MAN 4558 ~ Exam 3

Gus Lipkin ~ glipkin6737@floridapoly.edu

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.8
## v tidyr   1.2.0     v stringr 1.4.0
## v readr   2.1.2     v forcats 0.5.1

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(data.table)
```

```
##
## Attaching package: 'data.table'

## The following objects are masked from 'package:dplyr':
##
##     between, first, last

## The following object is masked from 'package:purrr':
##
##     transpose
```

Question 1

```
dt <- data.table("Sample" = 1:10,
                 "Obs1" = c(5:8, 3, 9, 5, 4, 5, 2),
                 "Obs2" = c(7, 6, 7, rep(5, 4), 3, 8, 2),
                 "Obs3" = c(6, 9, 5, 6, 7, 2, 4, 2, 8, 5))
dt
```

```
##     Sample Obs1 Obs2 Obs3
##  1:      1    5    7    6
##  2:      2    6    6    9
##  3:      3    7    7    5
##  4:      4    8    5    6
```

```
##  5:      5    3    5    7
##  6:      6    9    5    2
##  7:      7    5    5    4
##  8:      8    4    3    2
##  9:      9    5    8    8
## 10:     10    2    2    5
```

```
valueTable <- data.table("SampleSize" = 2:7,
                         "A2" = c(1.88, 1.02, .73, .58, .48, .42),
                         "D3" = c(rep(0, 5), .08),
                         "D4" = c(3.27, 2.57, 2.28, 2.11, 2.00, 1.92),
                         "d2" = c(1.13, 1.69, 2.06, 2.33, 2.53, 2.70))

valueTable <- valueTable[ncol(dt) - 2]
```

A.

Find the x and R of each sample and record above.

```
dt[, c("xBar", "R") := .(rowMeans(dt[,2:ncol(dt)]),
                         do.call(pmax, dt[,2:ncol(dt)]) -
                          do.call(pmin, dt[,2:ncol(dt)]))]
dt
```

```
##     Sample Obs1 Obs2 Obs3     xBar R
##  1:      1    5    7    6 6.000000 2
##  2:      2    6    6    9 7.000000 3
##  3:      3    7    7    5 6.333333 2
##  4:      4    8    5    6 6.333333 3
##  5:      5    3    5    7 5.000000 4
##  6:      6    9    5    2 5.333333 7
##  7:      7    5    5    4 4.666667 1
##  8:      8    4    3    2 3.000000 2
##  9:      9    5    8    8 7.000000 3
## 10:     10    2    2    5 3.000000 3
```

B

Find and record the grand mean $\bar{\bar{x}}$ and $\bar{R}$ in the appropriate boxes.

```
writeLines(paste("The grand mean is:", xBar <- mean(dt$xBar)))
```

```
## The grand mean is: 5.36666666666667
```

```
writeLines(paste("The R is:", R <- mean(dt$R)))
```

```
## The R is: 3
```

C

Find the UCL and LCL for the $\bar{x}$ chart.

```
writeLines(paste("The UCL for the x chart is:", xBarUCL <- xBar + (valueTable$A2 * R)))
```

```
## The UCL for the x chart is: 8.42666666666667
```

```
writeLines(paste("The LCL for the x chart is:", xBarLCL <- xBar - (valueTable$A2 * R)))
```

```
## The LCL for the x chart is: 2.30666666666667
```

D

Find the UCL and LCL for the R chart.

```
writeLines(paste("The UCL for the R chart is:", RUCL <- valueTable$D4 * R))
```

