Assignment-2.R

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Thu Oct 05 19:09:38 2017

```
library(Sleuth3)

## Warning: package 'Sleuth3' was built under R version 3.4.2

Q1
Statistically p-value determines whether the null hypothesis could be rejecte
d in order to support the alternative hypothesis. It is the probability to
find the observed results when a null hypothesis is true. Generally, alpha
value is set to be 0.05 and if p-value is less than or equal to alpha than we
can reject the null hypothesis else we need to accept it. If p-value is 0.049
then by statistical theory, we can reject the null hyothesis and accept the a
lternative hypothesis and if p-value is 0.051 then the null hypothesis cannot
be rejected. But in my view when p-value is 0.049, it means it holds a strong
correlation to the critical region but still could be considered that data is
significant. In other case if the alpha value is set to 0.01 or 0.1, then we
can accept or reject the null hypothesis respectively for the given p-value.
```

Q2- Ex:2.12

For α=0.05, df=1095, t=1.962(from t-distribution table)

Confidence interval for the difference of the two means = $(\bar{Y}_2\text{-}\bar{Y}_1) \pm$ t.SE$(\bar{Y}_2\text{-}\bar{Y}_1)$

= 280$\pm$ 1.962*46.66

= (188.45, 371.55)

Thus 95% confidence interval for $\mu_2 - \mu_1$ lies between (188.45, 371.55)

For α=0.1, t=1.646

90% confidence interval = 280$\pm$ 1.646*46.66

= (203.197,356.80)

t-statistics = $((\bar{Y}_2\text{-}\bar{Y}_1)$-(hypothesized value for $\mu_2 - \mu_1))/(SE(\bar{Y}_2\text{-}\bar{Y}_1))$

= (280-0)/46.66 = 6.00

Two sided p-value = 2*(1-pt(6.00,1095))(where pt is a function used in R)

= $2.678*10^{-9}$.

Q3- Ex:2.16

```
## Welch Two Sample t-test
t.test(Score~Treatment, data=case0101)

##
##  Welch Two Sample t-test
##
## data:  Score by Treatment
## t = -2.9153, df = 43.108, p-value = 0.005618
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -7.010803 -1.277603
## sample estimates:
## mean in group Extrinsic mean in group Intrinsic
##                15.73913                19.88333

## Two Sample t-test
t.test(Score~Treatment, data=case0101, var.equal = TRUE)
##  Two Sample t-test
##
## data:  Score by Treatment
## t = -2.9259, df = 45, p-value = 0.005366
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -6.996973 -1.291432
## sample estimates:
## mean in group Extrinsic mean in group Intrinsic
##                15.73913                19.88333
```

From the output we can see that p-value = 0.005 and hence it can reject the null hypothesis. Thus, the experiment gives an evidence that intrinsic questionnaire helped the student to score more rather than extrinsic one. The 95% confidence interval lies between 1.3 to 7. It is observed that the mean of intrinsic group is 4.1 point more than the extrinsic group, hence it can be concluded that increase in score is attributed to intrinsic group

Q4- Ex:2.22

The null and alternative hypothesis are:

H_0: $\mu_1=\mu_2$

H_1: $\mu_1\neq\mu_2$

```
library(psych)
```

```
summary(ex0222)
```

```
Gender         Arith             Word            Parag            Math       
 female:1278   Min.   : 0.00   Min.   : 0.00   Min.   : 0.0   Min.   : 0.0  
 male  :1306   1st Qu.:13.00   1st Qu.:23.00   1st Qu.:10.0   1st Qu.: 9.0  
               Median :19.00   Median :28.00   Median :12.0   Median :13.0  
               Mean   :18.52   Mean   :26.56   Mean   :11.2   Mean   :14.2  
               3rd Qu.:25.00   3rd Qu.:32.00   3rd Qu.:14.0   3rd Qu.:20.0  
               Max.   :30.00   Max.   :35.00   Max.   :15.0   Max.   :25.0  

AFQT       
 Min.   :  0.00  
 1st Qu.: 31.50  
 Median : 56.80  
 Mean   : 54.44  
 3rd Qu.: 78.10  
 Max.   :100.00  
```

```
describe(ex0222)
```

```
##         vars    n  mean    sd median trimmed   mad min max range  skew
## Gender*    1 2584  1.51  0.50    2.0    1.51  0.00   1   2     1 -0.02
## Arith      2 2584 18.52  7.16   19.0   18.63  8.90   0  30    30 -0.09
## Word       3 2584 26.56  7.05   28.0   27.43  7.41   0  35    35 -1.00
## Parag      4 2584 11.20  3.16   12.0   11.60  2.97   0  15    15 -1.08
## Math       5 2584 14.20  6.28   13.0   14.14  7.41   0  25    25  0.09
## AFQT       6 2584 54.44 27.76   56.8   55.17 34.10   0 100   100 -0.19
##         kurtosis   se
## Gender*    -2.00 0.01
## Arith      -1.09 0.14
## Word        0.38 0.14
## Parag       0.54 0.06
## Math       -1.15 0.12
## AFQT       -1.09 0.55
```

```
aggregate(ex0222$AFQT~ex0222$Gender, data=ex0222, FUN=mean)
```

```
##   ex0222$Gender ex0222$AFQT
## 1        female    53.40579
## 2          male    55.44625
```

```
aggregate(ex0222$AFQT~ex0222$Gender, data=ex0222, FUN=sd)
```

```
##   ex0222$Gender ex0222$AFQT
## 1        female    26.88500
## 2          male    28.56677
```

```
male <- ex0222[ which(ex0222$Gender=="male") , ]
female <- ex0222[ which(ex0222$Gender=="female") , ]
t.test(male$AFQT, female$AFQT)
```

```
##
##  Welch Two Sample t-test
```

```
##
## data:  male$AFQT and female$AFQT
## t = 1.8701, df = 2578.1, p-value = 0.06158
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.099000  4.179916
## sample estimates:
## mean of x mean of y
##  55.44625  53.40579
```

```
t.test(male$AFQT, female$AFQT, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  male$AFQT and female$AFQT
## t = 1.8689, df = 2582, p-value = 0.06175
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1004044  4.1813200
## sample estimates:
## mean of x mean of y
##  55.44625  53.40579
```

As we can see that the p-value is greater than 0.06, hence we cannot reject the null hypothesis. Thus, we can say that the provided data is insufficient to prove that male distribution difference female distribution AFQT scores. The 95% confidence interval is between -0.100 to 4.181

```
mean(male$AFQT-female$AFQT)
```

```
## Warning in male$AFQT - female$AFQT: longer object length is not a multiple
## of shorter object length
```

```
## [1] 2.11072
```

The mean difference between the AFQT score of male and female is 2.1 which seems to be on higher side

