# Appendix

Luke Coughlin

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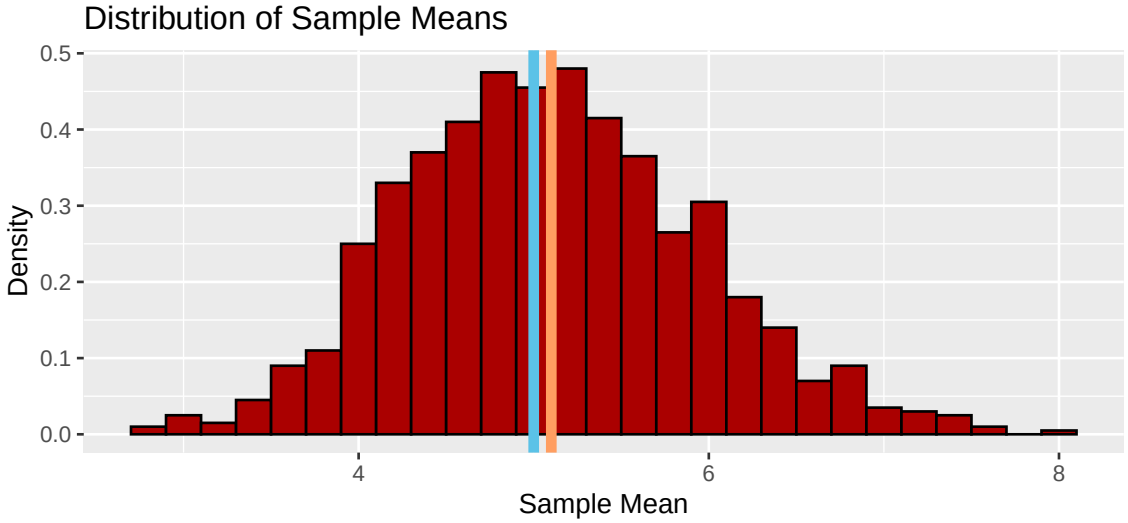
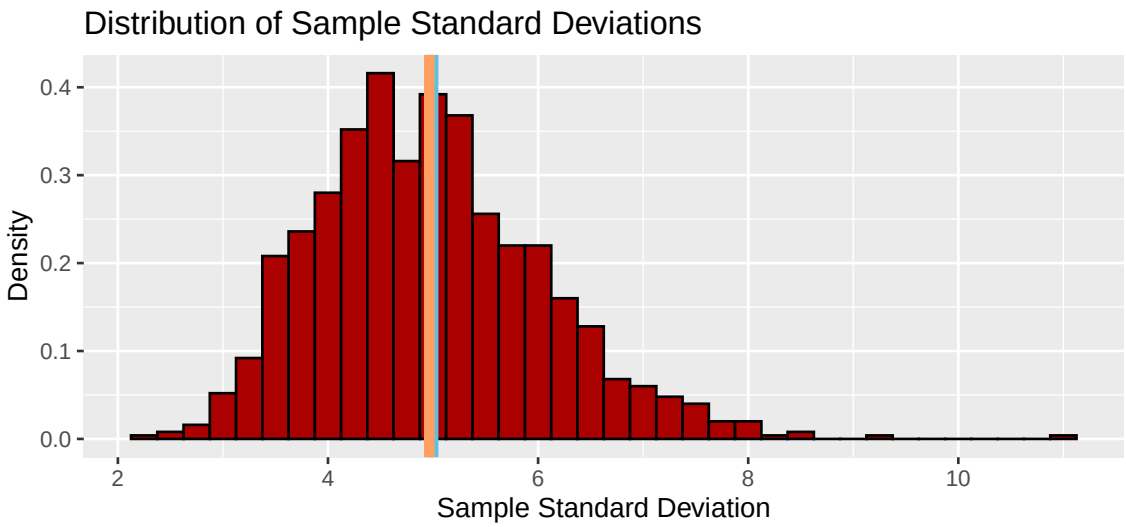
```
## ----setup, include=FALSE-----------------------------------------------------
knitr::opts_chunk$set(echo = FALSE)


## ----Load_Libraries, message = FALSE------------------------------------------
library(tidyverse); library(gridExtra)
phi <- (1+sqrt(5))/2 #For dimensions


## ----Simulation---------------------------------------------------------------
set.seed(1618033)
n <- 40
sims <- 1000
l <- 0.2 #lambda
multipleObs <- matrix(rexp(n*sims, l), sims, n)
means <- apply(multipleObs, 1, mean)
sds <- apply(multipleObs, 1, sd)


## ----Histogram_of_Sample_Means, fig.height= 3, fig.width = 3*phi--------------
muplot <- ggplot(data.frame(x = means), aes(x)) +
        geom_histogram(binwidth = 0.2, aes(y = ..density..),
                       fill = "#AA0000", colour = "#000000") +
        labs(x = "Sample Mean", y = "Density") +
        ggtitle("Distribution of Sample Means")
muplot + geom_vline(xintercept = 1/l, lwd = 2, colour = "#5BC2E7") +
        geom_vline(xintercept = mean(means), lwd = 2, colour = "#FF9E61")
```



```
## ----Histogram_of_sds, fig.height= 3, fig.width = 3*phi-----------------------
plot <- ggplot(data.frame(x = sds), aes(x)) +
        geom_histogram(binwidth = 0.25, aes(y = ..density..),
                       fill = "#AA0000", colour = "#000000") +
        geom_vline(xintercept = 1/l, lwd = 2, colour = "#5BC2E7") +
        geom_vline(xintercept = mean(sds), lwd = 2, colour = "#FF9E61") +
        labs(x = "Sample Standard Deviation", y = "Density") +
        ggtitle("Distribution of Sample Standard Deviations")
plot
```




```
## ----Outlier_Row--------------------------------------------------------------
multipleObs[sds > 10,]
```

```
##  [1]  1.1115223 69.5594991  2.5845742  4.1456691  0.9881980  0.5764390
##  [7] 10.8931832 15.0100879  5.7394382  6.7351328  5.6811038  3.2551634
## [13]  2.9895914  1.7589532  1.1060825  1.1251588  0.2900541  1.2472671
## [19] 10.5095757  2.2223170  5.0132533  2.6577173  7.1168531  2.3240154
## [25]  1.9439511  3.7382340 10.2663309  2.2563026  3.0793852  1.1044089
## [31]  4.5625495  9.5708496  6.3844310 17.5178723  5.6246395  4.6515142
## [37]  2.4609859  0.9532821  0.2766272  0.2400065
```

```
## ----Exp_Dist-----------------------------------------------------------------
exsam <- rexp(sims,l)

## ----Plot_Densities, fig.height= 3, fig.width = 3*phi-------------------------
explot <- ggplot(data.frame(x = exsam), aes(x))+
        geom_density(lwd = 2) +
        labs(x = "Value of Sample Data Points", y = "Density") +
        ggtitle("Expontential Distribution")
g1 <- explot +
        geom_vline(xintercept = mean(exsam),
              colour = "#FF0000", lwd = 2) +
        geom_vline(xintercept = median(exsam),
              colour = "#5BC2E7", lwd = 2)

CLTplot <- ggplot(data.frame(x = means), aes(x)) +
        geom_density(lwd = 2) +
        labs(x = "Sample Means", y = "Density") +
        ggtitle("Sample Mean Distribution")
g2 <- CLTplot +
        geom_vline(xintercept = mean(means),
```

```
            colour = "#FF0000", lwd = 2) +
        geom_vline(xintercept = median(means),
            colour = "#5BC2E7", lwd = 2)

grid.arrange(g1, g2, ncol = 2)
```