```
## The UCL for the R chart is: 7.71
```

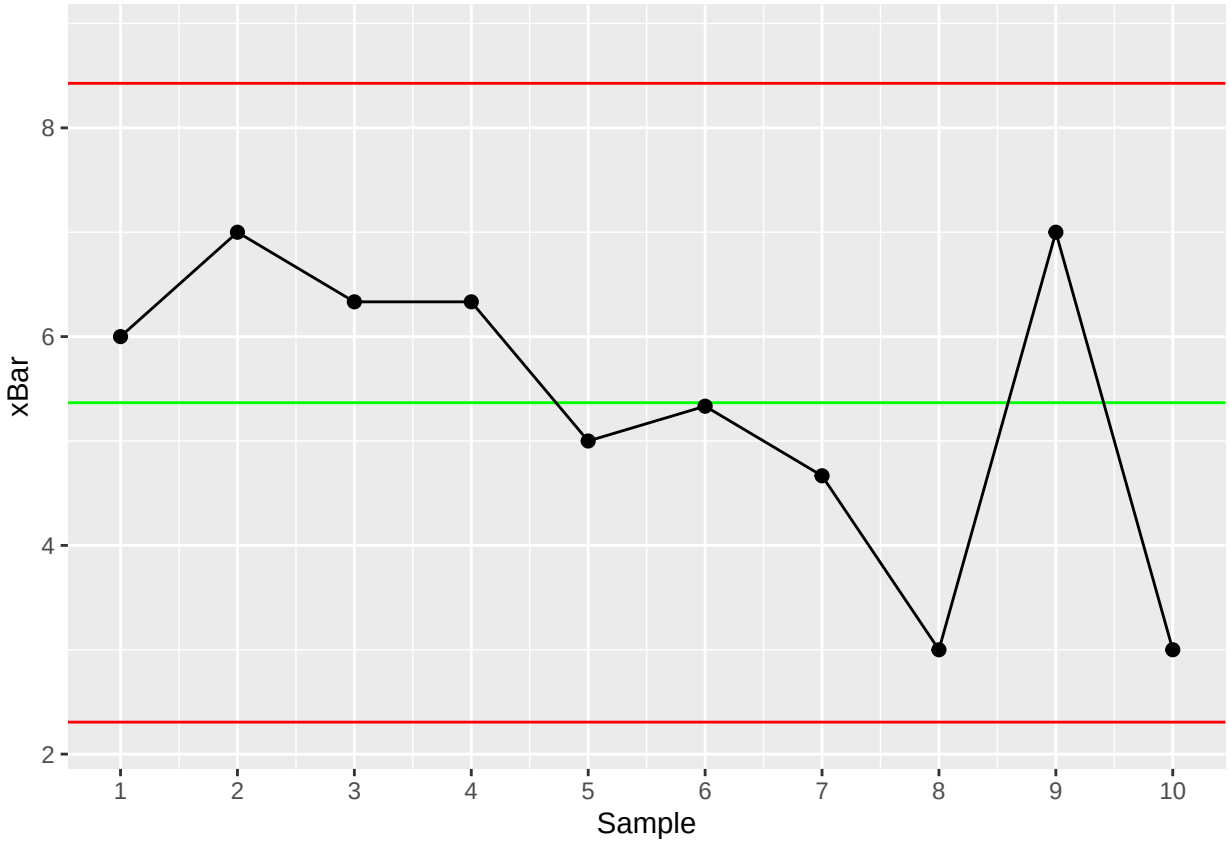
```
writeLines(paste("The LCL for the R chart is:", RLCL <- valueTable$D3 * R))
```

```
## The LCL for the R chart is: 0
```

E

Sketch out a control chart for the x-bar chart. Is the process in control in terms of the "average" vacuum pressure? _____ Yes or No If it's continuous

```
dt %>%
  ggplot() +
  geom_hline(yintercept = xBarLCL, color = "red") +
  geom_hline(yintercept = xBar, color = "green") +
  geom_hline(yintercept = xBarUCL, color = "red") +
  geom_line(aes(x = Sample, y = xBar)) +
  geom_point(aes(x = Sample, y = xBar), size = 2) +
  scale_x_continuous("Sample", 1:nrow(dt)) +
  ylim(c(min(xBarLCL - (xBarLCL * .05), dt$xBar - (dt$xBar * .05)),
         max(xBarUCL * 1.05, dt$xBar * 1.05)))
```



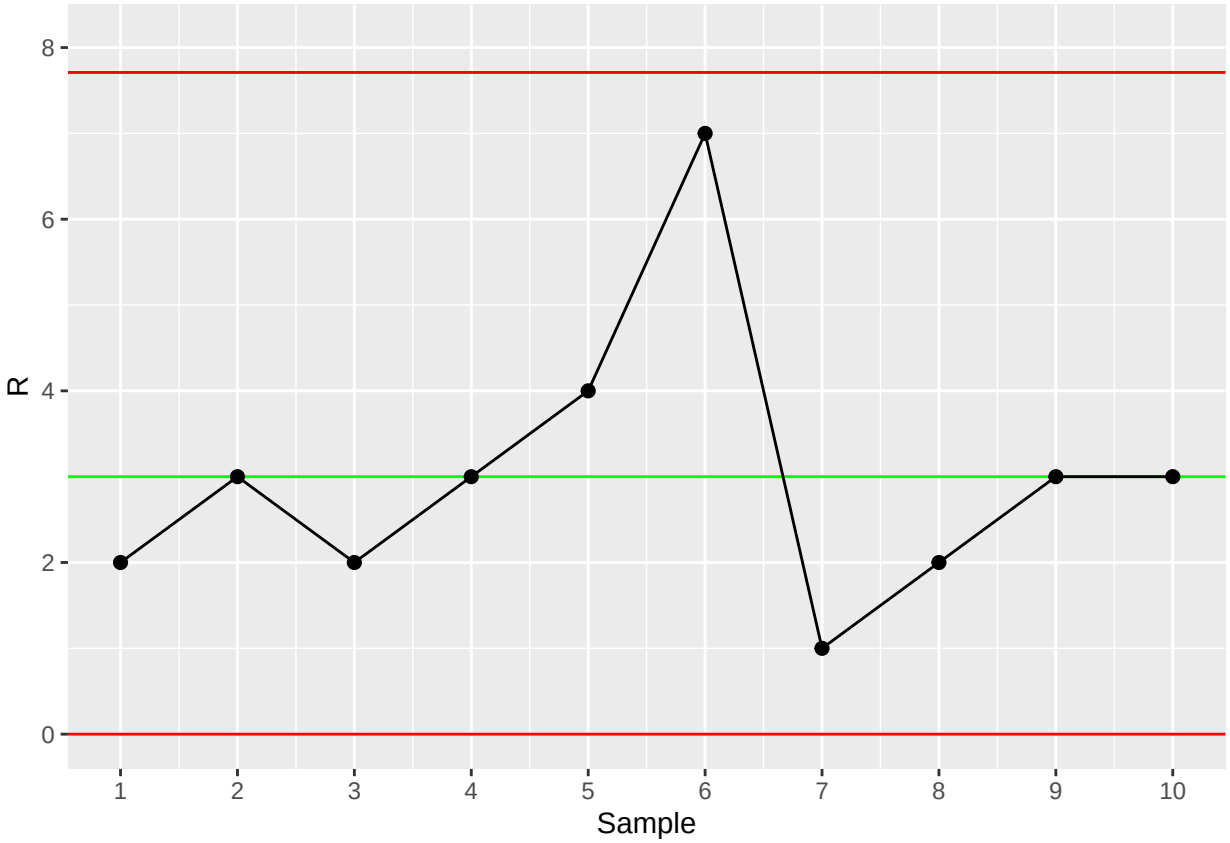

