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BIOSTAT 203A LAB 1A
Professor Hilary Aralis
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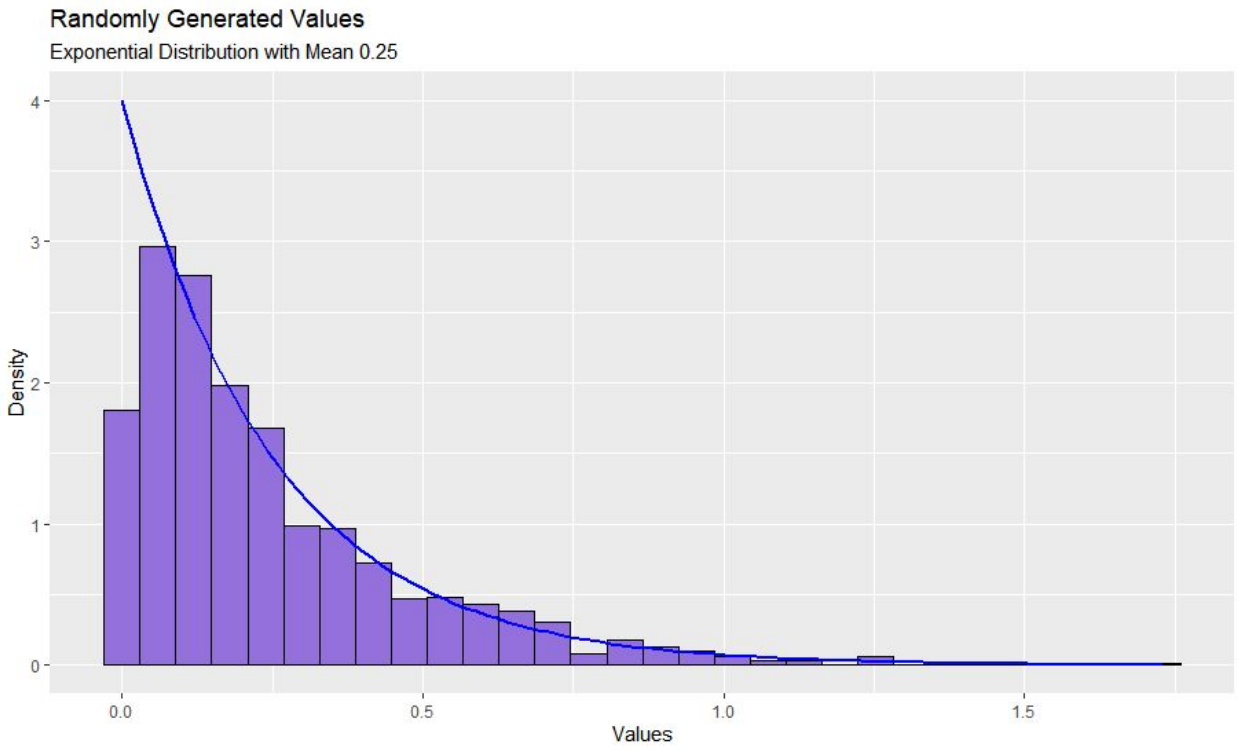
Lab 8

