

grid

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grid

references:

- McElreath, Statistical Rethinking, chap 2, p.40
- bootswatch themes
- multiple plots

grid approximation

uniform prior

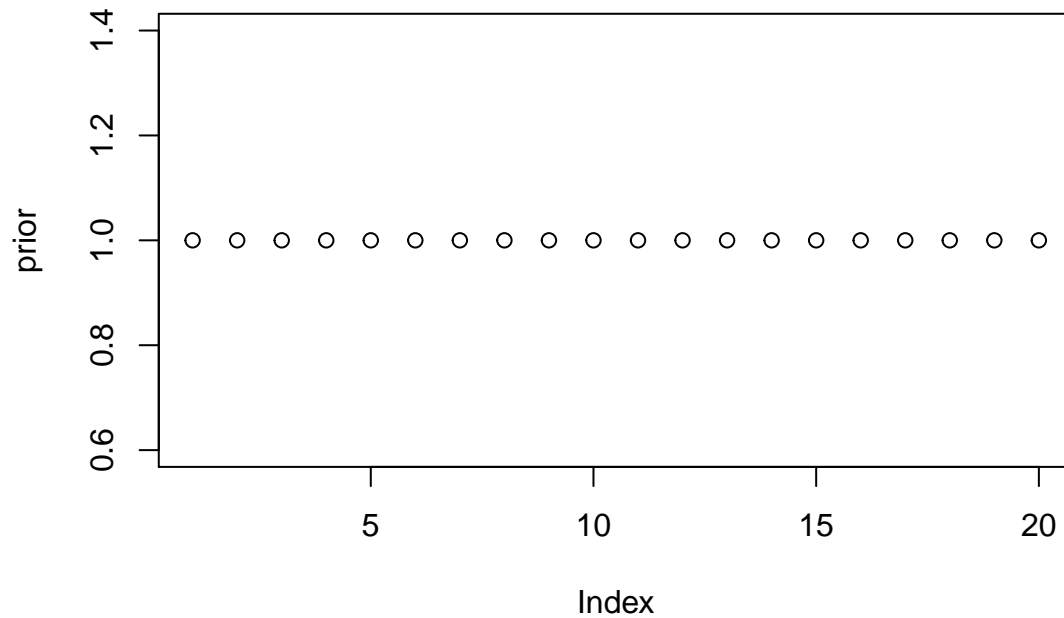
prior

Use a uniform prior.

```
## R code 2.3
# define grid
p_grid <- seq( from=0 , to=1 , length.out=20 )

# define prior
```

```
prior <- rep( 1 , 20 )  
plot(prior)
```

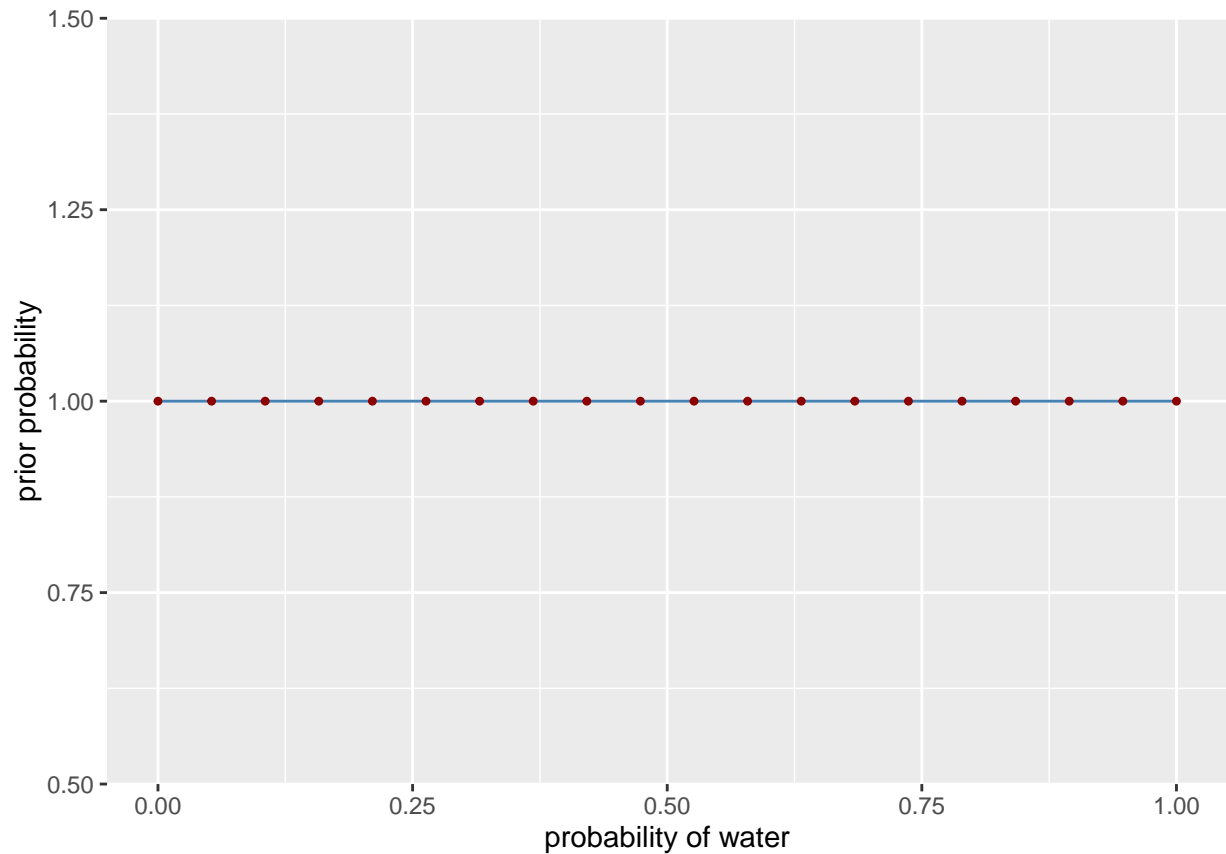


Plot prior with ggplot2

```
data <- data.frame(x = p_grid, y = prior)  
str(data)
```

```
## 'data.frame':  20 obs. of  2 variables:  
## $ x: num  0 0.0526 0.1053 0.1579 0.2105 ...  
## $ y: num  1 1 1 1 1 1 1 1 1 1 ...
```

```
library(ggplot2)  
plot.prior <- ggplot(data, aes(x, y)) +  
  geom_line(color = "steelblue") +  
  geom_point(shape = 20, color = "darkred") +  
  labs(x = "probability of water" , y = "prior probability")  
plot.prior
```



