

Chapter 3 Questions

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Chapter 3 points: $2 + 7 + 9 = 18$

Easy (2 points total)

The following code is given in the question:

```
library(rethinking)

## Loading required package: rstan
## Warning: package 'rstan' was built under R version 3.3.3
## Loading required package: ggplot2
## Warning: package 'ggplot2' was built under R version 3.3.3
## Loading required package: StanHeaders
## Warning: package 'StanHeaders' was built under R version 3.3.3
## rstan (Version 2.17.3, GitRev: 2e1f913d3ca3)
## For execution on a local, multicore CPU with excess RAM we recommend calling
## options(mc.cores = parallel::detectCores()).
## To avoid recompilation of unchanged Stan programs, we recommend calling
## rstan_options(auto_write = TRUE)
## Loading required package: parallel
## rethinking (Version 1.59)

p_grid <- seq(from = 0, to = 1, length.out = 1000)
prior <- rep(1, 1000)
likelihood <- dbinom(6, size = 9, prob = p_grid)
posterior <- likelihood * prior
posterior <- posterior / sum(posterior)
set.seed(100)
samples <- sample(p_grid, prob = posterior, size = 1e4, replace = TRUE)
```

3E1-3E7

```
question3e1 <- length(which(posterior < 0.2)) / length(posterior)
question3e2 <- length(which(posterior > 0.8)) / length(posterior)
question3e3 <- length(which(posterior > 0.2 & posterior < 0.8)) / length(posterior)
question3e4 <- quantile(posterior, 0.2)
question3e5 <- quantile(posterior, 0.8)

# Narrowest interval would be centred at 0.5, so we want 33% above and below 0.5
question3e6upper <- quantile(posterior, 0.5+0.33)
```

```
question3e6lower <- quantile(posterior, 0.5-0.33)

# Equal on both sides would mean there's (0.33/2) on either side.
question3e7upper <- quantile(posterior, 1-(0.33/2))
question3e7lower <- quantile(posterior, 0.33/2)
```

Medium (9 points total)

3M1 (2 points)

```
p_grid <- seq(from = 0, to = 1, length.out = 1000)
prior <- rep(1, 1000)
likelihood <- dbinom(8, size = 15, prob = p_grid)
unstd.posterior <- likelihood * prior
posterior <- unstd.posterior / sum(unstd.posterior)
```

3M2 (2 points)

```
samples <- sample(x = p_grid, size = 10000, prob = posterior, replace = TRUE)
HPDI(samples, 0.9)
```

```
##      |0.9      0.9|
## 0.3383383 0.7317317
```

3M3 (1 point)

```
posterior_predictive_check <- rbinom(n = 10000, size = 15, prob = samples)
sum(posterior_predictive_check == 8) / 10000
```

```
## [1] 0.1428
```

3M4 (2 points)

```
posterior_predictive_check <- rbinom(n = 10000, size = 9, prob = samples)
sum(posterior_predictive_check == 6) / 10000
```

```
## [1] 0.1695
```

3M5 (2 points)

```
prior <- c(rep(0, 500), rep(1, 500))
likelihood <- dbinom(8, size = 15, prob = p_grid)
unstd.posterior <- likelihood * prior
posterior <- unstd.posterior / sum(unstd.posterior)

# 3M2
```

```
samples <- sample(x = p_grid, size = 10000, prob = posterior, replace = TRUE)
HPDI(samples, 0.9)
```

```
##      |0.9      0.9|
## 0.5005005 0.7097097
```

```
# 3M3
posterior_predictive_check <- rbinom(n = 10000, size = 15, prob = samples)
sum(posterior_predictive_check == 8) / 10000
```

```
## [1] 0.1592
```

```
# 3M4
posterior_predictive_check <- rbinom(n = 10000, size = 9, prob = samples)
sum(posterior_predictive_check == 6) / 10000
```

```
## [1] 0.2357
```

Hard (7 points total)