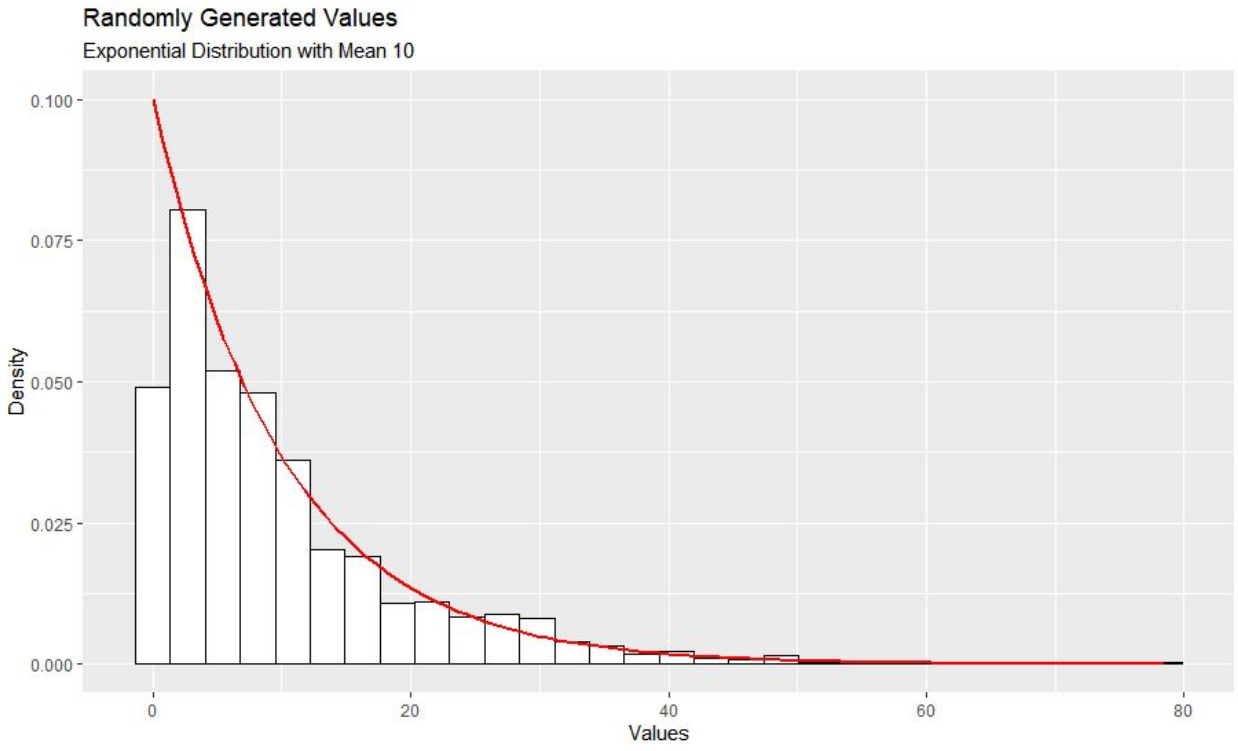
Exercise 1

```
x2 <- rexp(1000, rate = 4.00)

ggplot(data.frame(x2), aes(x2)) +
  geom_histogram(aes(x = x2, y = ..density..),
                 bins = 30,
                 fill = "mediumpurple",
                 colour = "black") +
  labs(x = "Values", y = "Density") +
  ggtitle(label = "Randomly Generated Values",
          subtitle = "Exponential Distribution with Mean 0.25") +
  stat_function(fun = function(x) dexp(x, rate = 4),
                color = "blue",
                size = 1)
```



