Frequency Interpretation of Probability

Simulating flipping a fair coin 500 times

(a) We create a "coin", a vector with two entries, namely "H" and "T".

In [1]:
```
coin = c("H","T")
print(coin)
```

```
[1] "H" "T"
```

(b) Now to simulate flipping the coin 500 times using `sample()`.

In [3]:
```
set.seed(89) #for reproducibility of results
n = 500 # number of flips

s = sample(coin, size = n, replace = TRUE)
#s = sample(coin, size = n, replace = TRUE, prob=c(0.5,0.5))

head(s)
length(s)
```

```
'H'  'T'  'T'  'T'  'T'  'T'
```

```
500
```

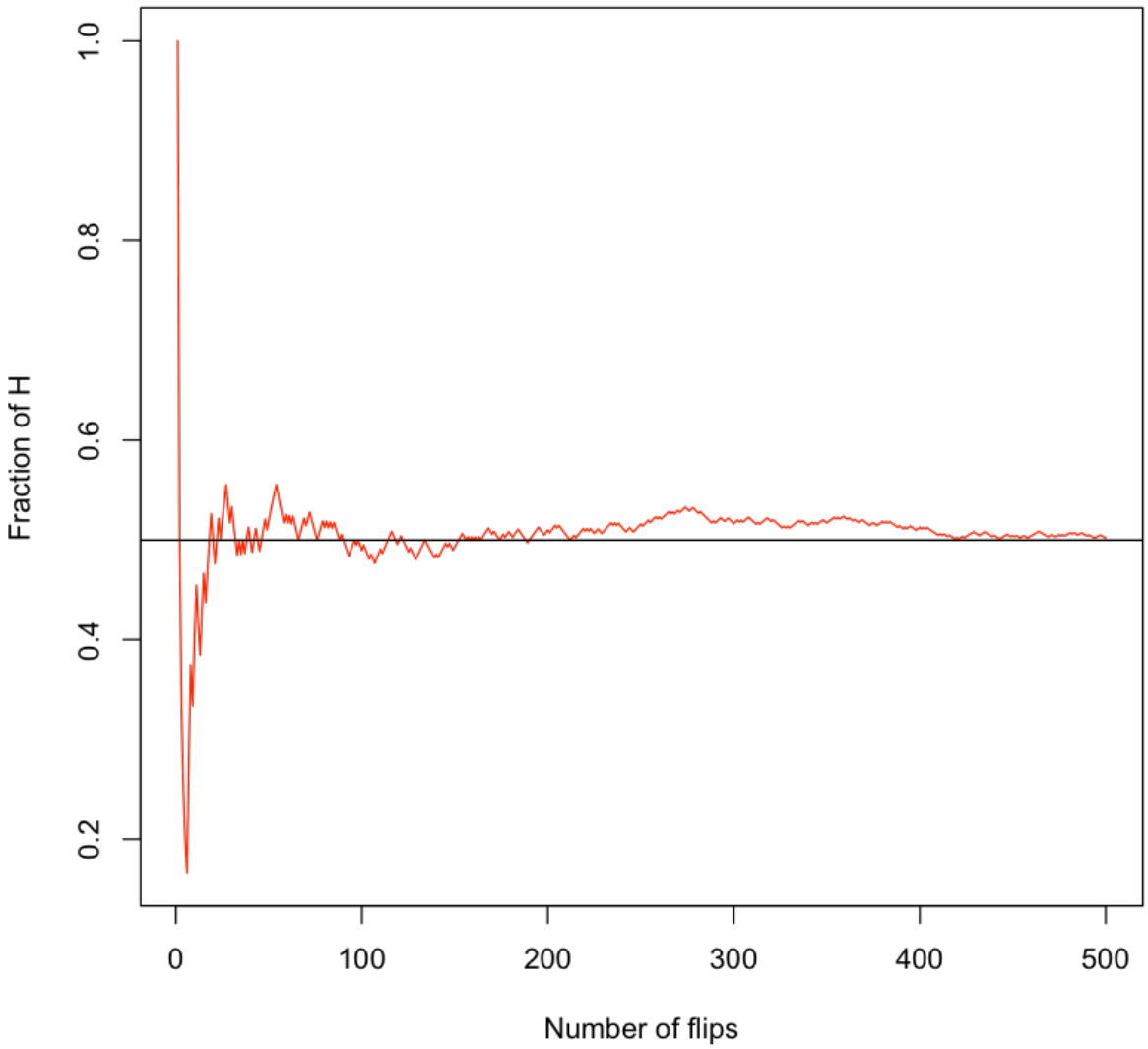
(c) We will now plot the fraction of times the coin lands on heads in the first 500 draws.

To plot the *cumulative fraction of heads* we will need to count the total number of heads obtained after each flip, the "cumulative sum" command, *i.e.* `cumsum()` command can help with this.

