STAT 461: Homework 2

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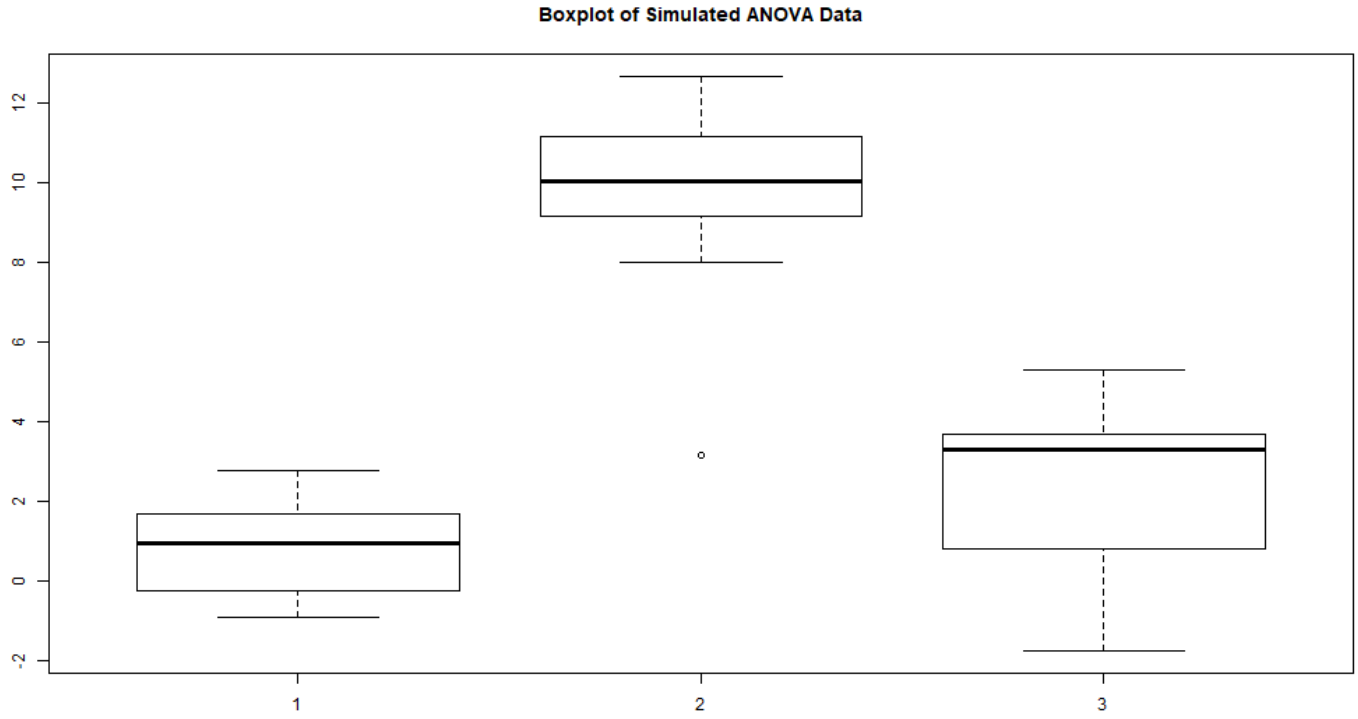
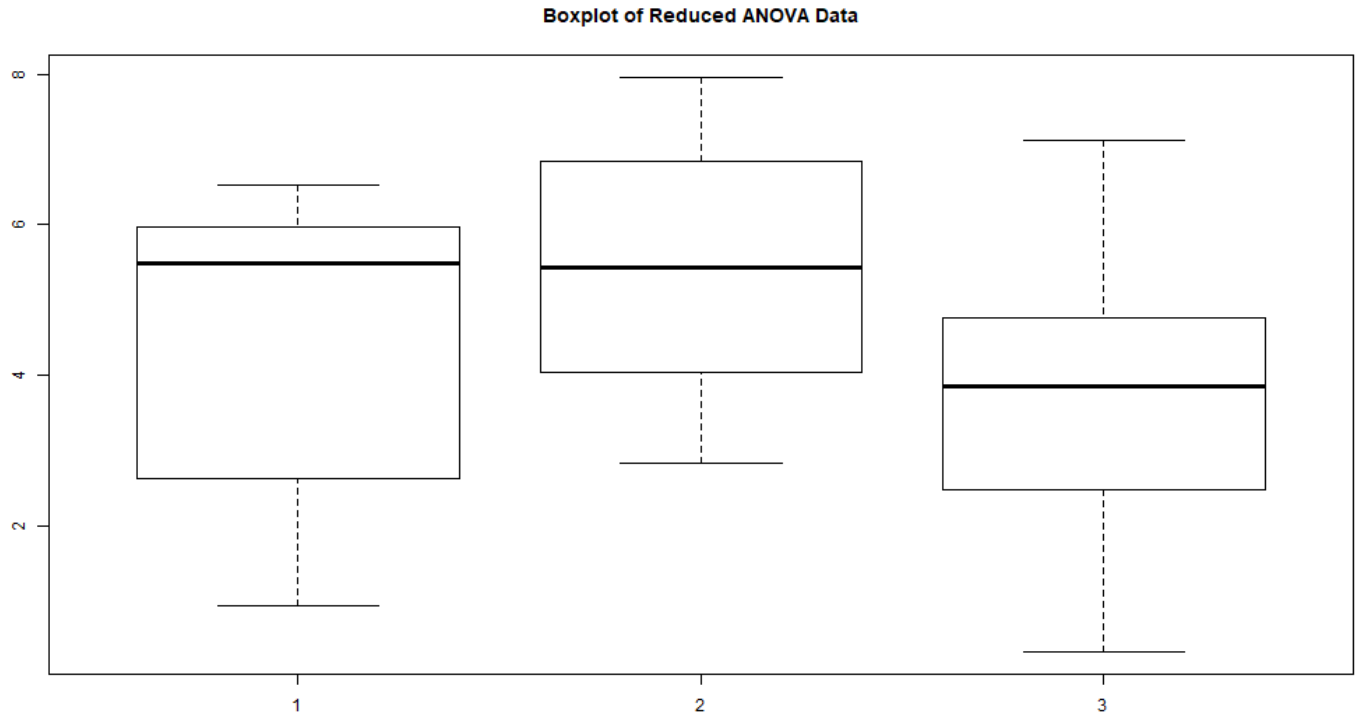
PROBLEM 1