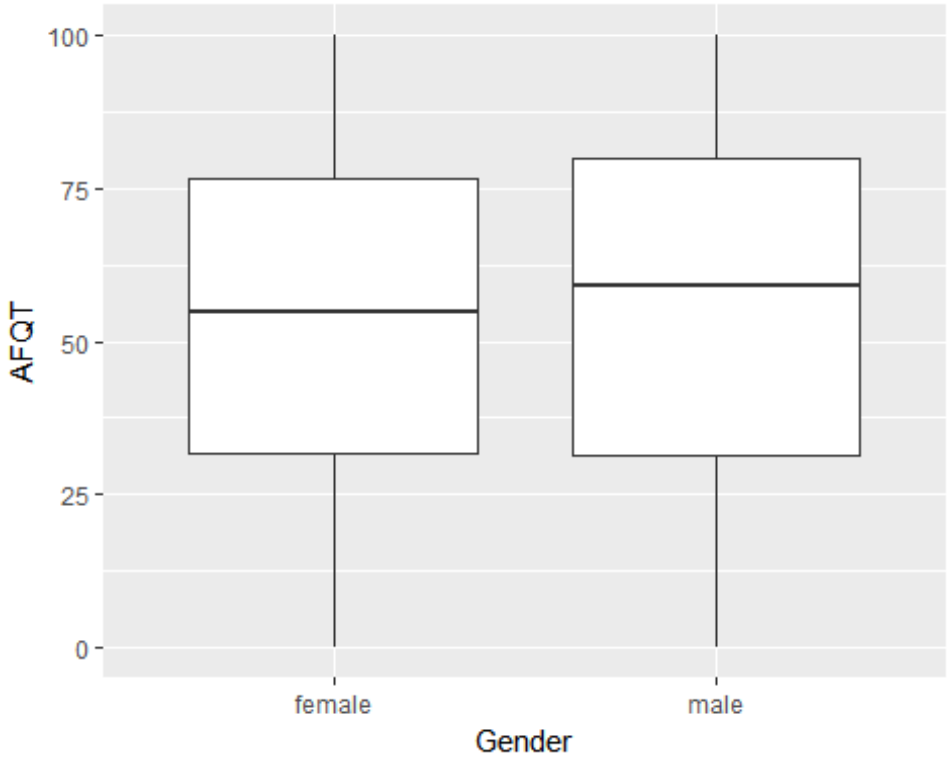
```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.4.2
```

```
##
## Attaching package: 'ggplot2'
```

```
## The following objects are masked from 'package:psych':
##
##     %+%, alpha
```

```
pl <- ggplot(data=ex0222, aes(ex0222$Gender,ex0222$AFQT)) + geom_boxplot()
pl+xlab("Gender")+ylab("AFQT")
```



The upper quartile of male is slightly higher than female. Additionally, male has a median of 55.65 whereas female has it at 53.41. According to the plot there is not much difference in the AFQT score of male and female but male tend to perform slightly better.

```
t.test(male$Arith, female$Arith)

##
##  Welch Two Sample t-test
##
## data:  male$Arith and female$Arith
## t = 7.3124, df = 2574.4, p-value = 3.486e-13
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.490802 2.583309
## sample estimates:
## mean of x mean of y
##  19.52297  17.48592

t.test(male$Arith, female$Arith, var.equal = TRUE)

##
##  Two Sample t-test
##
## data:  male$Arith and female$Arith
## t = 7.3064, df = 2582, p-value = 3.639e-13
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
```

```
##  1.490353 2.583758
## sample estimates:
## mean of x mean of y
##  19.52297  17.48592
```

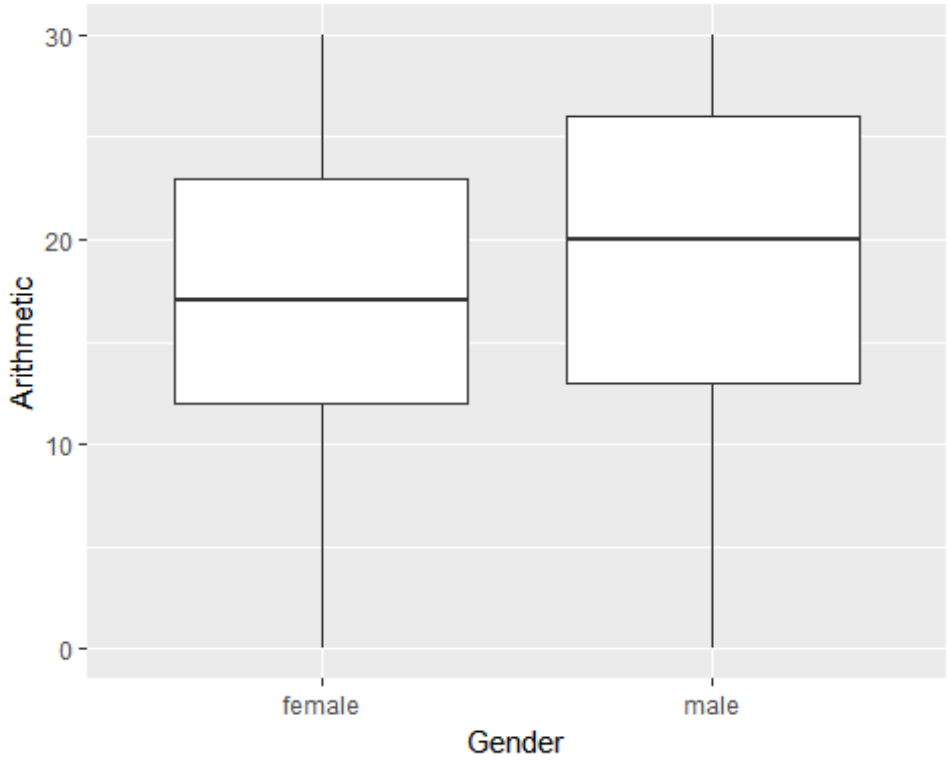
In this case we can reject the null hypothesis as the p-value is less than 0.05. Thus, we can say that there exist certain difference between the male and female distributions in Arithmetic.

```
mean(male$Arith-female$Arith)
```

```
## Warning in male$Arith - female$Arith: longer object length is not a
## multiple of shorter object length
```

```
## [1] 2.047473
```

```
arithm <- ggplot(data=ex0222, aes(ex0222$Gender,ex0222$Arith)) + geom_boxplot
()
arithm+xlab("Gender")+ylab("Arithmetic")
```