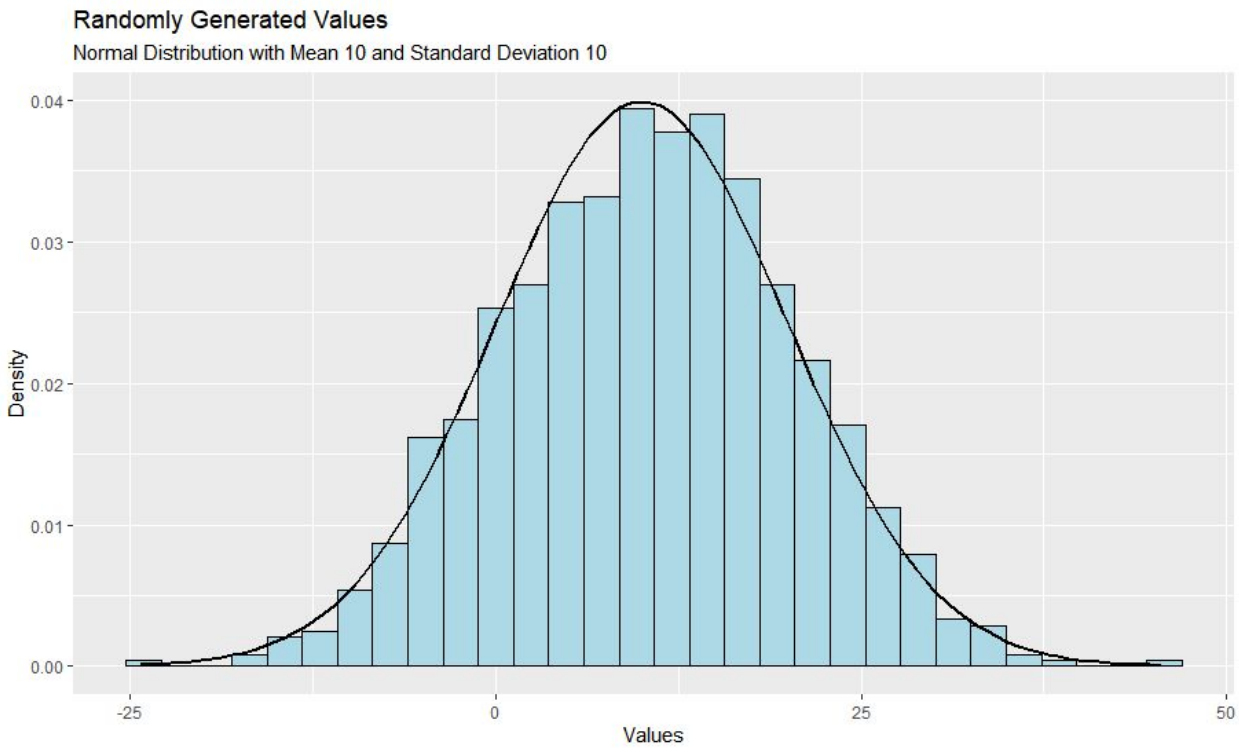
Exercise 2

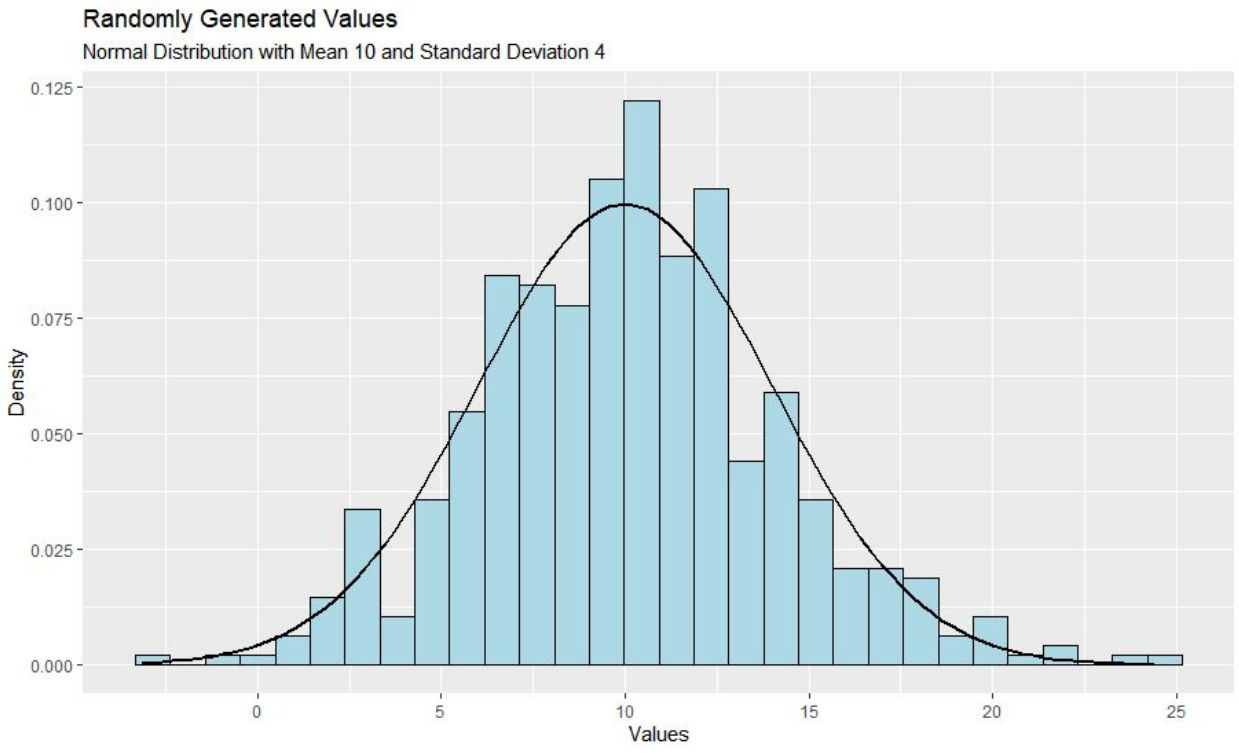
```
expplot <- function(rt, num, lclr, fclr) {
  x4 <- rexp(num, rt)
  ggplot(data.frame(x4), aes(x4)) +
    geom_histogram(aes(x = x4, y = ..density..),
                   bins = 30,
                   fill = fclr,
                   colour = "black") +
    labs(x = "Values", y = "Density") +
    ggtitle(label = "Randomly Generated Values",
            subtitle = paste("Exponential Distribution with Mean ", 1 / rt, sep = "")) +
    stat_function(fun = function(x) dexp(x, rate = rt),
                  color = lclr,
                  size = 1)
}

expplot(0.1, 1000, "red", "white")
```



