A5 (Q4) - Ram Yoogesh Gopu (20867060)

```
knitr::opts_chunk$set(echo = TRUE,
                      warning = FALSE,
                      message = FALSE,
                      fig.align = "center",
                      fig.width = 6,
                      fig.height = 5,
                      out.height = "40%")
set.seed(12314159)
library(loon.data)
library(loon)
```

```
## Loading required package: tcltk
```

```
library(gridExtra)

codeDirectory <- "./code"
imageDirectory <- "./img"
dataDirectory <- "./data"
path_concat <- function(path1, ..., sep="/") paste(path1, ..., sep = sep)
source("graphicalTests.R")
source("numericalTests.R")
source("generateData.R")
```

Full dataset is then read in as

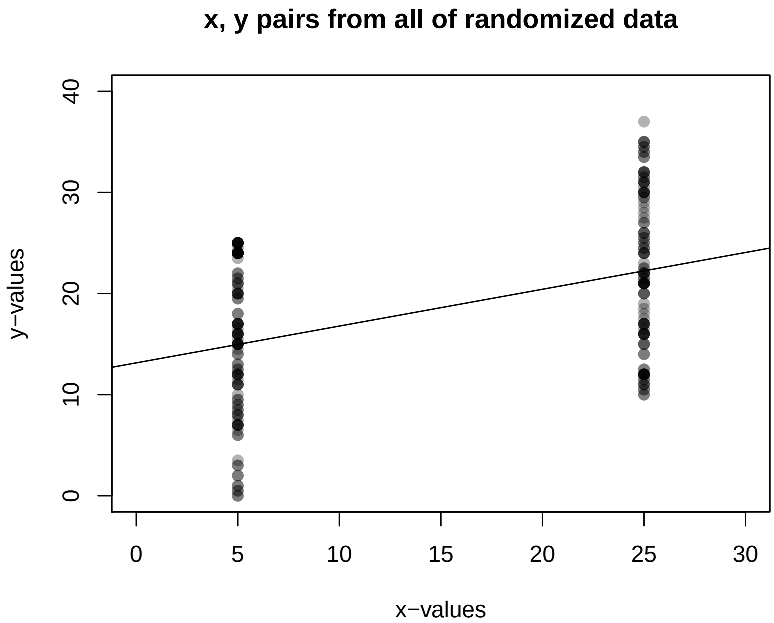
```
labData <- read.csv("labData.csv")
```

(A)

```
randomized <- labData[labData$type == "randomized", ]
```

(B)

```
plot(randomized$x, randomized$y, xlim = c(0, 30), ylim = c(0, 40), pch = 19, col = adjustcolor("black",
Bmod <- lm(y~x, randomized)
abline(Bmod)
```




```r
print("Value of slope estimate is")
```

```
## [1] "Value of slope estimate is"
```

```r
print(Bmod$coefficients[2])
```

```
##         x
## 0.3638889
```

(C)

(i)

```r
rand1 <- randomized[randomized$rep == 1, ]
rand2 <- randomized[randomized$rep == 2, ]
```

(ii)

```r
# defining the vectors and arrays
slopes1 <- c()
betas2 <- c()
first_t <- array()
second_t <- array()
```

```r
for (value in 1:18)
{
  first_t[value] <- lm(y~x, rand1[rand1$team == value, ])
  slopes1 <- c(slopes1, first_t[[value]][2])

  second_t[value] <- lm(y~x, rand2[rand2$team == value, ])
  betas2 <- c(betas2, second_t[[value]][2])
}
print("Average slope for Rep 1")
```

```
## [1] "Average slope for Rep 1"
```

```r
print(mean(slopes1))
```

```
## [1] 0.3703704
```

```r
print("Average slope for Rep 2")
```

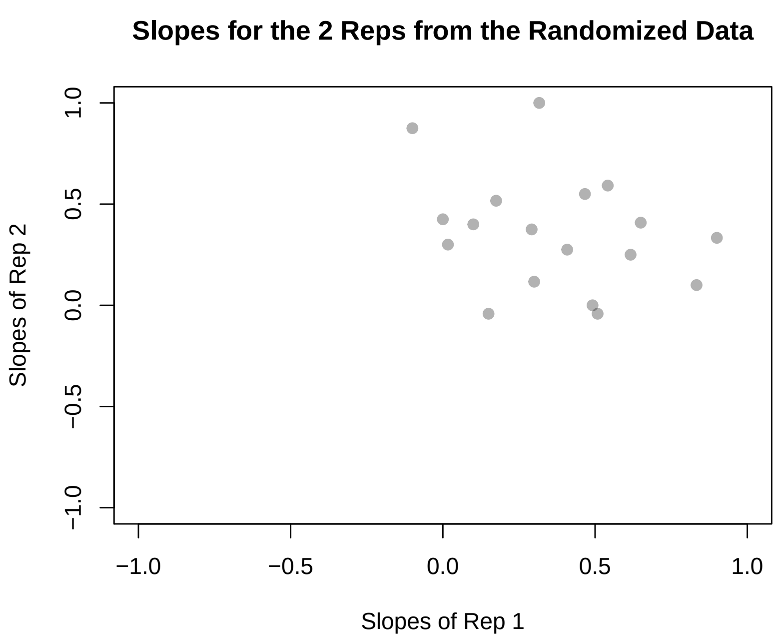
```
## [1] "Average slope for Rep 2"
```

```r
print(mean(betas2))
```

```
## [1] 0.3574074
```