According to the plot, male tends to perform better than female in arithmetic. It could be seen that median of male is 19.5 whereas female is 17.45. The upper quartile of the male is above 25 as compared to female which is below 25.

```
t.test(male$Parag, female$Parag)
```

```
##
##  Welch Two Sample t-test
##
## data:  male$Parag and female$Parag
## t = -4.6023, df = 2561.8, p-value = 4.382e-06
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.8120894 -0.3268312
## sample estimates:
## mean of x mean of y
##  10.92037  11.48983
```

```
t.test(male$Parag, female$Parag, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  male$Parag and female$Parag
## t = -4.5968, df = 2582, p-value = 4.497e-06
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.8123791 -0.3265415
## sample estimates:
## mean of x mean of y
##  10.92037  11.48983
```

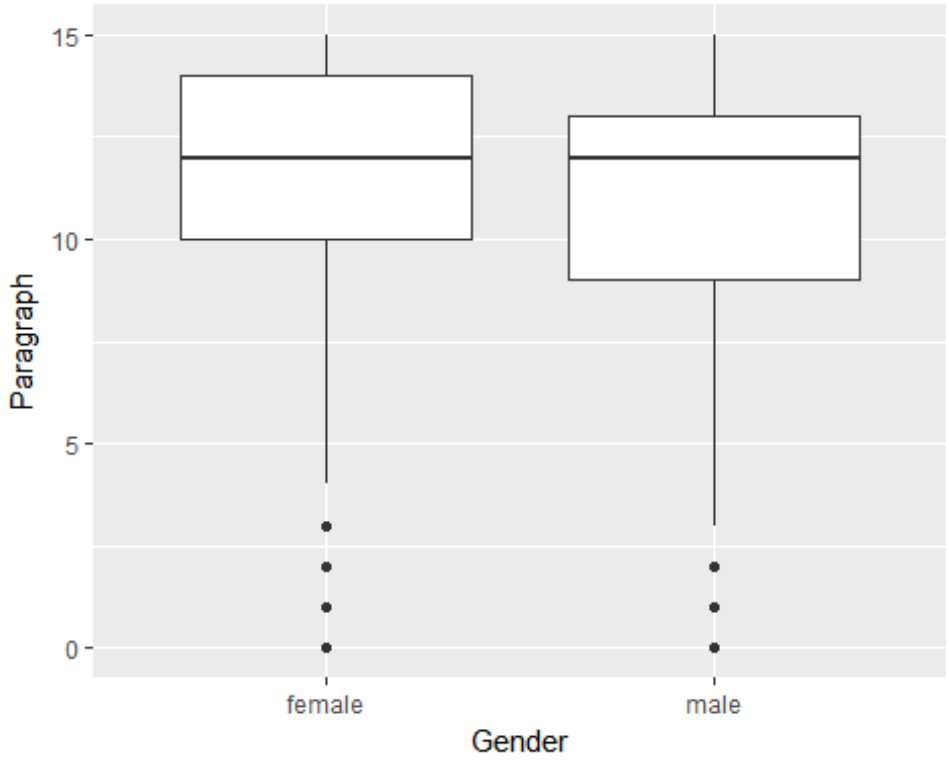
In this case the p-value is less than 0.05. Hence, we can reject the null hyp
othesis and state that there exist certain difference between the male and fe
male distributions in Paragraph

```
mean(male$Parag-female$Parag)
```

```
## Warning in male$Parag - female$Parag: longer object length is not a
## multiple of shorter object length
```

```
## [1] -0.5528331
```

```
para <- ggplot(data=ex0222, aes(ex0222$Gender,ex0222$Parag)) + geom_boxplot()
para+xlab("Gender")+ylab("Paragraph")
```