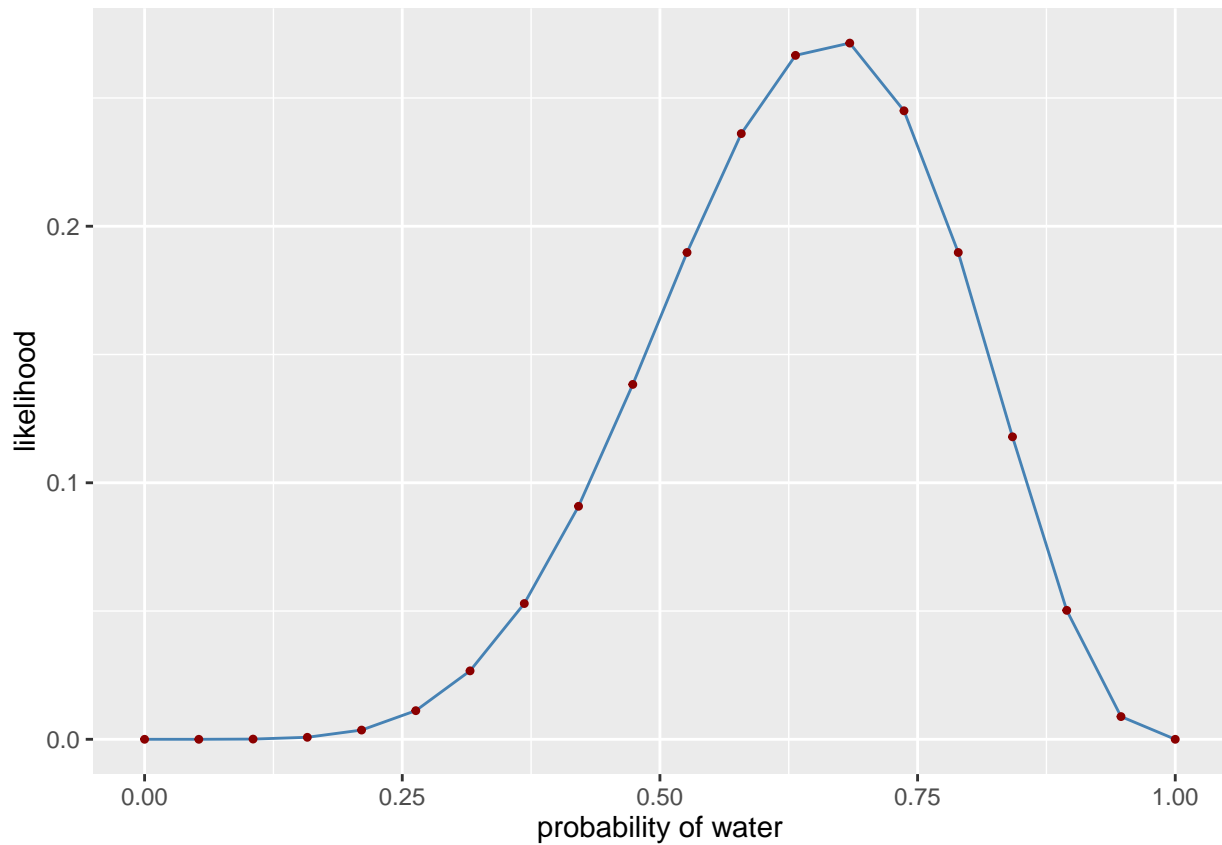
likelihood

```
# compute likelihood at each value in grid
likelihood <- dbinom( 6 , size=9 , prob=p_grid )

plot with ggplot2
data <- data.frame(x = p_grid, y = likelihood)
str(data)

## 'data.frame':  20 obs. of  2 variables:
## $ x: num  0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num  0.00 1.52e-06 8.19e-05 7.77e-04 3.60e-03 ...

plot.likelihood <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "likelihood")
plot.likelihood
```

