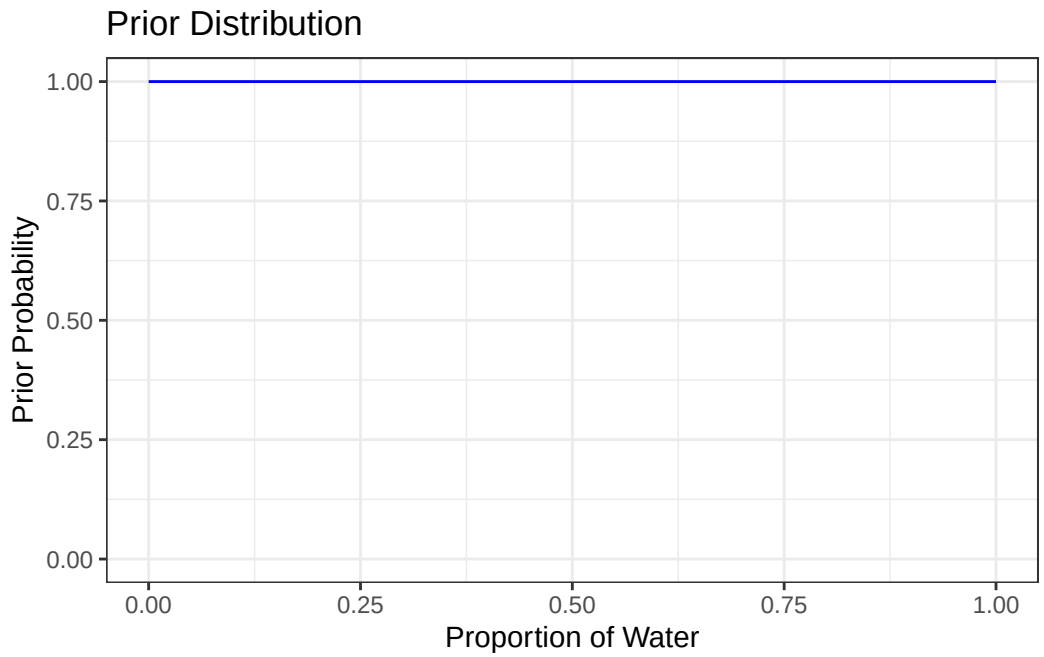
2M1: Grid Approximate Posterior with Uniform Prior

Recall the globe tossing model from the chapter. Compute and plot the grid approximate posterior distribution for each of the following sets of observations. In each case, assume a uniform prior for p.