The mean difference is negative which means female tends to have higher capacity. The above plot suggests that female has a better paragraph understanding capacity than male. The median of male and female are almost same but the lower and upper quartile of female are higher than the male group.

```
t.test(male$Word, female$Word)

##
##  Welch Two Sample t-test
##
## data:  male$Word and female$Word
## t = -0.079837, df = 2581.4, p-value = 0.9364
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.5657510  0.5214844
## sample estimates:
## mean of x mean of y
##  26.54594  26.56808

t.test(male$Word, female$Word, var.equal = TRUE)

##
##  Two Sample t-test
##
## data:  male$Word and female$Word
## t = -0.079805, df = 2582, p-value = 0.9364
## alternative hypothesis: true difference in means is not equal to 0
```

```
## 95 percent confidence interval:
##  -0.5659693  0.5217027
## sample estimates:
## mean of x mean of y
##  26.54594  26.56808

mean(male$Word-female$Word)

In this case, the p-value is greater than 0.05 and hence we fail to reject th
e null hypothesis. Thus it lacks evidence to show there exist certain differe
nce in male and female distribution for Word.

## Warning in male$Word - female$Word: longer object length is not a multiple
## of shorter object length

## [1] -0.006891271

word <- ggplot(data=ex0222, aes(ex0222$Gender,ex0222$Word)) + geom_boxplot()
word+xlab("Gender")+ylab("Word")
```

As per the mean difference, it tends to be negative indicating that female has a higher vocab capacity as compared male. There is a very slight difference in median of both the groups and the upper quartile. The extreme points in female are lower than male, hence one can make a prediction that female might poses higher vocab capacity.

```r
t.test(male$Math, female$Math)
```

```
##
##  Welch Two Sample t-test
##
## data:  male$Math and female$Math
## t = 3.0491, df = 2573, p-value = 0.002319
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.2684012 1.2356885
## sample estimates:
## mean of x mean of y
##  14.56738  13.81534
```

```r
t.test(male$Math, female$Math, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  male$Math and female$Math
## t = 3.0464, df = 2582, p-value = 0.002339
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.267979 1.236111
## sample estimates:
## mean of x mean of y
##  14.56738  13.81534
```