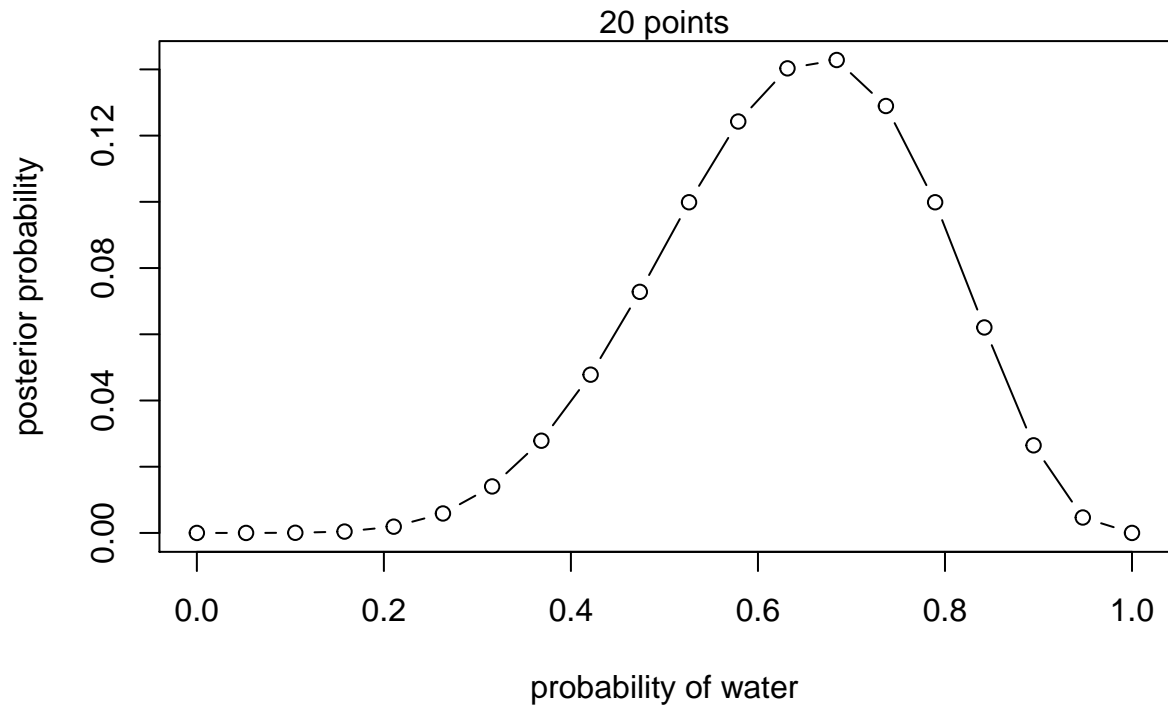


posterior

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

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

## R code 2.4
plot( p_grid , posterior , type="b" ,
      xlab="probability of water" , ylab="posterior probability" )
mtext( "20 points" )
```

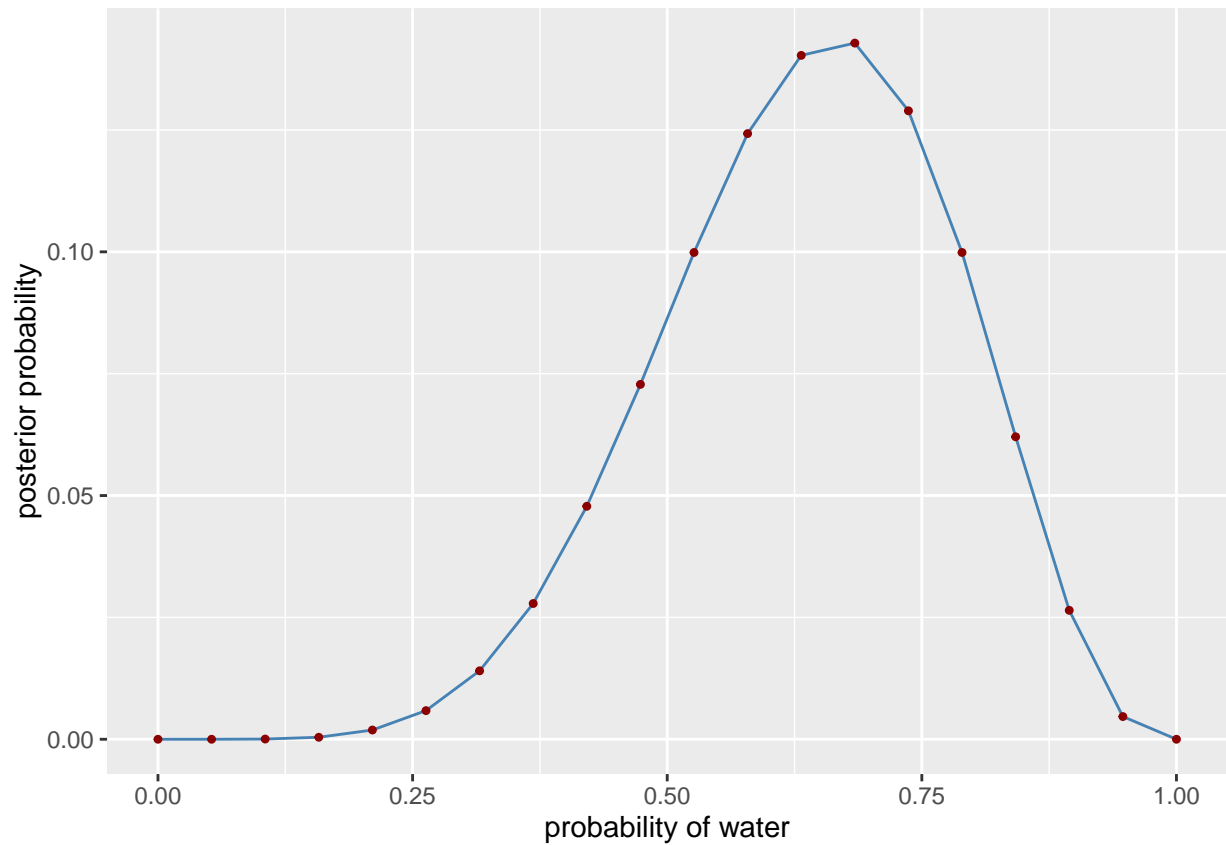


plot with ggplot2

```
data <- data.frame(x = p_grid, y = posterior)
str(data)
```

```
## 'data.frame': 20 obs. of 2 variables:
## $ x: num 0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num 0.00 7.99e-07 4.31e-05 4.09e-04 1.89e-03 ...
```

