ANOVA family

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Attach Data

```
library(readr)
HW8 <- read_csv("D:/Biostatistics/Lecture/Module 2/HW8.csv")
```

```
## Parsed with column specification:
## cols(
##   Treatment = col_character(),
##   `vitamin B` = col_character(),
##   Age = col_double(),
##   FBS = col_double(),
##   HbA1c = col_double()
## )
```

```
attach(HW8)
View(HW8)
```

Check normality :

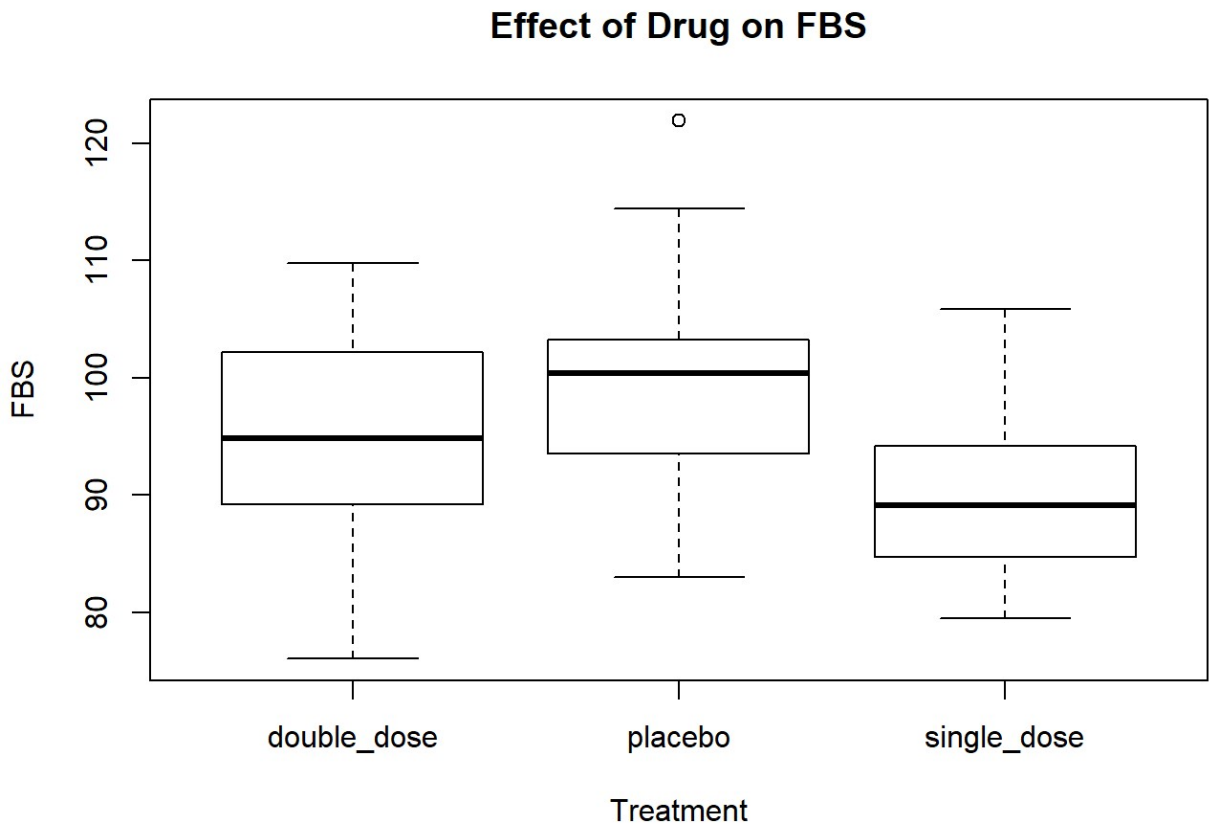
```
library(moments)
skewness(FBS)
```

```
## [1] 0.3448501
```

```
#accepted range from -1 to +1
kurtosis(FBS)
```

```
## [1] 2.833659
```

```
#accepted range from -2 to +2 may to +3
boxplot(FBS ~ Treatment , xlab = "Treatment" , ylab = "FBS" , main = "Effect of Drug o
n FBS")
```




```
#visually , the data is normally distributed
shapiro.test(FBS)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  FBS
## W = 0.98356, p-value = 0.2549
```

```
#P-value > 0.05 , So data in normally distributed
```