Exercise 3

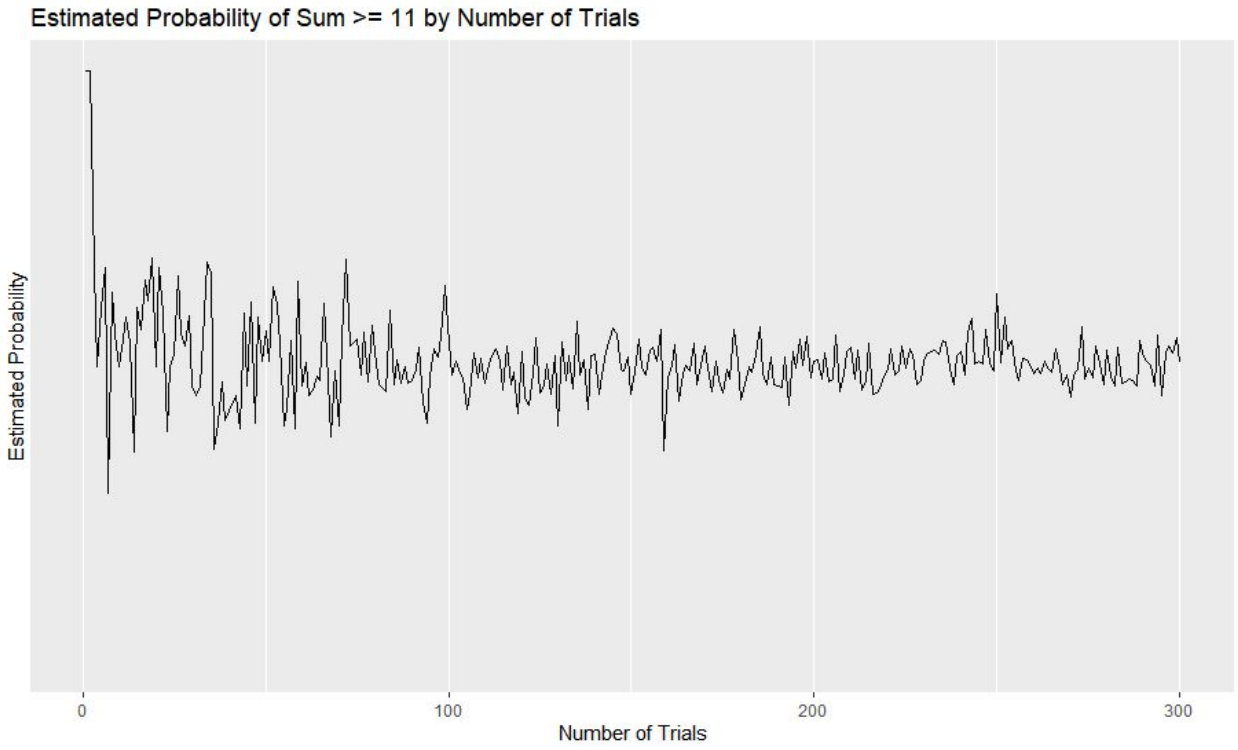
```
norm.or.exp.opt <- function(n, mn, std = mn) {
  dist <- sample(c("exp", "norm"), size = 1, prob = c(0.4, 0.6))
  if(dist == "exp") {
    x1 <- rexp(n, 1 / mn)
    st <- paste("Exponential Distribution with Mean ", mn, sep = "")
    fn <- function(x) dexp(x, rate = 1 / mn)
  } else if(dist == "norm") {
    x1 <- rnorm(n, mn, std)
    st <- paste("Normal Distribution with Mean ", mn,
                " and Standard Deviation ", std, sep = "")
    fn <- function(x) dnorm(x, mean = mn, sd = std)
  }
  ggplot(data.frame(x1), aes(x1)) +
    geom_histogram(aes(x = x1, y = ..density..),
                   bins = 30,
                   fill = "lightblue",
                   colour = "black") +
    labs(x = "Values", y = "Density") +
    ggtitle(label = "Randomly Generated Values",
            subtitle = st) +
    stat_function(fun = fn,
                  color = "black",
                  size = 1)
}
```


Randomly Generated Values
Normal Distribution with Mean 10 and Standard Deviation 10
0.04
0.03
0.02
0.01
0.00
Density
-25
0
25
50
Values


Randomly Generated Values
Normal Distribution with Mean 10 and Standard Deviation 4
0.125
0.100
0.075
0.050
0.025
0.000
Density
0
5
10
15
20
25
Values

