LAB-09

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# The Data set is loaded.  
library(readr)

## Warning: package 'readr' was built under R version 4.2.3

DRUG <- read\_csv("C:/Users/NILANJANA/Downloads/Exercise2\_data.csv")

## Rows: 60 Columns: 6  
## ── Column specification ────────────────────────────────────────────────────────  
## Delimiter: ","  
## chr (3): Gender, Drug, Procedure  
## dbl (3): Age, PreOpScore, PostOpScore  
##   
## ℹ Use `spec()` to retrieve the full column specification for this data.  
## ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

View(DRUG)  
DRUG

## # A tibble: 60 × 6  
## Gender Drug Procedure Age PreOpScore PostOpScore  
## <chr> <chr> <chr> <dbl> <dbl> <dbl>  
## 1 Male A X 44.1 66.4 71.3  
## 2 Male B Z 41.8 75.3 77.4  
## 3 Male B Z 57.8 67.3 73.0  
## 4 Female A Z 40.4 72.7 77.8  
## 5 Male A Y 51.8 60.9 67.5  
## 6 Female B Y 34.4 60.9 64.8  
## 7 Female A Z 30.5 76.9 86.2  
## 8 Female A X 33.3 67.2 71.0  
## 9 Male A X 44.5 74.9 75.1  
## 10 Male A Z 45.3 69.9 81.6  
## # ℹ 50 more rows

# the libraries are installed  
library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.2.3

library(ggpubr)

## Warning: package 'ggpubr' was built under R version 4.2.3

library(tidyverse)

## Warning: package 'tidyverse' was built under R version 4.2.3

## Warning: package 'tibble' was built under R version 4.2.3

## Warning: package 'tidyr' was built under R version 4.2.3

## Warning: package 'purrr' was built under R version 4.2.3

## Warning: package 'dplyr' was built under R version 4.2.3

## Warning: package 'stringr' was built under R version 4.2.3

## Warning: package 'forcats' was built under R version 4.2.3

## Warning: package 'lubridate' was built under R version 4.2.3

## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──  
## ✔ dplyr 1.1.1 ✔ stringr 1.5.0  
## ✔ forcats 1.0.0 ✔ tibble 3.2.1  
## ✔ lubridate 1.9.2 ✔ tidyr 1.3.0  
## ✔ purrr 1.0.1   
## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::lag() masks stats::lag()  
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(broom)

## Warning: package 'broom' was built under R version 4.2.3

library(AICcmodavg)

## Warning: package 'AICcmodavg' was built under R version 4.2.3

# we try to identify the levels of "Procedure" factor  
DRUG$Procedure=as.factor(DRUG$Procedure)  
levels(DRUG$Procedure)

## [1] "X" "Y" "Z"

# we try to identify the levels of "Gender" factor  
DRUG$Gender=as.factor(DRUG$Gender)  
levels(DRUG$Gender)

## [1] "Female" "Male"

# we try to identify the levels of "Gender" factor  
DRUG$Drug=as.factor(DRUG$Drug)  
levels(DRUG$Drug)

## [1] "A" "B"

ONE-WAY ANOVA:

H0:There is no significant difference in the PreOpScore with 2 levels of ‘Drug’ factor -> μ1 = μ2

vs

H1:μ1 != μ2

# we perform the one-way anova test for factor 'Drug'  
oneway <- aov(PreOpScore~Drug, data = DRUG)  
summary(oneway)

## Df Sum Sq Mean Sq F value Pr(>F)  
## Drug 1 7.8 7.782 0.249 0.619  
## Residuals 58 1810.4 31.214

##INTERPRETATION : The p-value is greater than 0.05 which indicates the acceptance of H0 which denotes that the ‘Drug’ factor is insignificant and does not have any effect on the “PreOpScore”.

H0:There is no significant difference in the PreOpScore with 2 levels of ‘Gender’ factor -> μ1 = μ2

vs

H1:μ1 != μ2

oneway2 <- aov(PreOpScore~Gender, data = DRUG)  
summary(oneway2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Gender 1 172.9 172.85 6.093 0.0165 \*  
## Residuals 58 1645.3 28.37   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

##INTERPRETATION : The p-value is less than 0.05 which indicates the rejection of H0 which denotes that the 'Drug' factor is significant and does effect the "PreOpScore".

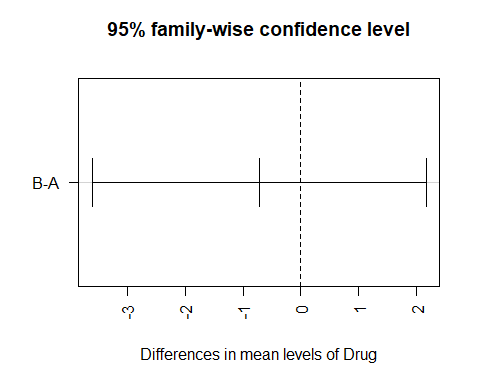
## PAIRED COMPARISON TEST

TukeyHSD(oneway2, conf.level=.95)

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = PreOpScore ~ Gender, data = DRUG)  
##   
## $Gender  
## diff lwr upr p adj  
## Male-Female -3.464641 -6.274158 -0.6551245 0.0165377

#Interpretation : Both of levels affect the "PreOpScore" which is evident from the p-value being less than 0.05.

## Graphical Representation of the confidence interval for the above test  
plot(TukeyHSD(oneway, conf.level=.95), las = 2)

 ##TWO WAY ANOVA

We will first check for difference with interaction effect between factors “Gender” and “Procedure”.

H0A: There is no significant difference in the PreOpScore with 2 levels of ‘Gender’ factor μ1 = μ2

H0B: There is no significant difference in the PreOpScore with 2 levels of ‘Procedure’ factor μ1 = μ2

H0AB: The interaction effect of “Gender” and “Procedure” is insignificant.

vs

H1A: atleast one inequality in H0A H1B: atleast one inequality in H0B H1AB: atleast one inequality in H0A

two.way <- aov(PreOpScore ~ Gender\*Procedure, data = DRUG)  
summary(two.way)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Gender 1 172.9 172.85 6.097 0.0167 \*  
## Procedure 2 81.6 40.82 1.440 0.2460   
## Gender:Procedure 2 32.7 16.33 0.576 0.5655   
## Residuals 54 1531.0 28.35   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

##INTERPRETATION : We can conclude that the interaction effect is not significant here which is evident from the p-value.But 'Gender' factor is significant.

## We again perform the two-way anova test without interaction effect.  
two.way2 <- aov(PreOpScore ~ Gender+Procedure, data = DRUG)  
summary(two.way2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Gender 1 172.9 172.85 6.190 0.0158 \*  
## Procedure 2 81.6 40.82 1.462 0.2405   
## Residuals 56 1563.7 27.92   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## Interpretation : "Gender" is the significant factor.

## We perform the paired comparison test.  
TukeyHSD(two.way2, conf.level=.95)

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = PreOpScore ~ Gender + Procedure, data = DRUG)  
##   
## $Gender  
## diff lwr upr p adj  
## Male-Female -3.464641 -6.254174 -0.6751089 0.0158465  
##   
## $Procedure  
## diff lwr upr p adj  
## Y-X -2.2419817 -6.772384 2.288420 0.4631827  
## Z-X 0.2236265 -4.244212 4.691465 0.9920273  
## Z-Y 2.4656082 -1.210125 6.141341 0.2478307

## Graphical representation of the confidence intervals  
plot(TukeyHSD(two.way2, conf.level=.95), las = 2)