```
plot.posterior <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "posterior probability")
plot.posterior
```

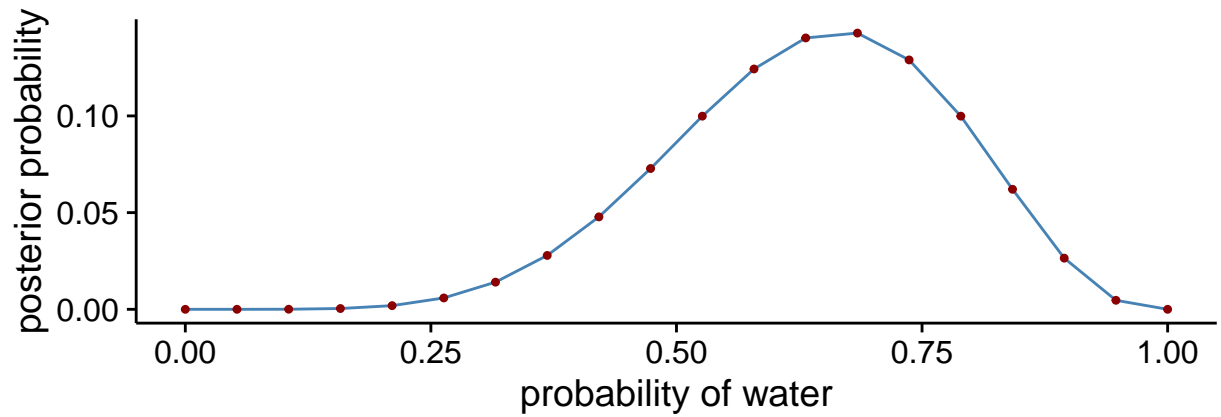
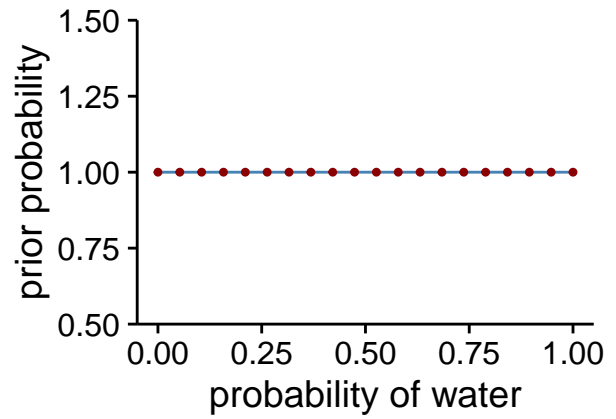
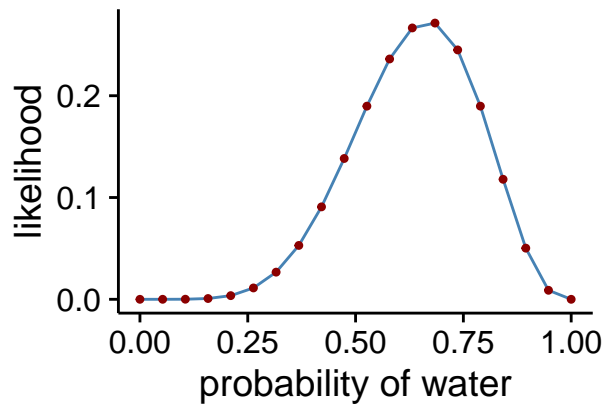


bayesian inference

plot with ggplot2

Plot prior, likelihood, and posterior.

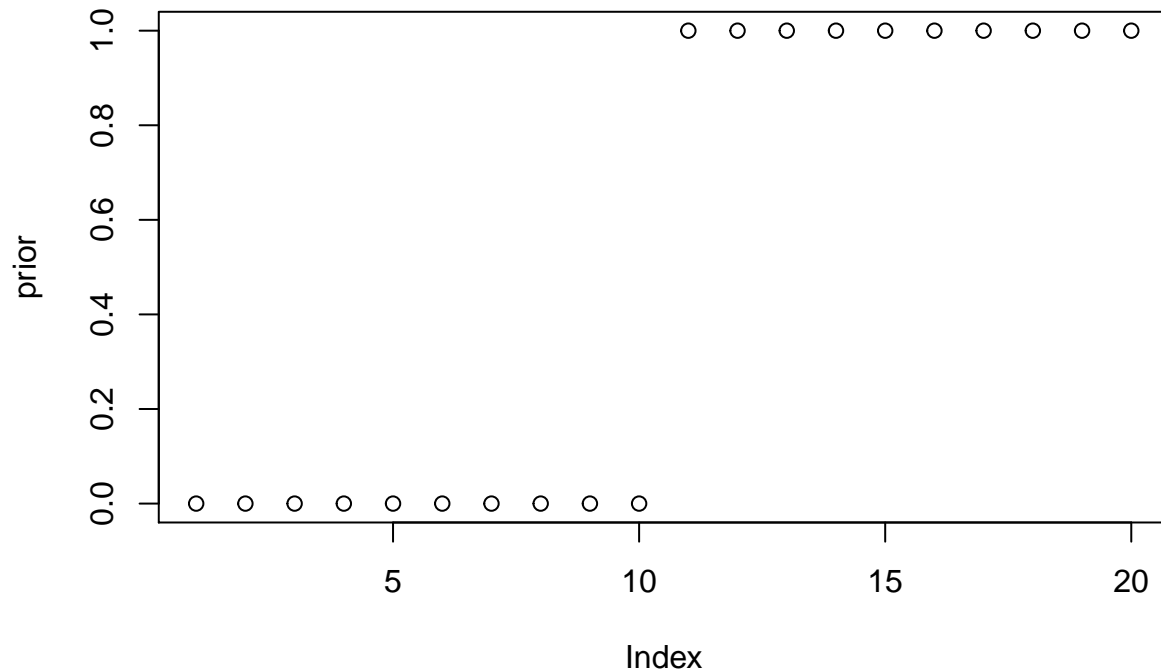
```
library(cowplot)
uniform.prior <- ggdraw() +
  draw_plot(plot.likelihood, 0, .5, .5, .5) +
  draw_plot(plot.prior, .5, .5, .5, .5) +
  draw_plot(plot.posterior, 0, 0, 1, .5)
uniform.prior
```



truncated prior

prior

```
## R code 2.5
# define prior
prior <- ifelse( p_grid < 0.5 , 0 , 1 )
plot(prior)
```

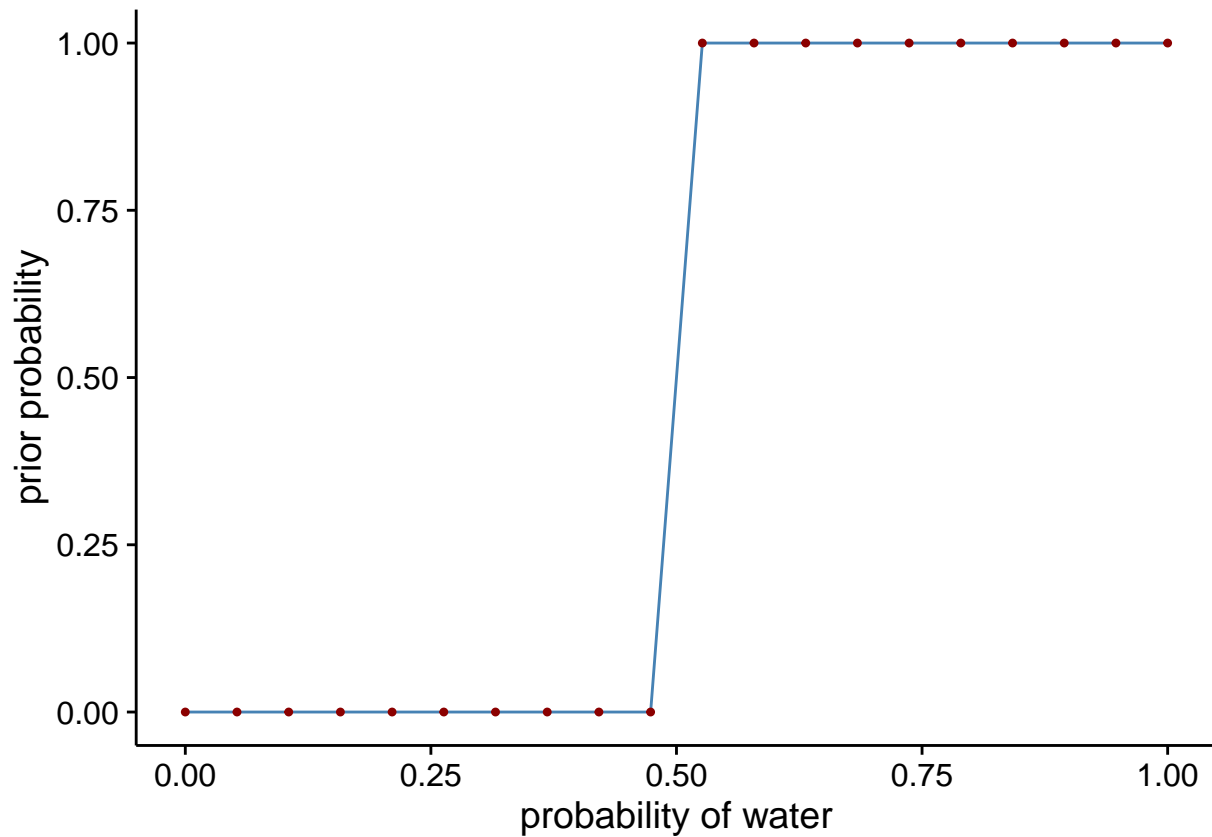


Plot prior with ggplot2