(ii)

```r
plot(slopes1, betas2, xlim = c(-1, 1), ylim = c(-1, 1), pch = 19, col = adjustcolor("black", 0.3), main
```



(iii)

```
sampobs <- data.frame(x = slopes1, y = betas2)
numericalTest(sampobs, generateFn = mixCoords, discrepancyFn = slopeDiscrepancy)
```

```
## [1] 0.23
```

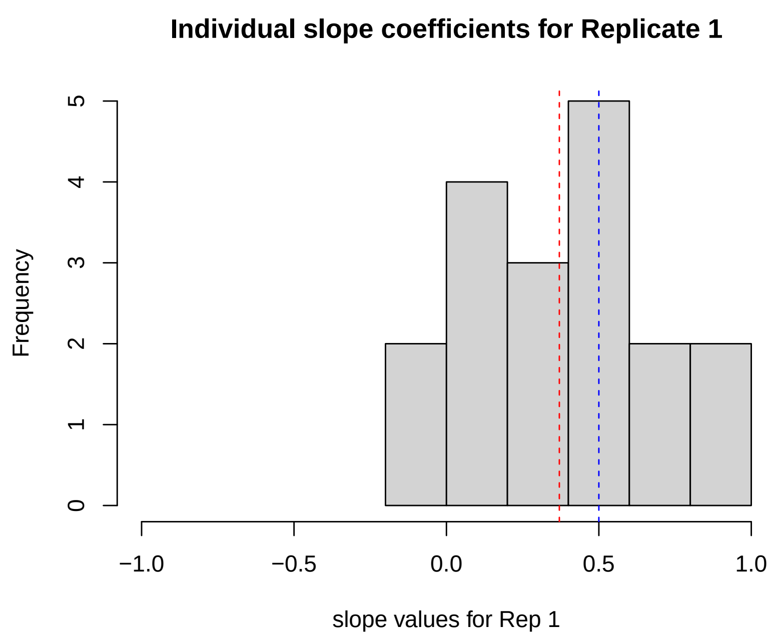
```
numericalTest(sampobs, generateFn = mixCoords, discrepancyFn = correlationDiscrepancy)
```

```
## [1] 0.2685
```

So from the outputs we can infer that the p-value is 0.23 (slopeDiscrepancy) (greater than 0.05) which is not strong enough against the null hypothesis. Also, the p-value is 0.2685 (correlationDiscrepancy) (greater than 0.05) which is not strong enough against the null hypothesis and the correlation cofficient must be a non-zero.

(iv)

```
hist (slopes1, xlim = c(-1, 1), col = "lightgrey", main = "Individual slope coefficients for Replicate 
abline(v = mean(slopes1), col = "red", lty =2)
abline(v = 0.5, col = "blue", lty = 2)
```




```
print("Average of slope estimates")
```

```
## [1] "Average of slope estimates"
```

```r
print(mean(slopes1))
```

```
## [1] 0.3703704
```

```r
print("Standard deviation of slope estimates")
```

