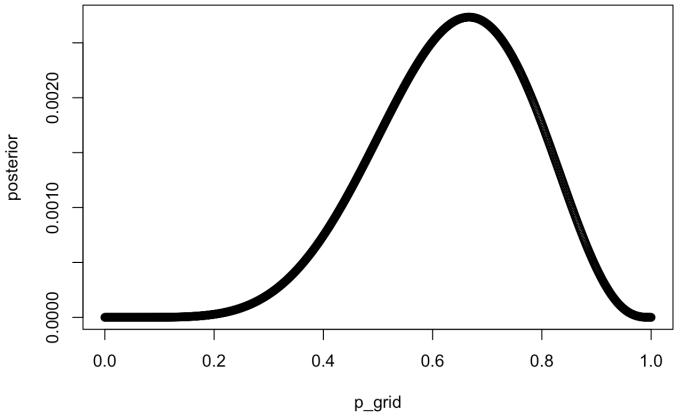
statistical-rethinking-chapter-3

2024-07-27

Preliminary Code

```
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)
plot(p_grid, posterior)
```




```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
```

3E1.

```
sum(samples < 0.2) / length(samples)
```

```
## [1] 5e-04
```

3E2.

```
sum(samples > 0.8) / length(samples)
```

```
## [1] 0.1188
```

3E4.

```
quantile(samples, 0.2)
```

```
##       20%
## 0.5185185
```

3E5.

```
quantile(samples, 0.8)
```

```
##       80%
## 0.7567568
```

3E6.

```
HPDI(samples, prob=0.66)
```

```
##     |0.66     0.66|
## 0.5255255 0.7927928
```

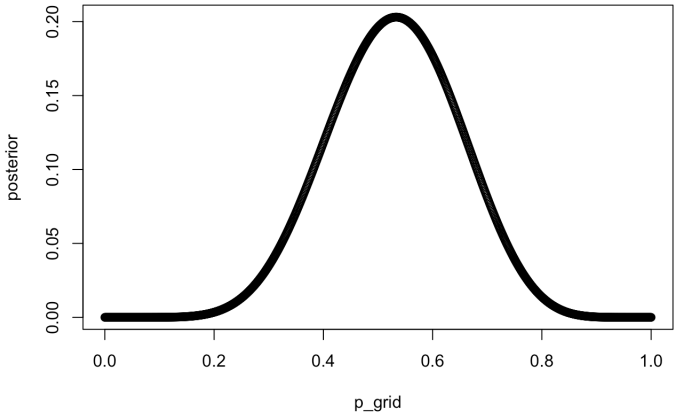
3E7.

```
PI(samples, prob=0.66)
```

```
##       17%       83%
## 0.4994995 0.7727728
```

3M1.

```
p_grid <- seq(from=0, to=1, length.out=1e3)
prior <- rep(1, length(p_grid))
likelihood <- dbinom(8, 15, prob=p_grid)
posterior <- likelihood * prior
plot(p_grid, posterior)
```



3M2.

```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
HPDI(samples, prob=0.90)
```

```
##      |0.9      0.9|
## 0.3383383 0.7267267
```

3M3.

Construct a posterior predictive check

```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
w <- rbinom(1e4, size=15, prob=samples)
sum(w == 8) / 1e4
```

```
## [1] 0.1544
```

3M4.

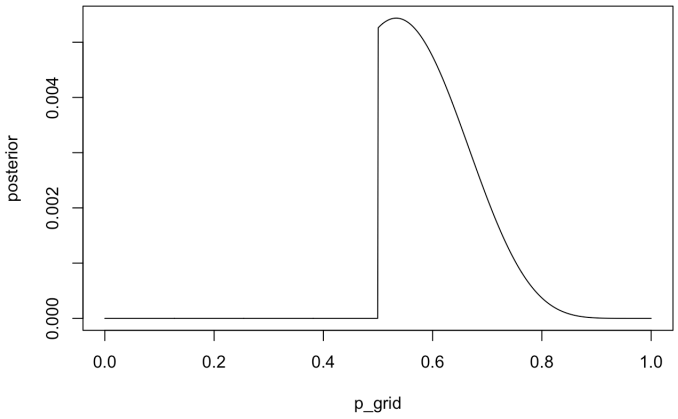
```
w <- rbinom(1e4, size=9, prob=samples)
sum(w==6) / 1e4
```

```
## [1] 0.1788
```

3M5.

Redo 3M1.

```
p_grid <- seq(from=0, to=1, length.out=1000)
prior <- ifelse(p_grid < 0.5, 0, 1)
likelihood <- dbinom(x=8, size=15, prob=p_grid)
posterior <- likelihood * prior
posterior <- posterior / sum(posterior)
plot(p_grid, posterior, type="l")
```



Redo 3M2.

```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
HPDI(samples, prob=0.9)
```

```
##      |0.9      0.9|
## 0.5005005 0.7107107
```

Redo 3M3.

```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
w <- rbinom(1e4, size=15, prob=samples)
sum(w == 8) / 1e4
```

```
## [1] 0.1563
```

Redo 3M4.

```
samples <- sample(p_grid, prob=posterior, size=1e4, replace=TRUE)
w <- rbinom(1e4, size=9, prob=samples)
sum(w == 6) / 1e4
```

```
## [1] 0.2262
```

3M6.

You want the 99% percentile interval of the posterior distribution of *p* to be only 0.05 wide. This means the distance between the upper and lower bound of the interval should be 0.05. How many times will you have to toss the globe to do this?

```
real_water <- 0.7
p_grid <- seq(from=0, to=1, length.out=1e4)
prior <- rep(1, length(p_grid))

posteriors <- function(N) {
  likelihood <- dbinom(round(N*real_water), size=N, prob=p_grid)
  posterior <- likelihood * prior
  posterior <- posterior / sum(posterior)
  return(posterior)
}

for (i in 1:3000) {
  posterior = posteriors(i)
  samples <- sample(p_grid, prob=posterior, size=1e4, replace=T)
  interval <- PI(samples, prob=0.99)
  diff <- (interval[2] - interval[1])
  if (diff <= 0.05) {
    print(i)
    break
  }
}
```

```
## [1] 2156
```

Hard Problems

```
data(homeworkch3)
```

3H1.

```
p_grid <- seq(from=0, to=1, length.out=1e3)
```