```
data <- data.frame(x = p_grid, y = prior)
str(data)
```

```
## 'data.frame': 20 obs. of 2 variables:
## $ x: num 0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num 0 0 0 0 0 0 0 0 0 0 ...
```

```
plot.prior <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "prior probability")
plot.prior
```

likelihood

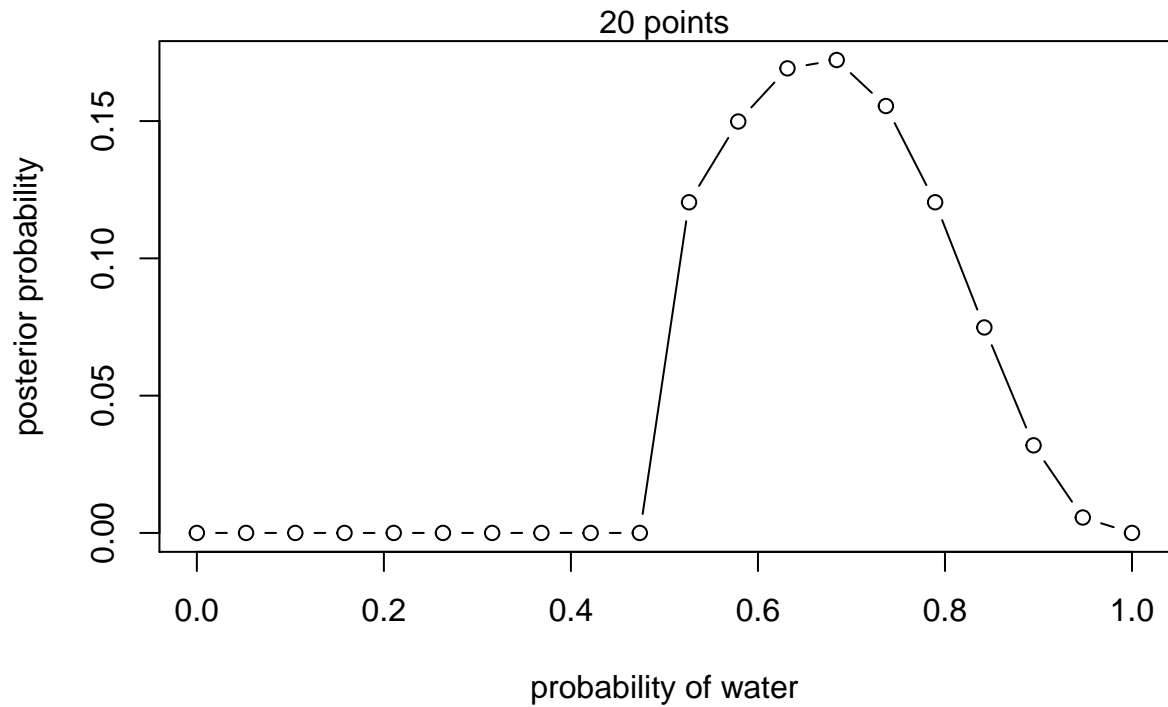
```
# compute likelihood at each value in grid
likelihood <- dbinom( 6 , size=9 , prob=p_grid )
```

posterior

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

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

## R code 2.4
plot( p_grid , posterior , type="b" ,
      xlab="probability of water" , ylab="posterior probability" )
mtext( "20 points" )
```