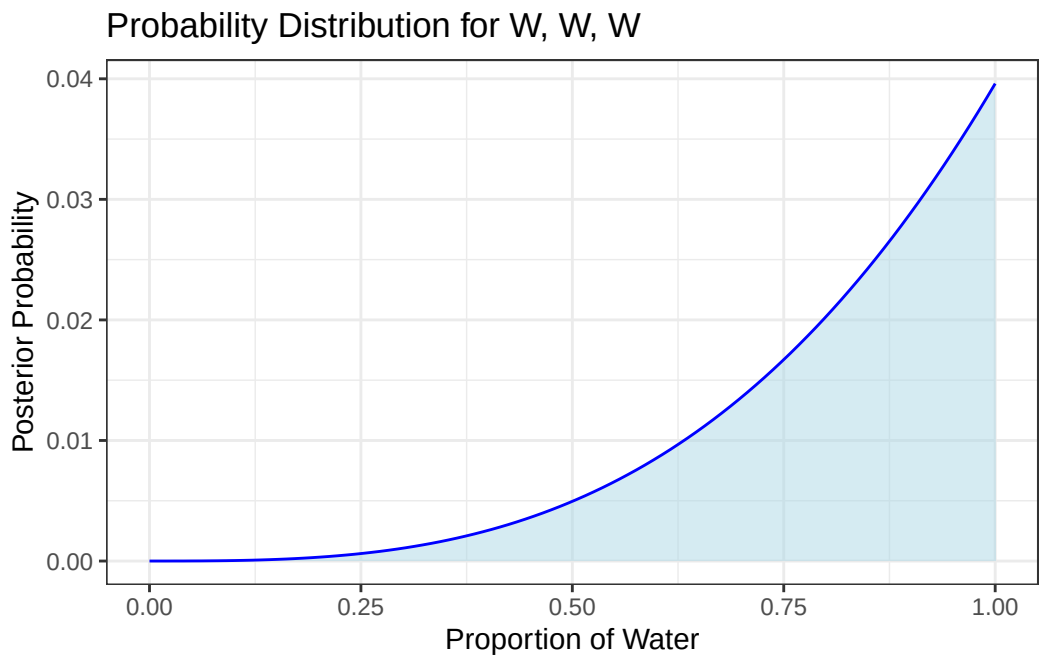
1. W, W, W
2. W, W, W, L
3. L, W, W, L, W, W, W

```r
library(dplyr)
library(ggplot2)

n_points <- 100

# define grid
p_grid <- seq(from=0, to=1, length.out=n_points)

# define prior
# A flat/uniform prior-every value of p is equally plausible before seeing data.
# This is the "I have no prior information" stance.
prior <- rep(1, n_points)

# plot the prior
df_prior <- tibble(grid = p_grid, prior = prior)

ggplot(df_prior, aes(x = grid, y = prior)) +
  geom_line(color = "blue", linewidth = 0.5) +
  labs(x = "Proportion of Water", y = "Prior Probability") +
  ggtitle("Prior Distribution") +
  ylim(0, 1) +
  theme_bw()
```



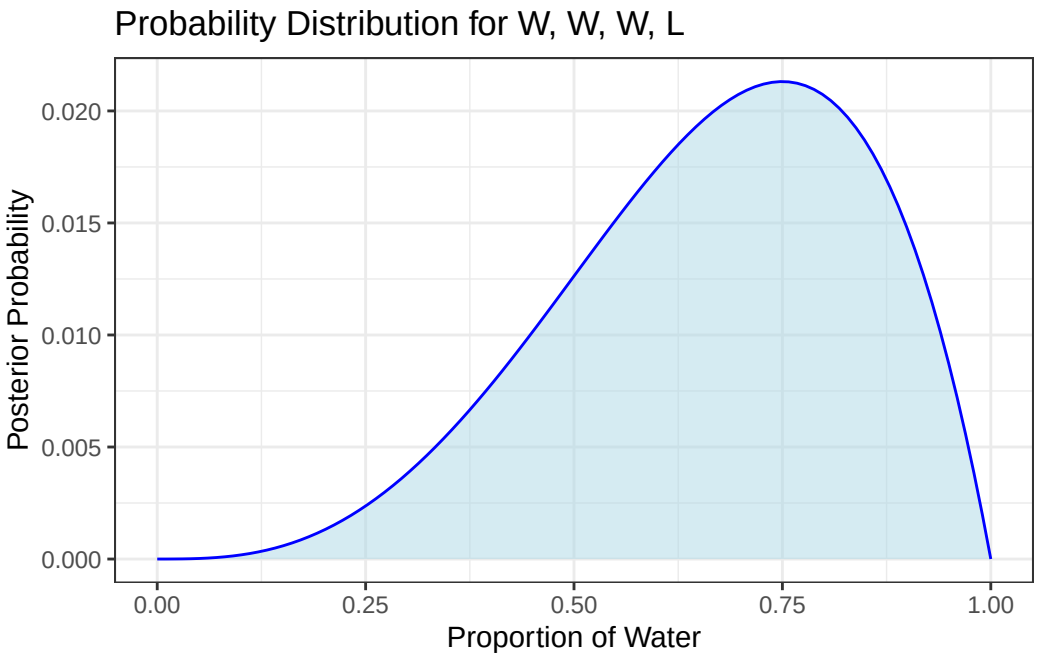
W, W, W

```
# compute likelihood at each value in grid
# using a binomial distribution
likelihood <- dbinom(3, size = 3, prob = p_grid)

# compute product of likelihood and prior
unstd.posterior <- likelihood * prior

# standardize the posterior, so it sums to 1
posterior <- unstd.posterior / sum(unstd.posterior)

df <- tibble(grid = p_grid, posterior = posterior)

ggplot(df, aes(x = grid, y = posterior)) +
  geom_area(fill = "lightblue", alpha = 0.5) +
  geom_line(color = "blue", linewidth = 0.5) +
  labs(x = "Proportion of Water", y = "Posterior Probability") +
  ggtitle("Probability Distribution for W, W, W") +
  theme_bw()
```



