chapter 2

Zachary Himmelberger

```
knitr::opts_chunk$set(echo = TRUE)
```

Importing the rethinking package

```
library(rethinking)
```

```
## Loading required package: rstan
## Loading required package: StanHeaders
## Loading required package: ggplot2
## rstan (Version 2.19.3, 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
## Loading required package: dagitty
## rethinking (Version 2.00)
##
## Attaching package: 'rethinking'
## The following object is masked from 'package:stats':
##
##     rstudent
```

Chapter 2

2E1

$$P(rain|Monday)$$

2E2

$$The probability that it is Monday, given that it is raining.$$

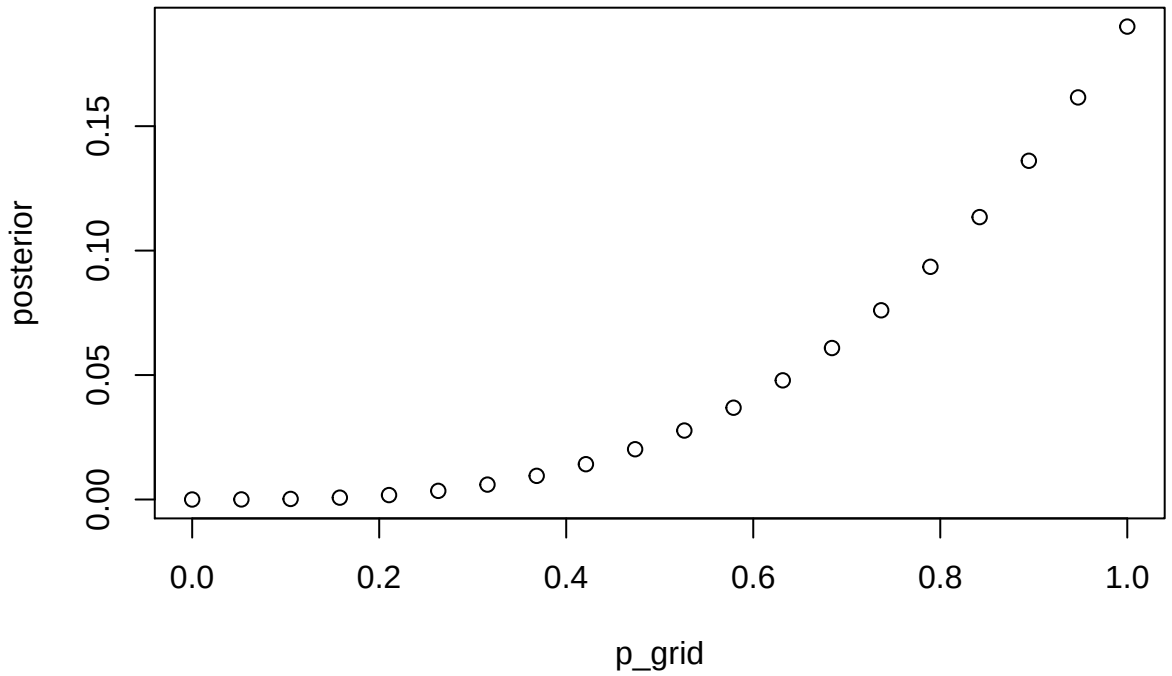
2E3

$$P(Monday|rain)$$

2E4

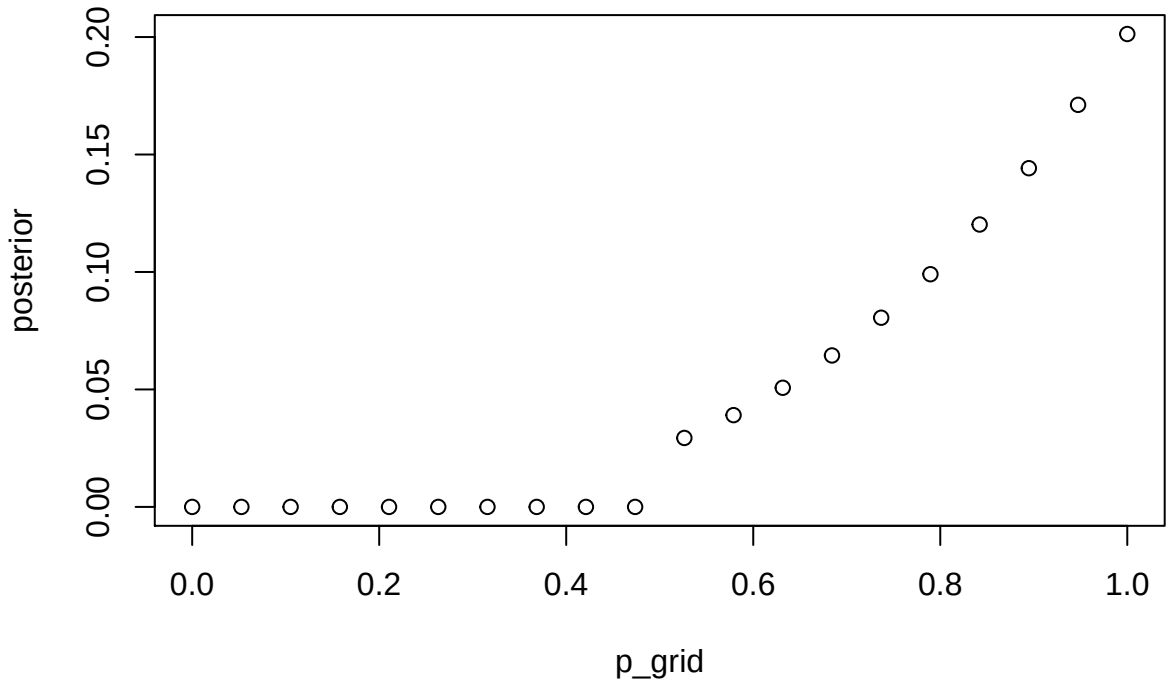
In the globe tossing example, the amount of water on Earth is being estimated. The parameter of interest is a value that is exact. The uncertainty exists only in the model. Probability, therefore, is a function of our knowledge about the parameter. # 2M1

```r
p_grid <- seq(from=0, to=1, length.out=20)
prior <- rep(1,20)
likelihood <- dbinom(3, size=3, prob=p_grid)
unstd.posterior <- likelihood*prior
posterior <- unstd.posterior / sum(unstd.posterior)
plot(p_grid,posterior)
```



2M2

```r
p_grid <- seq(from=0, to=1, length.out=20)
prior <- c(rep(0,10), rep(1,10))
likelihood <- dbinom(3, size=3, prob=p_grid)
unstd.posterior <- likelihood*prior
posterior <- unstd.posterior / sum(unstd.posterior)