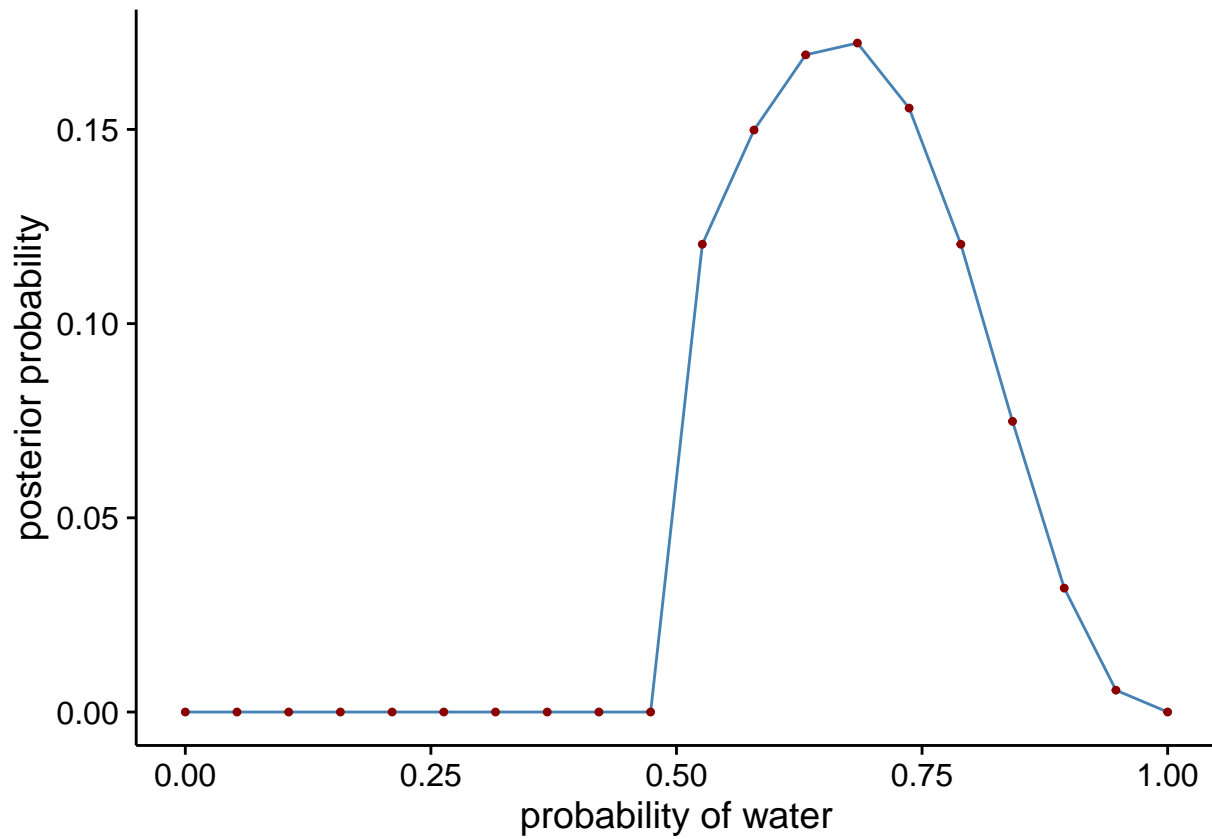


plot with ggplot2

```
data <- data.frame(x = p_grid, y = posterior)
str(data)
```

```
## 'data.frame': 20 obs. of 2 variables:
## $ x: num 0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num 0 0 0 0 0 0 0 0 0 0 ...
```

```
plot.posterior <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "posterior probability")
plot.posterior
```

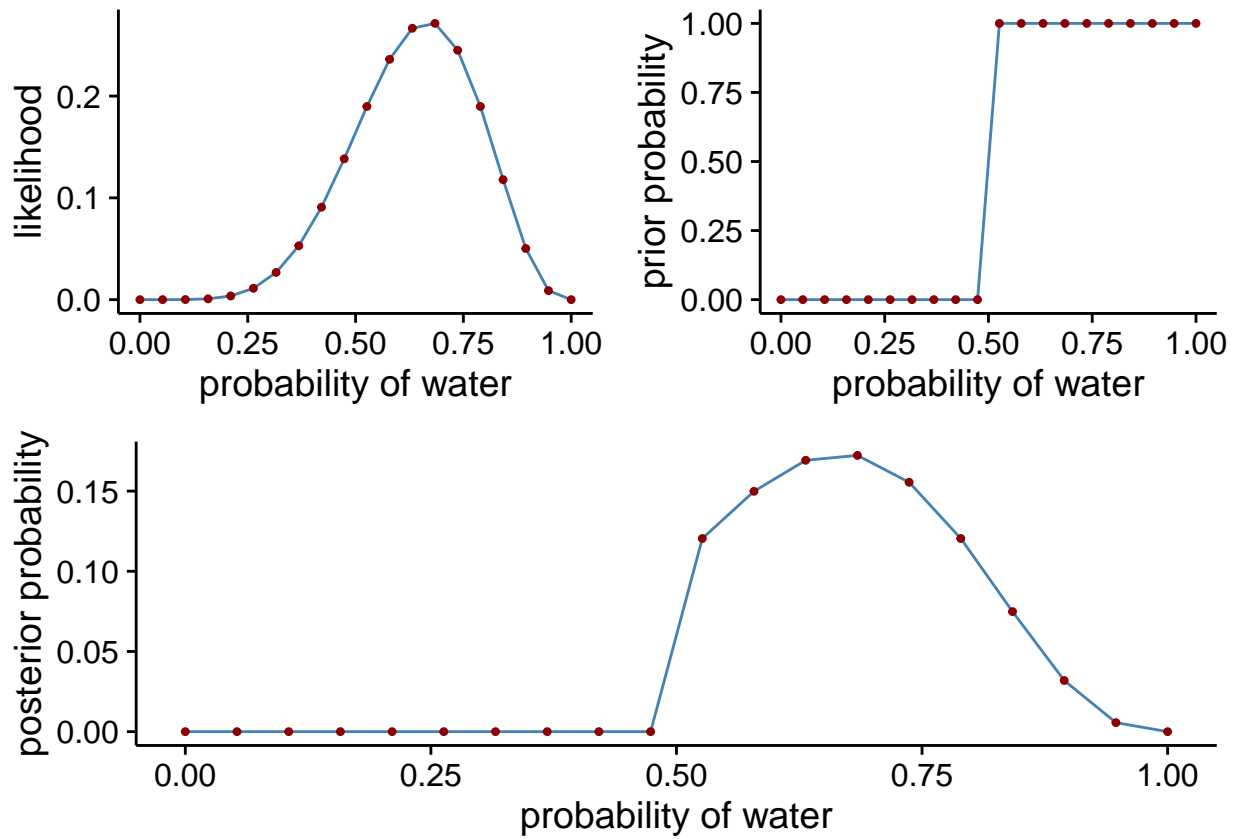


bayesian inference

plot with ggplot2

Plot prior, likelihood, and posterior.