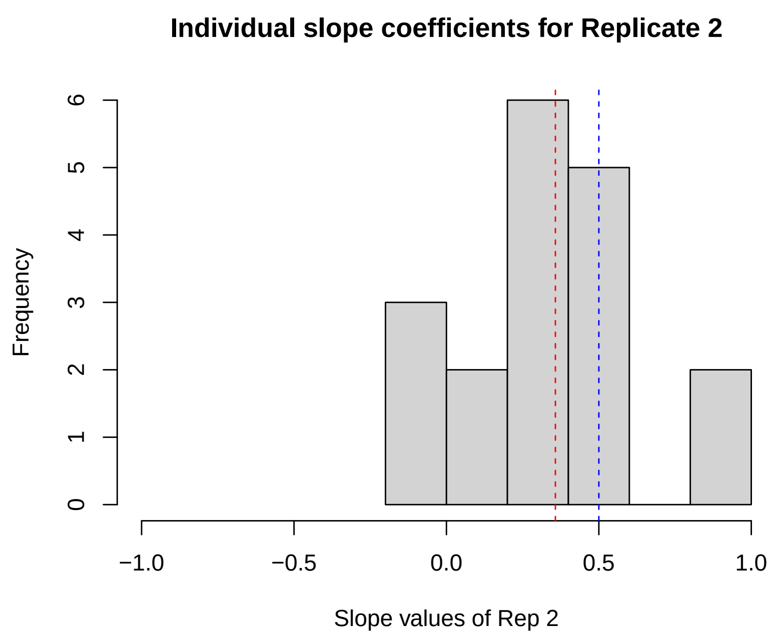
```
## [1] "Standard deviation of slope estimates"
```

```r
print(sd(slopes1))
```

```
## [1] 0.283351
```

(v)

```r
hist(betas2, xlim = c(-1, 1), col = "lightgrey", main = "Individual slope coefficients for Replicate 2"
abline(v = mean(betas2), col = "red", lty = 2)
abline(v = 0.5, col = "blue", lty = 2)
```




```r
print("Average of slope estimates")
```

```
## [1] "Average of slope estimates"
```

```r
print(mean(betas2))
```

```
## [1] 0.3574074
```

```r
print("Standard deviation of slope estimates")
```

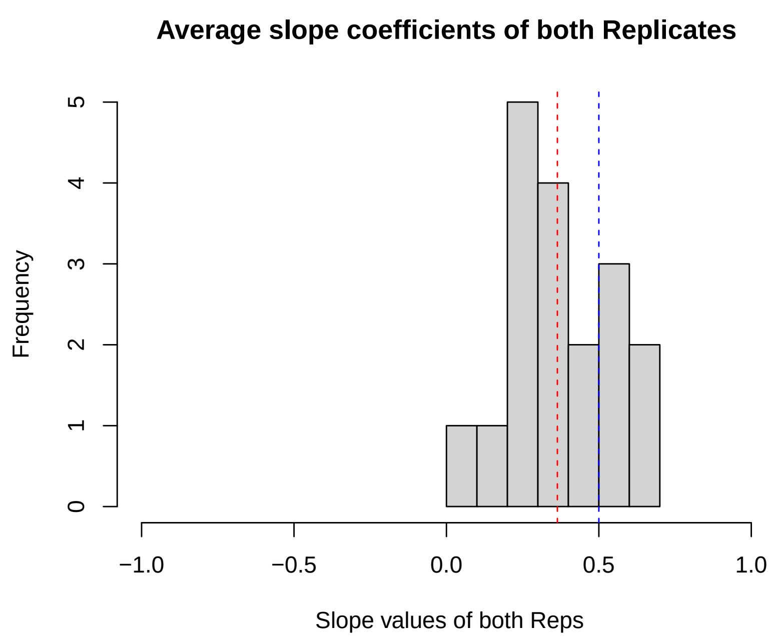
```
## [1] "Standard deviation of slope estimates"
```

```r
print(sd(betas2))
```

```
## [1] 0.2869847
```

(Vi)

```r
avg_reps <- (slopes1 + betas2) / 2
hist(avg_reps, xlim = c(-1, 1), col = "lightgrey", main = "Average slope coefficients of both Replicates
abline(v = mean(avg_reps), col = "red", lty = 2)
abline(v = 0.5, col = "blue", lty = 2)
```




```r
print("Average of slope estimates for both reps")
```

```
## [1] "Average of slope estimates for both reps"
```

```r
print(mean(avg_reps))
```

```
## [1] 0.3638889
```

```r
print("Standard deviation of slope estimates for both reps")
```

```
## [1] "Standard deviation of slope estimates for both reps"
```

```r
print(sd(avg_reps))
```

```
## [1] 0.1692267
```

(E)

From the study we can infer that the average slope estimates are closer to the true slope values. Hence, I would conclude that the quality of team slope estimates in randomized study is good and better than observational design.

(F)

From the output, we know that the average of replicates is 0.36388 which is somewhat close to the true value 0.5. This gives a better understanding of slope estimates instead of viewing a single repetition on a individual basis. Hence, this is more preferrable.

(G)

Since Z is a lurking variable for the above problem, it is clear that it has a fixed value which fixes (hyperplane). This has an effect on the values of y. Also, there would be different y values when we change Z. Furthermore, the hyperplane and the height of the markers imposes a constraint on y.