restrict it be greater than zero

4M6

The variance is the square of σ so we can adjust the the following

$$\sigma \sim \text{Uniform}(0, 8)$$

4H1

```r
library(rethinking)
library(tidyverse)
library(brms)

data(Howell1)
d <- Howell1
rm(Howell1)
detach(package:rethinking, unload = T)

d2 <-
  d %>%
  filter(age >= 18)

b4.3 <-
  brm(data = d2, family = gaussian,
      height ~ 1 + weight,
      prior = c(prior(normal(156, 100), class = Intercept),
                prior(normal(0, 10), class = b),
                prior(uniform(0, 50), class = sigma)),
      iter = 41000, warmup = 40000, chains = 4, cores = 4,
      seed = 4)


new_weight <- tibble(weight = c(46.95, 43.72, 64.78, 32.59, 54.63))

predict_df <-
  predict(
    b4.3,
    newdata = new_weight
   ) %>%
  as_tibble() %>%
  bind_cols(new_weight)
```

Estimate	Est.Error	Q2.5	Q97.5	weight
156.1600	5.058221	146.1596	166.0260	46.95
153.3686	5.126961	143.4550	163.4415	43.72
172.6576	5.174166	162.7569	182.9770	64.78
143.3466	5.068738	133.2765	153.3536	32.59
163.3763	5.094728	153.3635	173.5900	54.63