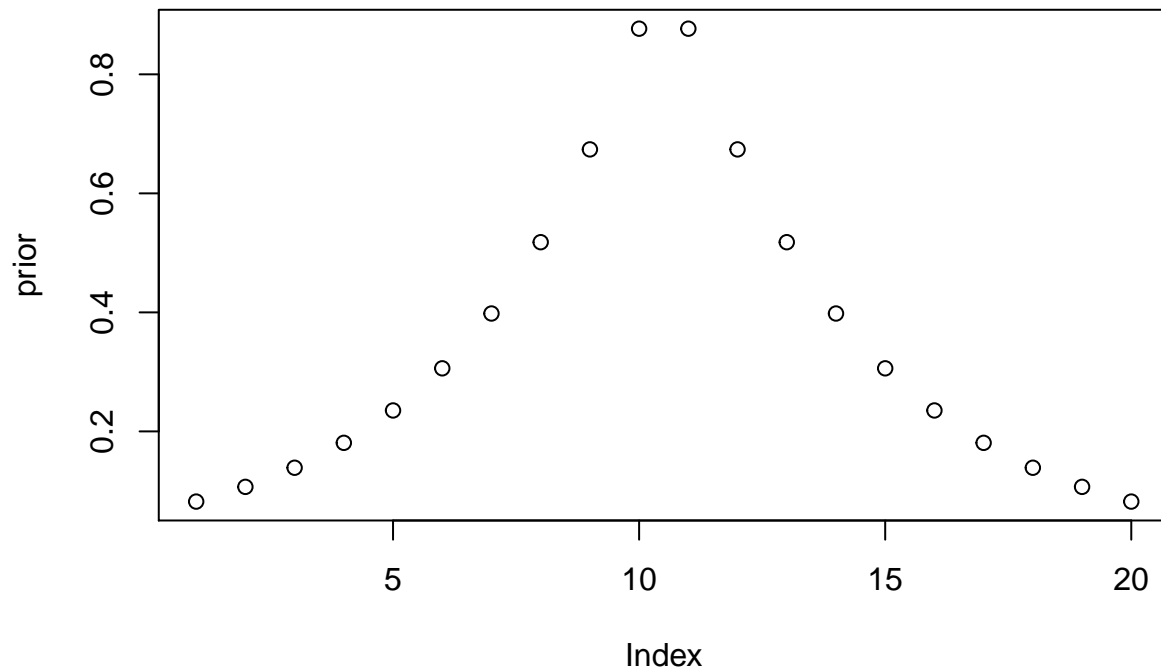
```
library(cowplot)
truncated.prior <- ggdraw() +
  draw_plot(plot.likelihood, 0, .5, .5, .5) +
  draw_plot(plot.prior, .5, .5, .5, .5) +
  draw_plot(plot.posterior, 0, 0, 1, .5)
truncated.prior
```



double exponential prior

prior

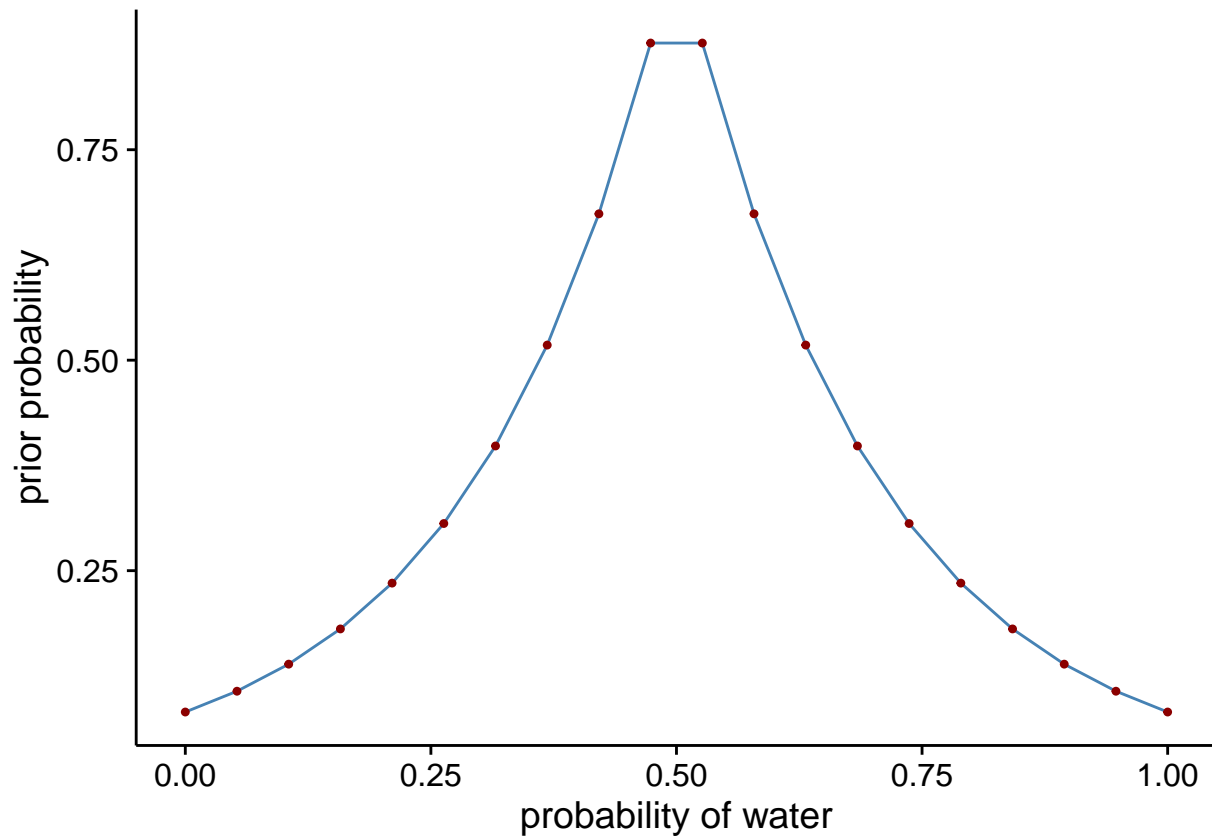
```
# define prior
prior <- exp( -5*abs( p_grid - 0.5 ) )
plot(prior)
```



```
data <- data.frame(x = p_grid, y = prior)
str(data)

## 'data.frame':  20 obs. of  2 variables:
## $ x: num  0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num  0.0821 0.1068 0.1389 0.1808 0.2352 ...

library(ggplot2)
plot.prior <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "prior probability")
plot.prior
```