In [4]:

```
#Calculate fraction of heads so far, divide number of heads by number
of flips so far
frac.heads = cumsum(s == "H")/1:n

#make the plot
plot(frac.heads, type = "l", xlab = "Number of flips", ylab = "Fractio
n of H",col="red")
abline(0.5,0) #draws a line, inputs are y-intercept = 0.5 and slope =
0

# calculating the total ratio of heads out of n=500 flips
ratio.head<-length(s[s=="H"])/n

# or can get the ratio of heads from the vector p
ratio.head.alt<-frac.heads[n]

cat("The ratio of heads is ",ratio.head,"\n")
cat("The ratio of heads is ",ratio.head.alt)
```

```
The ratio of heads is  0.502
The ratio of heads is  0.502
```

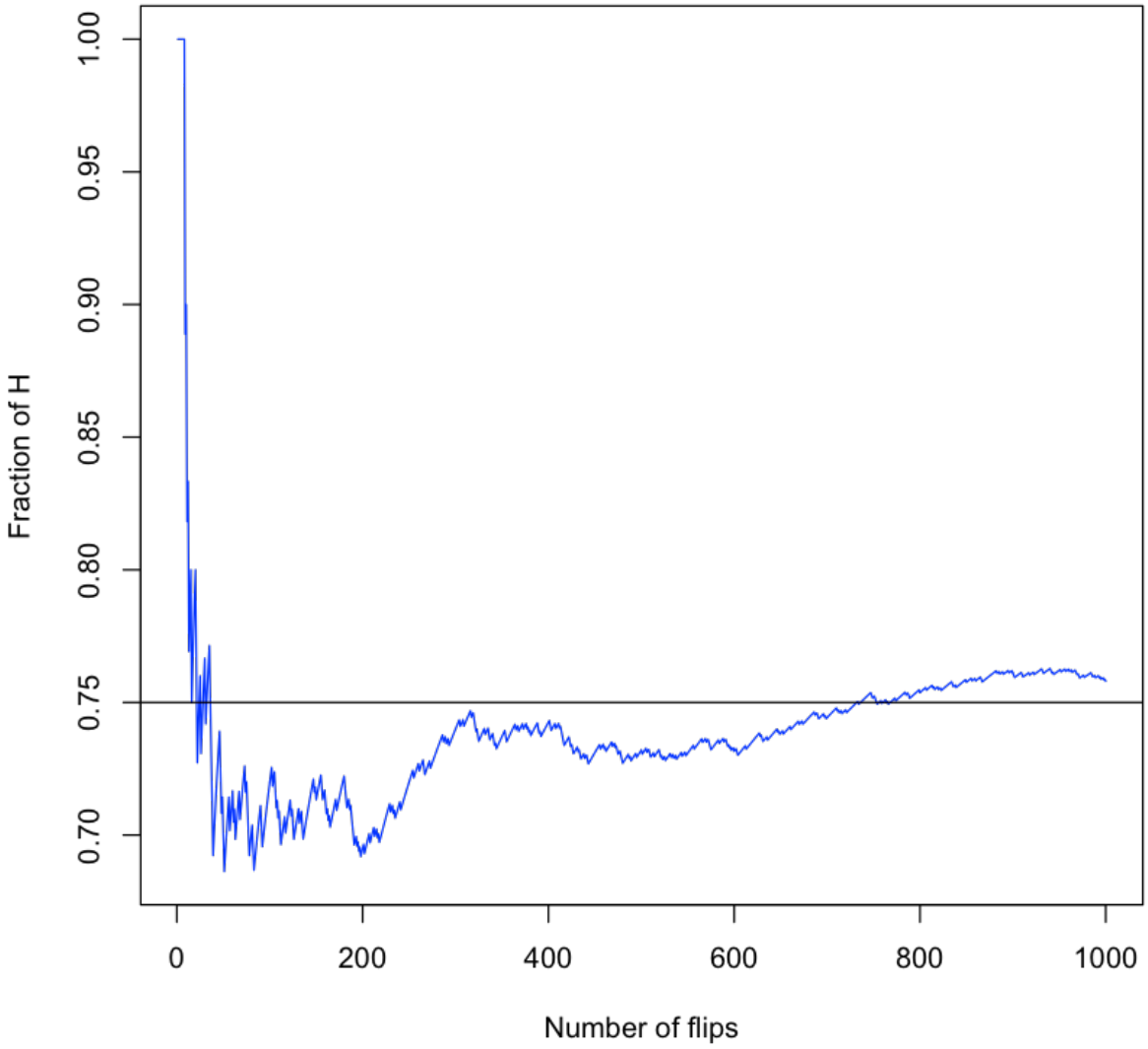


(d) Let's repeat this process for a biased coin, where the probability of heads is 0.75 and the number of flips is 1000.

In [6]:

```
#set.seed(89)

# no. of flips
m = 1000

#Generate bais sample
s_bias = sample(c("H","T"), size = m, replace = TRUE, prob = c(0.75,0.
25))

#Determine fraction of heads so far
p_bias = cumsum(s_bias == "H")/1:m

#Create plot
plot(p_bias, type = "l", xlab = "Number of flips", ylab = "Fraction of
H",col="blue");
abline(0.75, 0)

 # calculate ratio of heads
length(s_bias[s_bias=="H"])/m
```

0.758


Fraction of H
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0
200
400
600
800
1000
Number of flips