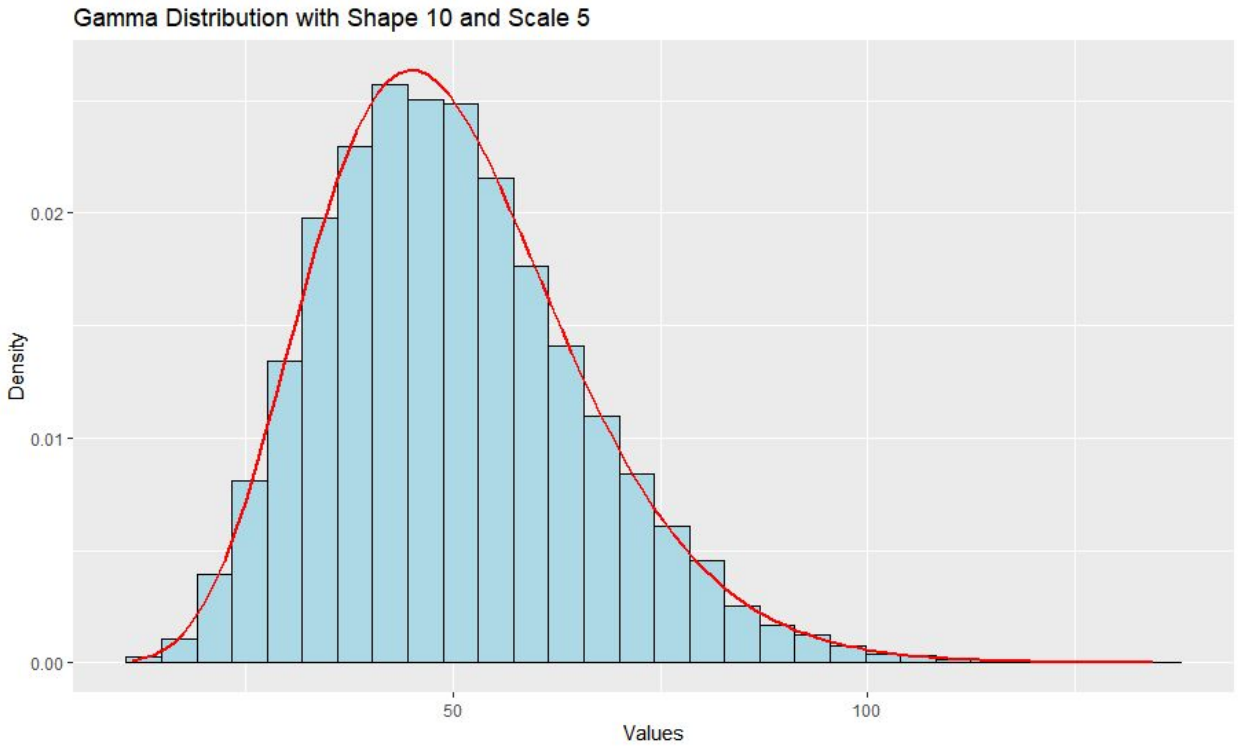
Exercise 4

```
HighRoll <- function(numDice, numSides, targetValue, numTrials) {
  apply(matrix(sample(1:numSides, numDice*numTrials, replace = TRUE), nrow = numDice),
        2, sum) >= targetValue
}

x1 <- matrix(NA, nrow = 300, ncol = 2)

for(i in 1:300) {
  x1[i, ] <- c(i, mean(HighRoll(3, 6, 11, i)))
}

ggplot(data.frame(x1), aes(x = x1[, 1], y = x1[, 2])) +
  geom_line(y = x1[, 2]) +
  labs(x = "Number of Trials", y = "Estimated Probability") +
  ggtitle(label = "Estimated Probability of Sum >= 11 by Number of Trials")
```



Exercise 5

```
sum.exp <- function(reps, N, M) {
  x1 <- replicate(reps, sum(rexp(n = N, rate = M)))
  st <- paste("Gamma Distribution with Shape", N, "and Scale", 1/M, sep = " " )
  ggplot(data.frame(x1), aes(x1)) +
    geom_histogram(aes(x = x1, y = ..density..),
                   bins = 30,
                   fill = "lightblue",
                   color = "black") +
    labs(x = "Values", y = "Density") +
    ggtitle(label = st) +
    stat_function(fun = function(x) dgamma(x, shape = N, scale = 1 / M),
                  color = "red",
                  size = 1)
}

sum.exp(10000, 10, 0.2)
```



Exercise 6

```
x1 <- replicate(500000, min(rexp(1, rate = 0.3), rexp(1, rate = 0.2)))
round(sum(x1 < 2) / length(x1), 5)

round(pexp(2, 0.5), 5)
```

The probability that M < 2 using at least 500,000 replicates is 0.63213.
The probability obtained from using the pexp function is 0.63212.