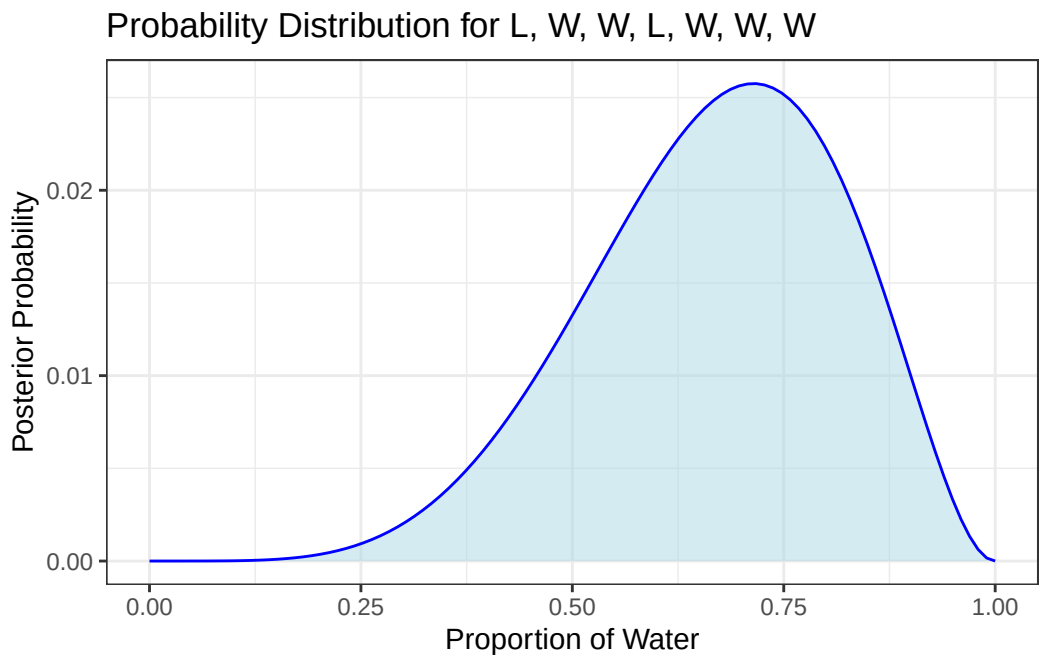
W, W, W, L

```
# compute likelihood at each value in grid
# using a binomial distribution
likelihood <- dbinom(3, size = 4, prob = p_grid)

# compute product of likelihood and prior
unstd.posterior <- likelihood * prior

# standardize the posterior, so it sums to 1
posterior <- unstd.posterior / sum(unstd.posterior)

df <- tibble(grid = p_grid, posterior = posterior)

ggplot(df, aes(x = grid, y = posterior)) +
  geom_area(fill = "lightblue", alpha = 0.5) +
  geom_line(color = "blue", linewidth = 0.5) +
  labs(x = "Proportion of Water", y = "Posterior Probability") +
  ggtitle("Probability Distribution for W, W, W, L") +
  theme_bw()
```