```
if(min(dt$xBar) > xBarLCL & max(dt$xBar) < xBarUCL) {
  writeLines("The process is in control in terms of the average.")
} else {
  writeLines("The process is not in control in terms of the average.")
}
```

```
## The process is in control in terms of the average.
```

F

Sketch out a control chart for the R chart. Is the process in control in terms of the "variation" in the process? _____ Yes or No

```
dt %>%
  ggplot() +
  geom_hline(yintercept = R, color = "green") +
  geom_hline(yintercept = RLCL, color = "red") +
  geom_hline(yintercept = RUCL, color = "red") +
  geom_line(aes(x = Sample, y = R)) +
  geom_point(aes(x = Sample, y = R), size = 2) +
  scale_x_continuous("Sample", 1:nrow(dt)) +
  ylim(c(min(RLCL - (RLCL * .05), dt$R - (dt$R * .05)),
         max(RUCL * 1.05, dt$R * 1.05)))
```




```
if(min(dt$R) > RLCL & max(dt$R) < RUCL) {
  writeLines("The process is in control in terms of the variation")
} else {
  writeLines("The process is not in control in terms of the variation")
}
```

```
## The process is in control in terms of the variation
```

G

Find the process standard deviation (σ)

```
writeLines(paste("The standard deviation is:", sigma <- (R / valueTable$d2)))
```

```
## The standard deviation is: 1.77514792899408
```

H

Find the appropriate process capability index for the process if the lower and upper specification limits are 8 to 20.

```
LSL <- 2
USL <- 8
if((LSL + USL) / 2 == xBar) {
  writeLines("The process is centered")
  C <- (USL - LSL) / (6 * sigma)
} else {
  writeLines("The process is not centered")
  C <- min((USL - xBar) / (3 * sigma),
           (xBar - LSL) / (3 * sigma))
}
```

```
## The process is not centered
```

```
writeLines(paste("C is:", C))
```

```
## C is: 0.494481481481482
```

I

What is your interpretation of the capability index?

```
if(C < 1) {
  writeLines("Because C is less than one, the process is not capable and process improvement should begi
} else {
  writeLines("Because C is greater than one, the process is capabale.")
  if(C < 1.33) {
    writeLines("However, because C is still under 1.33, we should probably improve the process a bit mo
  }
}
```

```
## Because C is less than one, the process is not capable and process improvement should begin immediat
```

Question 2

```
df <- data.table("towns" = LETTERS[1:4],
                 "distanceA" = c(21, 16, 10.5, 4.5),
                 "distanceB" = c(12, 16, 30, 14),
                 "loads" = c(15, 11, 12, 18))
writeLines(paste("Distance to Martin:", sum(df$loads * df$distanceA)))
```

```
## Distance to Martin: 698
```

```
writeLines(paste("Distance to Dyersburg:", sum(df$loads * df$distanceB)))
```

```
## Distance to Dyersburg: 968
```

The supply center should be located in Martin because the load distance is less than that if it was located in Dyersburg.