Exercises: Chapter 3

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3-1 The running proportions plot.

```
# Goal: toss a coin N times and get the running proportion of heads
N <- 500
p.heads <- 0.8 # Assume biased coin

# Heads = 1, Tails=0
flipsequence <- sample(x=c(0,1), prob=c(1-p.heads,p.heads), size=N, replace=TRUE)

r <- cumsum(flipsequence)
n <- 1:N

runprop <- r/n
```

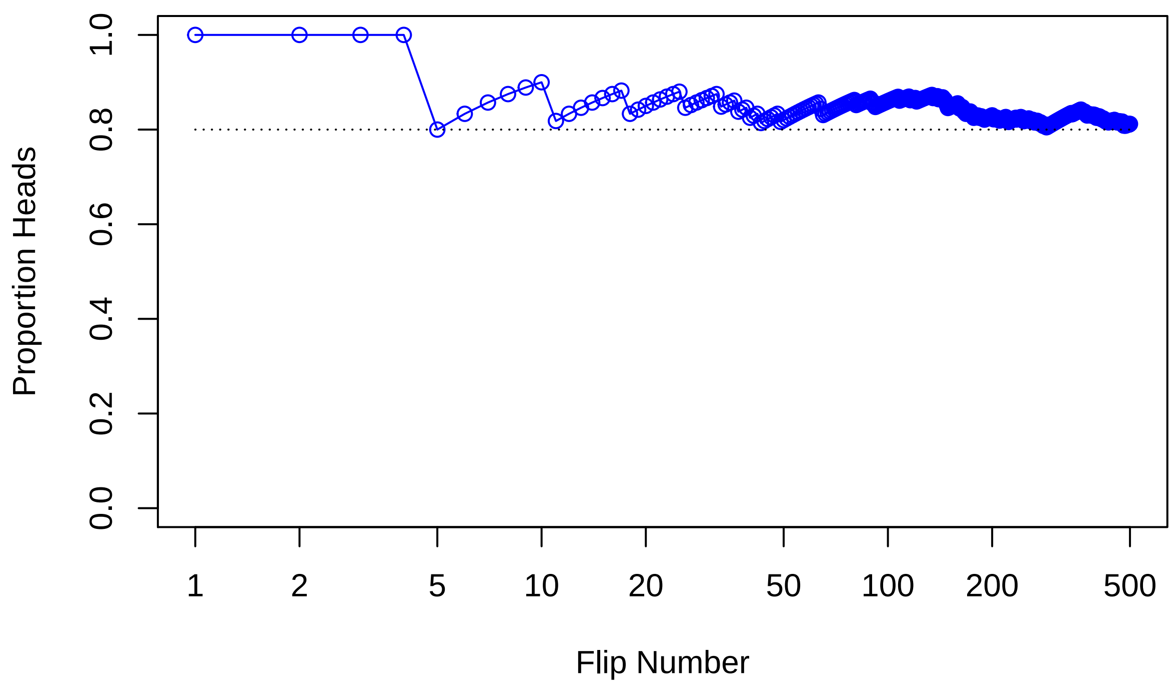

Figure 1: Running Proportions Plot, # of Heads

3-2 Detemine the probability of drawing a 10 from a pinochle deck (9-Ace, 6 of each).

To do this, we will randomly sample from the deck and see what proportion are tens.

```
cards <- c("9", "10", "Jack", "Queen", "King", "Ace")
suits <- c("Hearts", "Diamonds", "Spades", "Clubs")

draws <- cbind.data.frame(sample(cards, size=1000000, replace=TRUE),
                          sample(suits, size=1000000, replace=TRUE))

length(draws[which(draws[,1]=='10'),1])/length(draws[,1])
```

```
## [1] 0.166
```

```
length(draws[which(draws[,1]=='10'|draws[,1]=='Jack'),1])/length(draws[,1])
```

```
## [1] 0.3328
```

Thus, we estimate that the probability of drawing a jack is 0.166 and the probability of drawing a 10 or a jack is 0.333.

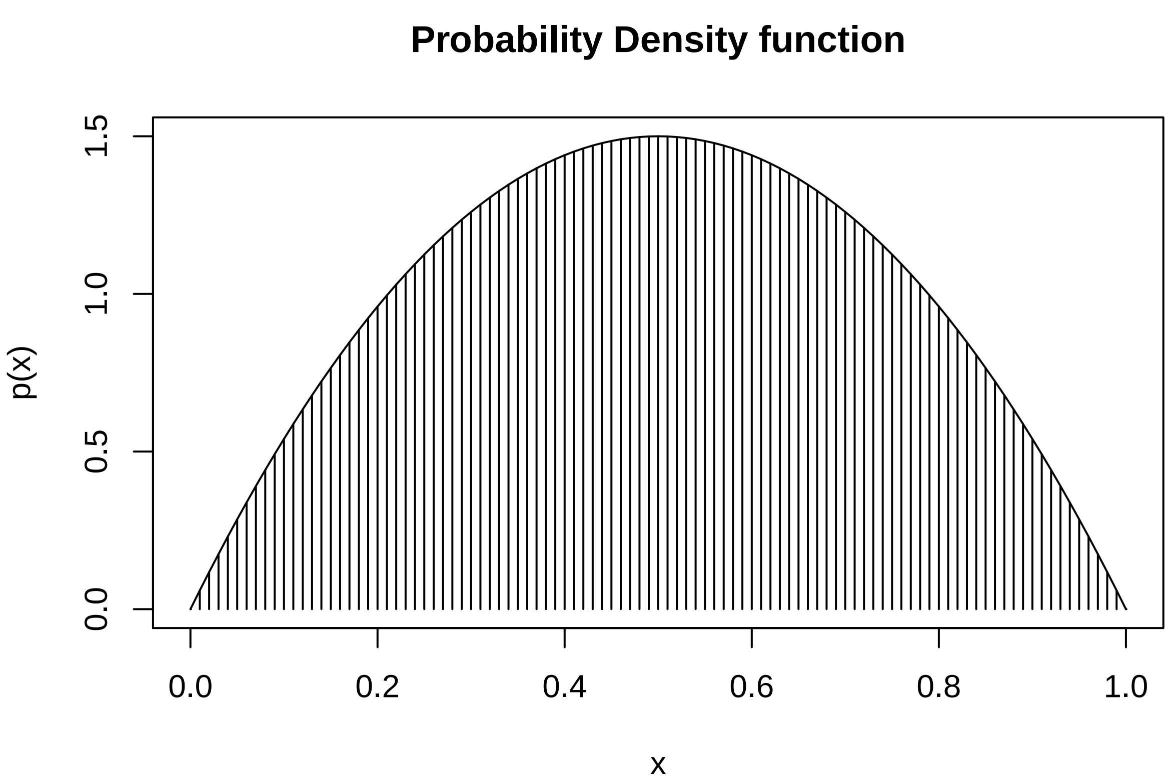

Figure 2: plot of chunk ex3

3-3 From this plot, we estimate that the area underneath the curve is

$$\sum_{i}^{n} p(x_i)\delta x$$

which is estimated numerically by `R` as 0.9999. Analytically, the solution is

$$\begin{aligned}
\int 6x(1-x)\delta x &= \int (6x - 6x^2)\delta x \\
&= \int 6x\delta x - \int 6x^2\delta x \\
&= 3x^2|_0^1 - 2x^3|_0^1 \\
&= (3-2) - (0-0) \\
&= 1
\end{aligned}$$

Thus, because the area under the curve is 1, $p(x)$ is a probability density function.