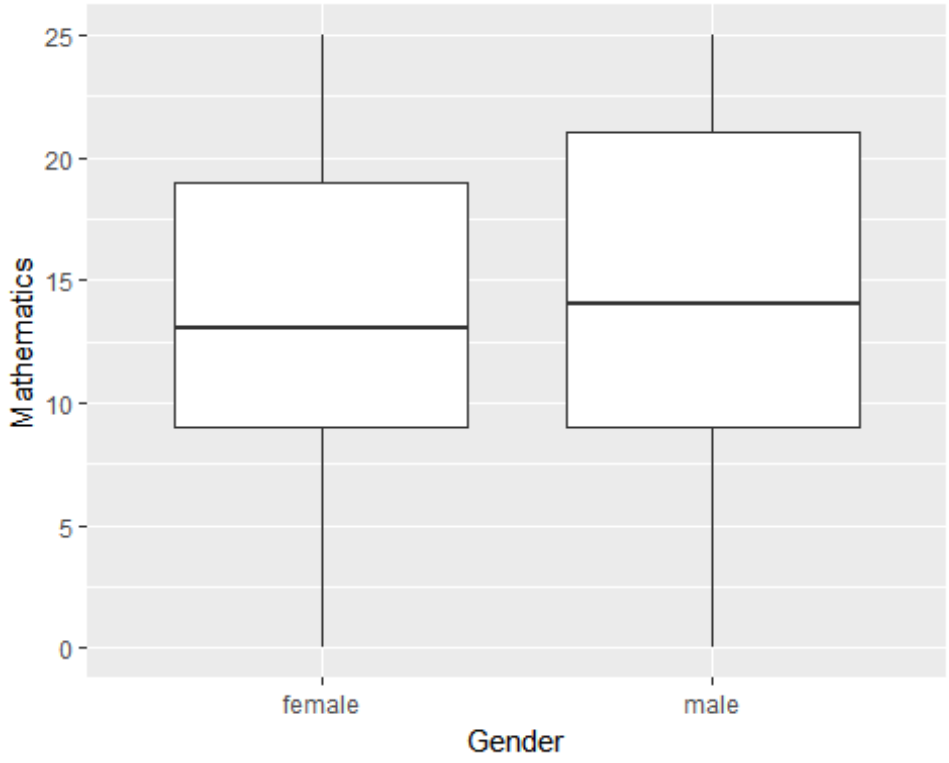
In this case we can reject the null hypothesis as p-value is less than 0.05.

```r
mean(male$Math-female$Math)
```

```
## Warning in male$Math - female$Math: longer object length is not a multiple
## of shorter object length
```

```
## [1] 0.7611026
```

```r
math <- ggplot(data=ex0222, aes(ex0222$Gender,ex0222$Math)) + geom_boxplot()
math+xlab("Gender")+ylab("Mathematics")
```



According to the mean difference, male tends to have better mathematics than female. The above plot suggests that male tends to have a better performance. The median of male is slightly high, whereas upper quartile is above 20 in case of male as compared to female who has below 20.

Summary of Statistical findings:

- According to the plot there is not much difference in the AFQT score of male and female but male tend to perform slightly better. Additionally, male has a mean of 55.65 whereas female has it at 53.41. Since the p-value is greater than 0.05, so the null hypothesis could not be rejected. Thus, the provided data is insufficient to prove the difference between male and female distribution. The 95 CI is between -0.100 to 4.181.

- The male tends to perform better than female in arithmetic. It could be seen that median of male is 19.5 whereas female is 17.45. The upper quartile of the male is above 25 as compared to female which is below 25. The mean difference is positive. Additionally, as per the p-value, we can reject the null hypothesis.

- As the p-value is less than 0.05, we can reject the null hypothesis . The mean difference is negative which means female tends to have higher capacity. The above plot suggests that female has a better paragraph understanding capacity than male. The median of male and female are almost same but the lower and upper quartile of female are higher than the male group

- As per the mean difference, it tends to be negative indicating that female has a higher vocab capacity as compared male. There is a very slight difference in median of both the groups and the upper quartile. The p-value is greater than 0.05 so we cannot reject the null hypothesis.
- According to the plot male tends to have a better performance in Mathematics. Moreover, p-value is less than 0.05 so we can reject the null hypothesis. The median of male is slightly high, whereas upper quartile is above 20 in case of male as compared to female who has below 20.

Scope of Inference:

It could be concluded that male tends to perform better in Mathematical and arithmetic. It means male has good calculation skills, whereas female tends to perform better in paragraph and vocabs. Thus, female has a good understanding and memory capacity.