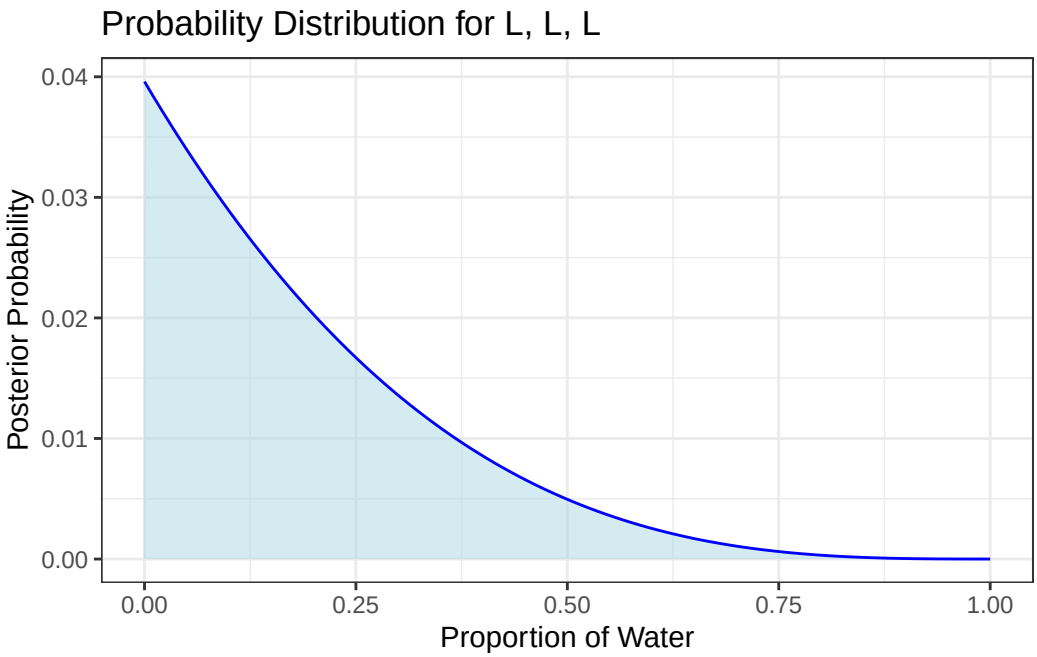
L, W, W, L, W, W, W

```
# compute likelihood at each value in grid
# using a binomial distribution
likelihood <- dbinom(5, size = 7, prob = p_grid)

# compute product of likelihood and prior
unstd.posterior <- likelihood * prior

# standardize the posterior, so it sums to 1
posterior <- unstd.posterior / sum(unstd.posterior)

df <- tibble(grid = p_grid, posterior = posterior)

ggplot(df, aes(x = grid, y = posterior)) +
  geom_area(fill = "lightblue", alpha = 0.5) +
  geom_line(color = "blue", linewidth = 0.5) +
  labs(x = "Proportion of Water", y = "Posterior Probability") +
  ggtitle("Probability Distribution for L, W, W, L, W, W, W") +
  theme_bw()
```



L, L, L

```
# compute likelihood at each value in grid
# using a binomial distribution
likelihood <- dbinom(0, size = 3, prob = p_grid)

# compute product of likelihood and prior
unstd.posterior <- likelihood * prior

# standardize the posterior, so it sums to 1
posterior <- unstd.posterior / sum(unstd.posterior)

df <- tibble(grid = p_grid, posterior = posterior)

ggplot(df, aes(x = grid, y = posterior)) +
  geom_area(fill = "lightblue", alpha = 0.5) +
  geom_line(color = "blue", linewidth = 0.5) +
  labs(x = "Proportion of Water", y = "Posterior Probability") +
  ggtitle("Probability Distribution for L, L, L") +
  theme_bw()
```


Probability Distribution for L, L, L
Posterior Probability
0.04
0.03
0.02
0.01
0.00
0.00
0.25
0.50
0.75
1.00
Proportion of Water