Homework 1

Setup

```
set.seed(123)
```

Problem 1

```
trial <- function()
{
    rolls <- sample(1:6, 30, replace = TRUE)
    rolls_tb <- as.data.frame(table(rolls))
    if(TRUE %in% (rolls_tb$Freq < 3))
    {
        return(FALSE) #Some value did not appear at least 3 times
    }
    else
    {
        return(TRUE) #Some value did appear at least 3 times
    }
}

results <- replicate(104, trial())
print(length(results[results==TRUE]) / length(results))
```

```
## [1] 0.4807692
```

The probability of at least 3 of each of the values 1, 2, 3, 4, 5, and 6 appearing is 0.48, as shown by the above simulation.

Problem 2

1.

```
dbinom(8, size=12, prob=0.71)
```

```
## [1] 0.226081
```

The probability that your finger will land on water 8 times is 0.22.

2.

```
pbinom(3, size=9, prob=0.08, lower.tail=FALSE)
```

```
## [1] 0.003715075
```

The probability that the reearcher finds three or more colorblind men in the first nine she examines is 0.0037.

Problem 3

1.

```r
pnorm(60, mean = 63.6, sd = 2.5) + pnorm(65, mean = 63.6, sd = 2.5, lower.tail=FALSE)
```

```
## [1] 0.3626734
```

The probability that X $<$ 60 or X $>$ 65 is 0.36.

2.

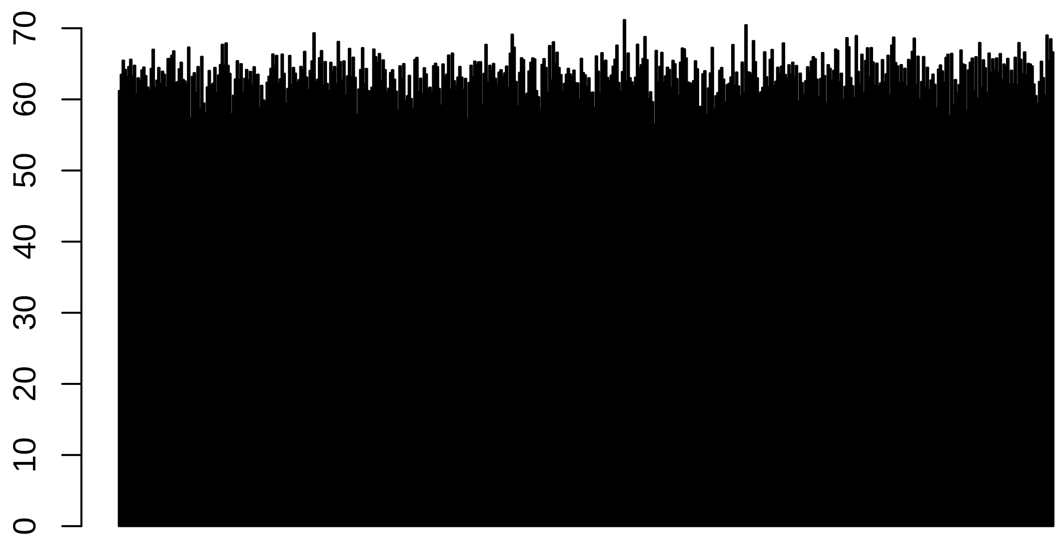
```r
pnorm(72, mean = 63.6, sd = 2.5, lower.tail=FALSE)
```

```
## [1] 0.0003897124
```

0.00039 percent of the women in this population need to duck through a 72 inch door.

3.

```r
sample <- rnorm(500, mean = 63.6, sd = 2.5)
barplot(sample)
```



As can be seen in the plot, the distribution of the sample is roughly uniform.

Problem 4

1. The support of X is the set of all positive integers. It is a discrete random variable.
2.

```
dgeom(4, prob=(1/8))
```

```
## [1] 0.07327271
```

The probability $P(X = 4)$ is 0.07.

3.

```
pgeom(4, prob=(1/8)) - pgeom(1, prob=(1/8))
```

```
## [1] 0.2527161
```

The probability $P(1 < X < 4)$ is 0.25.

4.

```
set.seed(123)
observations <- rgeom(1000, prob=(1/8))

print(paste0("Calculated expected value: ", mean(observations)))
```

```
## [1] "Calculated expected value: 7.202"
```

```
print(paste0("Theoretical expected value: ", ((1-(1/8))/(1/8))))
```

```
## [1] "Theoretical expected value: 7"
```

The calculated expected value was 7.202, and the theoretical expected value was 7. The absolute distance between the two is 0.202.

Problem 5

1.

```
trial <- function()
{
    lineup <- sample(LETTERS[1:10], 10, replace=FALSE)
    if(((which(lineup == "B")[1]) == (which(lineup == "A")[1] + 1)) || ((which(lineup == "B")[1]) == (wh
    {
        return(TRUE)
    }
    else
    {
        return(FALSE)
    }
}
mean(replicate(1000, trial()) == TRUE)
```

```
## [1] 0.217
```

The probability that "A" and "B" are next to each other in the line is 0.217.

2.

```r
set.seed(123)
x <- 0:1000
y <- 1
for(i in 1:1000)
{
    y <- c(y, mean(replicate(i, trial()) == TRUE)
)
}
plot(x, y, type="l", main="Simulating Lining Up", xlab="Replication", ylab="Probability")
abline(h=0.2, col="red")
```