EEEB UN3005/GR5005
Lab - Week 05 - 25 and 27 February 2019

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Statistical Distributions and Summary Statistics

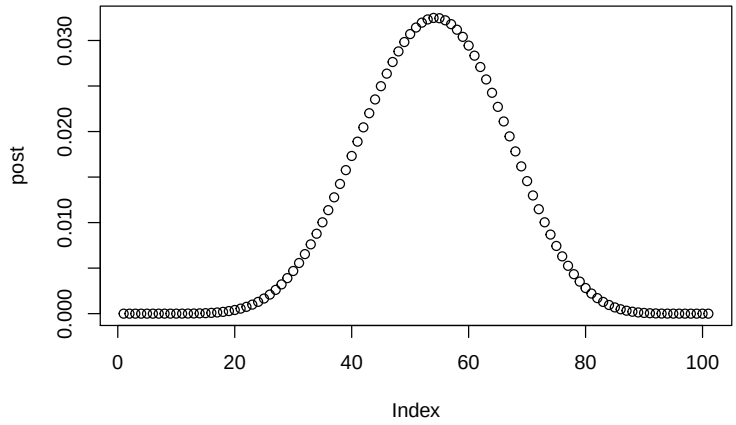
Exercise 1: Grid Approximation, Our Old Friend

Imagine the globe tossing example from the *Statistical Rethinking* text and class resulted in 8 water observations out of 15 globe tosses.

With this set of observations, use grid approximation (with 101 grid points) to construct the posterior for p (the probability of water). Assume a flat prior.

Plot the posterior distribution.

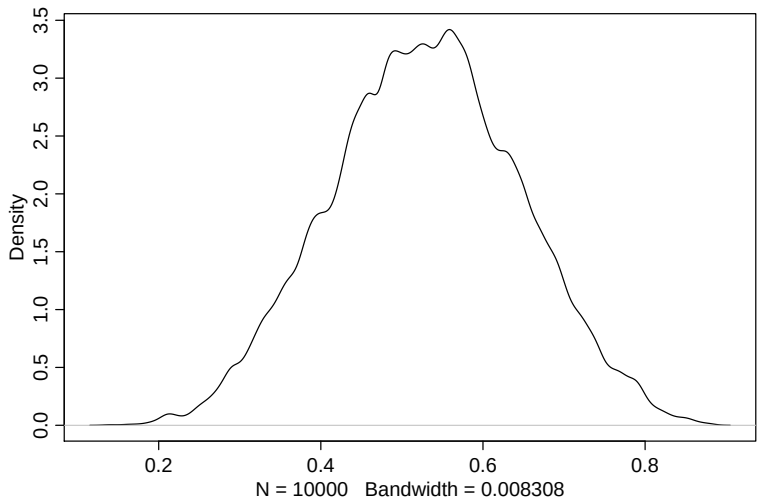
```
grid = seq(0, 1, length.out = 101)
prior = rep(1, 101)
likelihood = dbinom(8, 15, prob = grid)
unstd.post = likelihood * prior
post = unstd.post / sum(unstd.post)
plot(post)
```



Exercise 2: Sampling From a Grid-Approximate Posterior

Draw 10,000 samples from the posterior distribution of p. Call these samples `post.samples`. Visualize `post.samples` using the `dens()` function. Re-run your sampling and plotting code multiple times to observe the effects of sampling variation.

```
post.samples = sample(grid, siz = 10000, replace = TRUE, prob = post)
dens(post.samples)
```



Exercise 3: Summarizing Samples

Return the mean, median, and mode (using `chainmode()`) of `post.samples`. Then calculate the 80%, 90%, and 99% highest posterior density intervals.

```
print(mean(post.samples))
```

```
## [1] 0.529125
```

```
print(median(post.samples))
```

```
## [1] 0.53
```

```
print(chainmode(post.samples))
```

```
## [1] 0.5535459
```

```
print(HPDI(post.samples, 0.8))
```

```
## |0.8 0.8|
## 0.36 0.66
```

```
print(HPDI(post.samples, 0.9))
```

```
## |0.9 0.9|
## 0.33 0.71
```

```
print(HPDI(post.samples, 0.99))
```

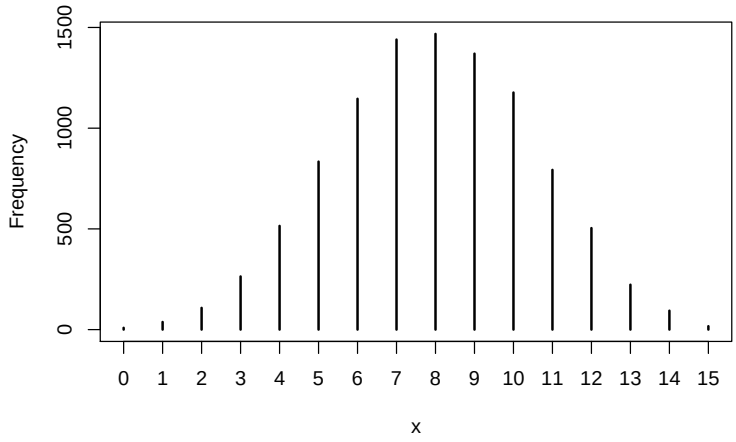
```
## |0.99 0.99|
##  0.24  0.80
```

Exercise 4: Implied Model Predictions

Using `post.samples`, generate 10,000 simulated model predictions for a binomial trial of size 15 (you can call these `preds`). Visualize the model predictions using the `simplehist()` function.

Based on these posterior predictions, what is the probability of observing 8 waters in 15 globe tosses?

```
preds = rbinom(10000, size = 15, prob = post.samples)
simplehist(preds)
```



Answer:

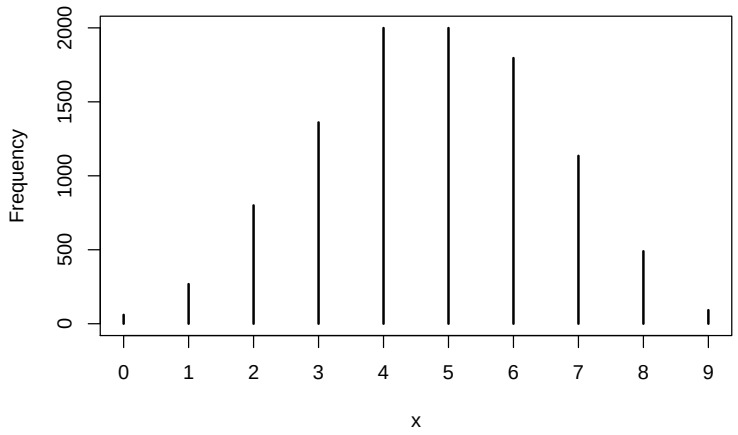
Based on the graph, the maximum is at 8 out of 15 with frequency 1500. So the probability will be

$$Pr(8w) = \frac{N_8}{N_{total}} = \frac{1500}{10000} = 0.15$$

Exercise 5: More Implied Model Predictions

Using the *same* posterior samples (i.e., `post.samples`), calculate the posterior probability of observing 8 waters in 9 tosses.

```
preds2 = rbinom(10000, size = 9, prob = post.samples)
simplehist(preds2)
```



Answer:

There are about 500 times that the result is 8 out of 9. So the probability is

$$P(8w) = \frac{N_8}{N_{total}} = \frac{500}{10000} = 0.05$$