likelihood

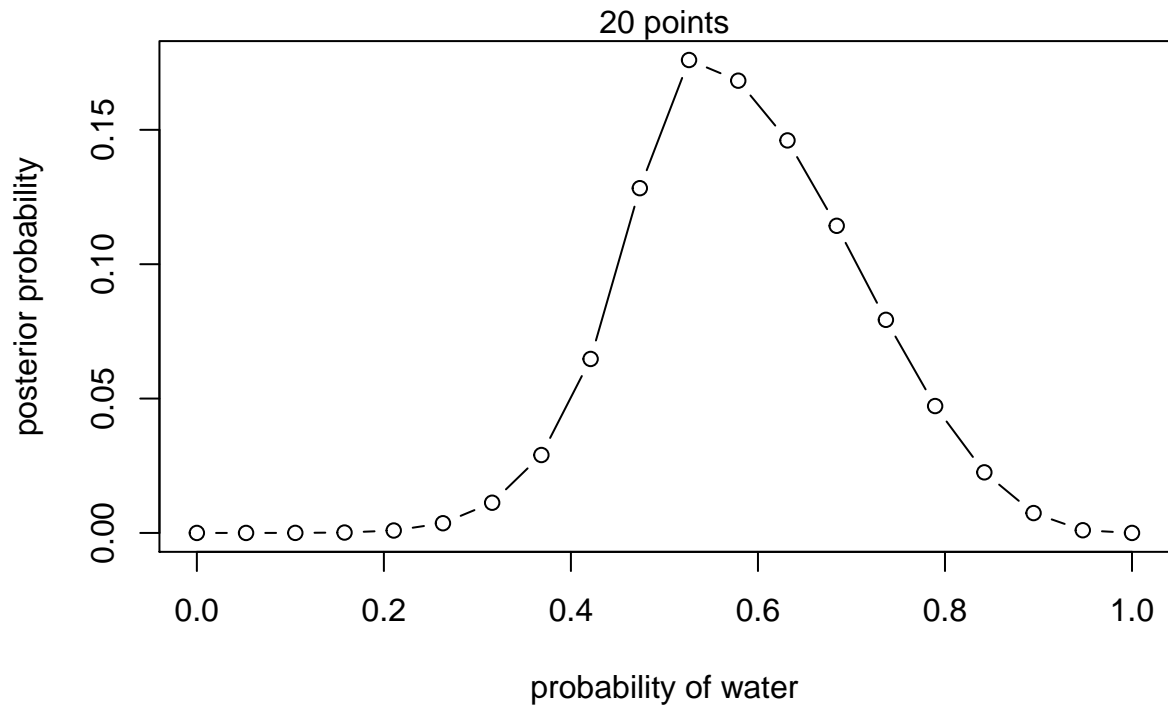
```
# compute likelihood at each value in grid
likelihood <- dbinom( 6 , size=9 , prob=p_grid )
```

posterior

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

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

## R code 2.4
plot( p_grid , posterior , type="b" ,
      xlab="probability of water" , ylab="posterior probability" )
mtext( "20 points" )
```

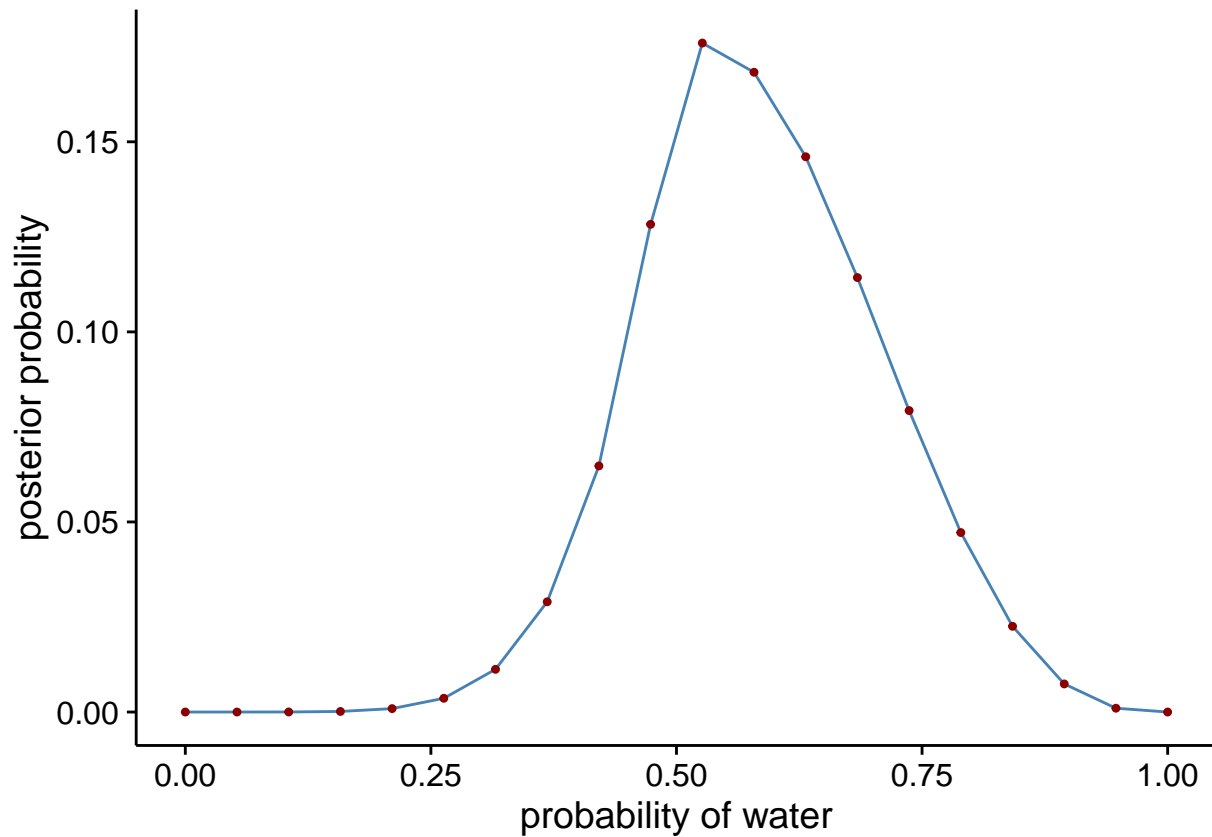


plot with ggplot2

```
data <- data.frame(x = p_grid, y = posterior)
str(data)
```

```
## 'data.frame':  20 obs. of  2 variables:
## $ x: num  0 0.0526 0.1053 0.1579 0.2105 ...
## $ y: num  0.00 1.71e-07 1.20e-05 1.49e-04 8.95e-04 ...
```

```
plot.posterior <- ggplot(data, aes(x, y)) +
  geom_line(color = "steelblue") +
  geom_point(shape = 20, color = "darkred") +
  labs(x = "probability of water" , y = "posterior probability")
plot.posterior
```



bayesian inference

plot with ggplot2

Plot prior, likelihood, and posterior.

```
library(cowplot)
double.exp.prior <- ggdraw() +
  draw_plot(plot.likelihood, 0, .5, .5, .5) +
  draw_plot(plot.prior, .5, .5, .5, .5) +
  draw_plot(plot.posterior, 0, 0, 1, .5)
double.exp.prior
```