Below is a plot of the simulated ANOVA distribution:



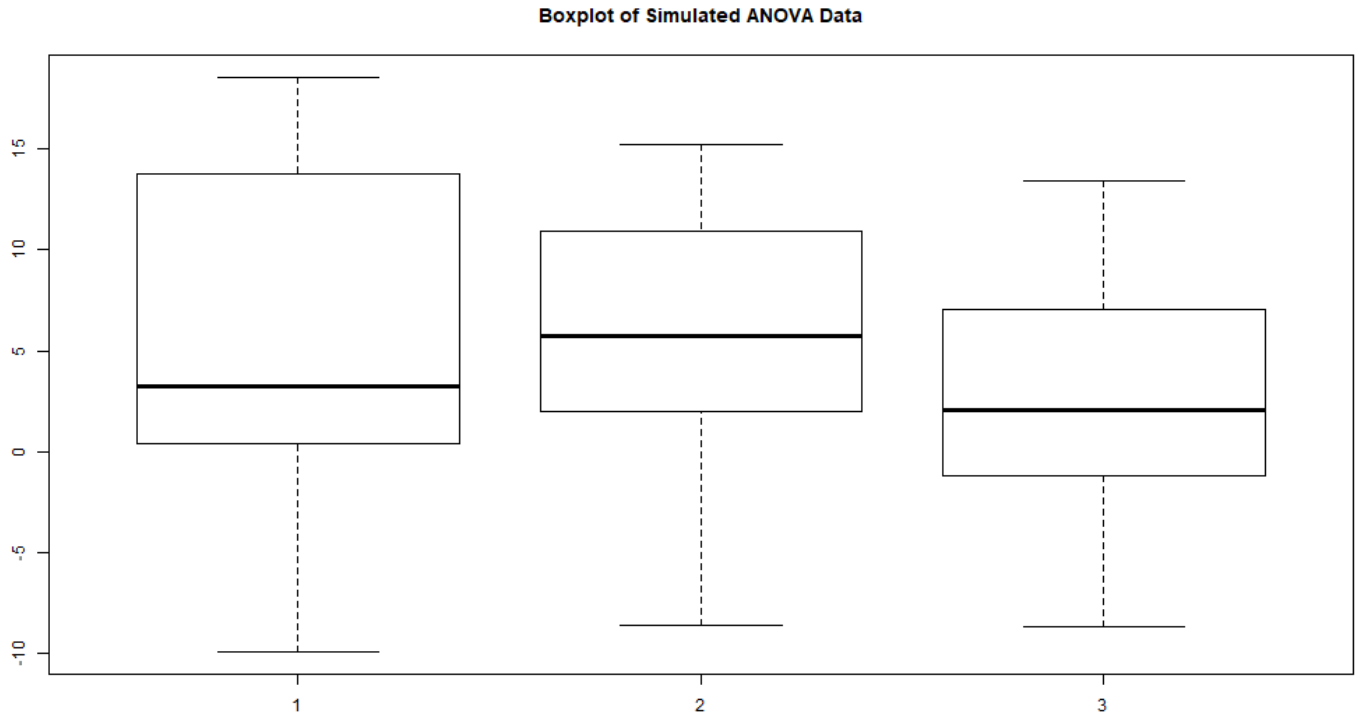
PROBLEM 2

Below is a plot of the simulated reduced ANOVA distribution:



PROBLEM 3

Below is a plot of the simulated ANOVA distribution with an extremely large variance:



PROBLEM 4

$$Y_{23} = Y_{2t} = \mu + \tau_1 + \epsilon_{it}; \quad \epsilon_{it} \overset{iid}{\sim} N(0,4)$$
$$Y_{2t} = 4.7 + 5 + N(0,4)$$
$$Y_{2t} \sim N(9.7,4)$$

PROBLEM 5

$$\hat{Y_{2\cdot}} = \frac{1}{r_2}\sum_{t=1}^{r_2} Y_{2t}; \quad r_2 = 10$$
$$\sum_{t=1}^{r_2} Y_{2t} \sim N(9.7,4) + \overset{8}{\cdots} + N(9.7,4)$$
$$\sum_{t=1}^{r_2} Y_{2t} \sim N(97,40)$$
$$\frac{1}{10} Y_{2t} \sim \frac{1}{10} N(97,40) = N\left(\frac{1}{10} * 97, \left(\frac{1}{10}\right)^2 40\right)$$
$$\frac{1}{10} Y_{2t} \sim N(9.7,0.4)$$

PROBLEM 6

$Y_{1t} \sim 4.7 - 3 + N(0,4)$

$Y_{1t} \sim N(1.7,4)$

$Y_{2t} \sim N(9.7,4)$

$Y_{1t} - Y_{2t} \sim N(1.7,4) - N(9.7,4)$

$Y_{1t} - Y_{2t} \sim N(1.7,4) + -1 * N(9.7,4)$

$Y_{1t} - Y_{2t} \sim N(1.7,4) + N(-1 * 9.7, (-1)^2 * 4)$

$Y_{1t} - Y_{2t} \sim N(1.7,4) + N(-9.7,4)$

$Y_{1t} - Y_{2t} \sim N(1.7 - 9.7, 4 + 4)$

$Y_{1t} - Y_{2t} \sim N(-8,8)$

Code Appendix

```r
#####################################################################
#### Setup
#####################################################################
## Install and load libraries
# ipak function taken from: https://gist.github.com/stevenworthington/3178163
# ipak <- function(pkg) {
#   new.pkg <- pkg[!(pkg %in% installed.packages()[, "Package"])]
#   if (length(new.pkg))
#     install.packages(new.pkg, dependencies = TRUE)
#   sapply(pkg, require, character.only = TRUE)
# }
#
# packages <- c("ggplot2", "reshape2", "gridExtra", "TSA", "astsa", "orcutt",
#               "nlme", "fGarch", "vars")
# ipak(packages)

# Set up variables for first few questions
treatmentsSorted = c(rep("none",5), rep("low", 5), rep("medium", 5), rep("high", 5))
units = 1:length(treatmentsSorted)

#####################################################################
#### Problem 1
#####################################################################
sample1 = sample(treatmentsSorted)
experiment1 = data.frame(units, sample1)
experiment1

#####################################################################
#### Problem 2
#####################################################################
sample2 = sample(treatmentsSorted)
experiment2 = data.frame(units, sample2)
experiment2

#####################################################################
#### Problem 3
#####################################################################
q3treats = c(rep("r1", 3), rep("r2", 5), rep("r3", 5))
q3units = 1:length(q3treats)
q3sample = sample(q3treats)
q3experiment = data.frame(q3units, q3sample)
q3experiment


#####################################################################
#### Problem 6
#####################################################################
## Part A
q6_X = rnorm(1000, mean = -2, sd = 3)

png("./figures/p6_a.png", width = 1024, height = 576)
hist(q6_X)
dev.off()

## Part B
q6_Y = rnorm(1000, mean = 3, sd = 1)

png("./figures/p6_b.png", width = 1024, height = 576)
hist(q6_Y)
dev.off()

## Part C
q6_Z = q6_X + q6_Y

```

```r
png("./figures/p6_c.png", width = 1024, height = 576)
hist(q6_Z)
dev.off()


## Part E
# Z ~ N(1, 4)
mean(q6_Z)
sd(q6_Z)
```