plot(p_grid,posterior)
```



#2 M3

$$P(E|land) = \frac{P(land|E)P(E)}{P(land|E)P(E) + P(land|M)P(M)}$$

```
p.E.given.land <- (.3*.5) / (.3*.5 + 1*.5)
```

2M4

W/W has 0 ways; W/B has 1 way; B/B has 2 ways therefore, B/B has 2 of 3 ways or P(B/B) = .66 # 2M5 W/W has 0 ways; W/B has 1 way; B/B has 2 ways; B/B has 2 ways therefore, B/B has 4 of 5 ways or P(B/B) = .80 # 2M6 W/W has 0 ways; W/B has 1 way; B/B has 2 ways multiplied by prior probs results in 0*3; 1*2; 2*1 therefore, B/B has 2 of 4 ways or P(B/B) = .50

2M7

probabilities of first card are W/W has 0 ways; W/B has 2 ways; B/B has 6 ways therefore, B/B has 6 of 8 ways or P(B/B) = .75

2H1

$$P(sB|twins) = \frac{P(twins|sB)P(sB)}{P(twins|sB)P(sB) + P(twins|sA)P(sA)}$$

```
p.sB.given.twins <- (.2*.5) / (.2*.5 + .1*.5)
```

$$P(twins) = P(twins|s1)P(s1) + P(twins|s2)P(s2)$$

```
p.twins <- (.2*.66)+(.1*.33)
```

2H2

$$P(sA|twins) = \frac{P(twins|sA)P(sA)}{P(twins|sA)P(sA) + P(twins|sB)P(sB)}$$

```
p.sA.given.twins <- (.1*.5) / (.1*.5 + .2*.5)
```

2H3

$$P(sA|single) = \frac{P(single|sA)P(sA)}{P(single|sA)P(sA) + P(single|sB)P(sB)}$$

```
p.sA.given.single <- (.9*.33) / (.9*.33 + .8*.66)
```

2H4

$$P(sA|testA) = \frac{P(testA|sA)P(sA)}{P(testA|sA)P(sA) + P(testA|sB)P(sB)}$$

```
p.sA.given.testA <- (.8*.5) / (.8*.5 + .65*.5)
```

including new test information but using prior from above

```
p.sA.given.testA.prior <- (.8*.36) / (.8*.36 + .65*.64)
```