The following code is used in all of the following questions.

```
library(rethinking)
data(homeworkch3)
```

3H1 (1 point)

```
num_births <- length(birth1) + length(birth2)
num_boys <- sum(birth1) + sum(birth2)
prior <- rep(1, 1000)
likelihood <- dbinom(x = num_boys, size = num_births, prob = p_grid)
unstd.posterior <- prior * likelihood
posterior <- unstd.posterior / sum(unstd.posterior)

p_grid[which.max(posterior)]
```

```
## [1] 0.5545546
```

3H2 (2 points)

```
my_sample <- sample(p_grid, 10000, prob = posterior, replace = TRUE)
HPDI(my_sample, 0.5)
```

```
##      |0.5      0.5|
## 0.5255255 0.5725726
```

```
HPDI(my_sample, 0.89)
```

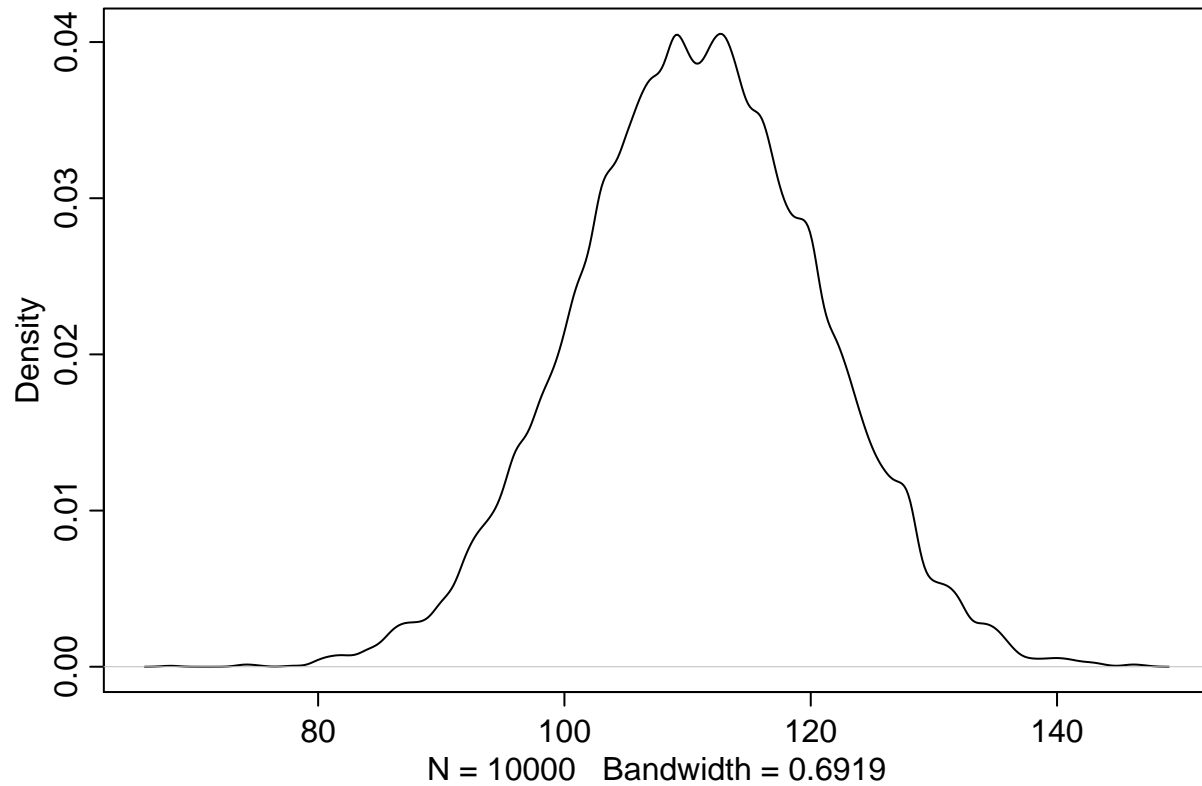
```
##      |0.89     0.89|
## 0.5015015 0.6116116
```

```
HPDI(my_sample, 0.97)
```

```
##      |0.97      0.97|  
## 0.4764765 0.6286286
```

3H3 (2 points)

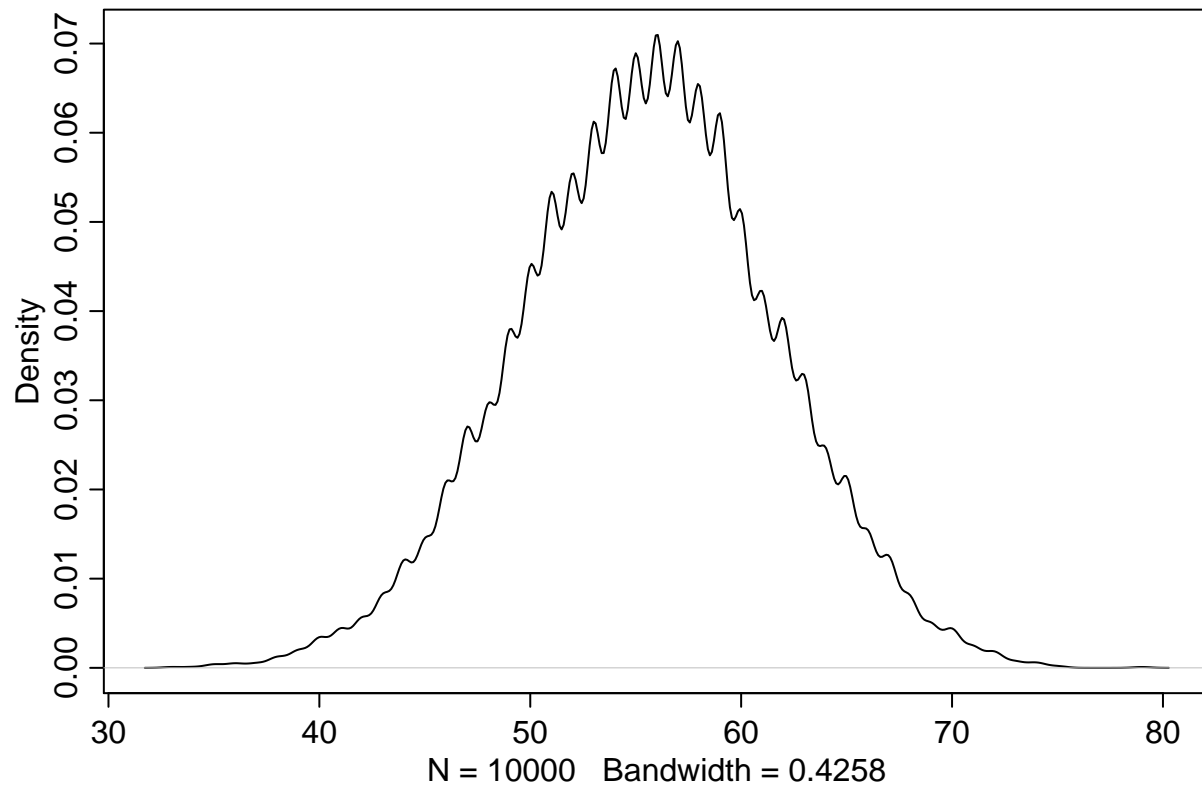
```
simulation <- rbinom(10000, size = 200, prob = my_sample)  
dens(simulation)
```



```
# yes, it looks like 111 is right near the centre of the distribution.
```

3H4 (1 point)

```
new_simulation <- rbinom(10000, size = 100, prob = my_sample)  
dens(new_simulation)
```



3H5 (1 point)

```
boys_born_after_girls <- birth2[birth1 == 0]
posterior_predictive_check <- rbinom(n = 10000, size = length(boys_born_after_girls), prob = length(boys_born_after_girls) / length(birth2))
dens(posterior_predictive_check)
```