More than 2 levels in variable >> So use ANOVA family

1st case : phase III trial to assess the efficacy of single & double dosing of an oral hypoglycemic

primary endpoint :acheving normal FBS

H0 :

mu FBS(single dose) = mu FBS(double dose) = mu FBS(placebo)

```
ANOVA1 <- (aov(formula = FBS ~ Treatment , data = HW8))
summary(ANOVA1)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Treatment    2   1556   777.8   12.06 2.12e-05 ***
## Residuals   96   6191    64.5
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

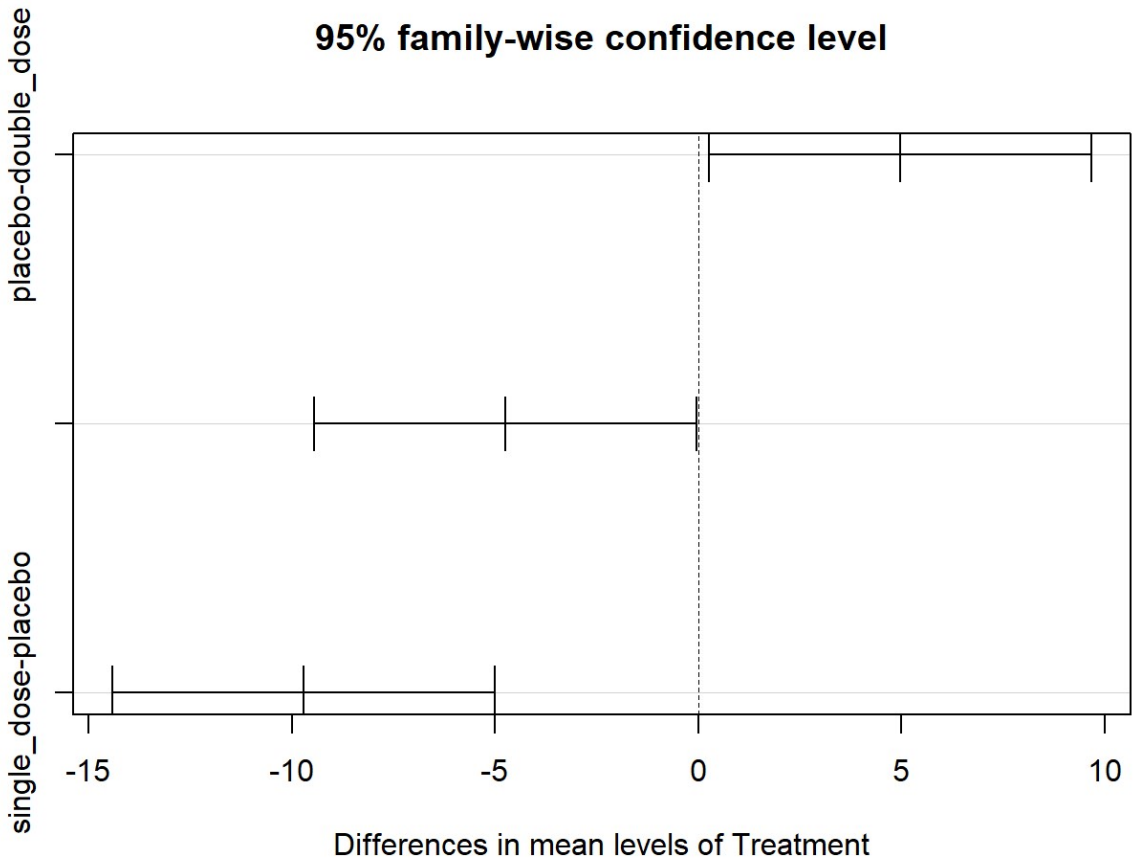
```
#p-value (F distribution)  < 0.05  , reject H0
#there is significant difference >> The Drug has an effect on FBS
```

I need to Know which type of treatment is significant :

```
TukeyHSD(ANOVA1)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = FBS ~ Treatment, data = HW8)
##
## $Treatment
##                               diff         lwr         upr     p adj
## placebo-double_dose       4.968588   0.2621729  9.67500286 0.0360170
## single_dose-double_dose -4.740552  -9.4469665 -0.03413654 0.0479501
## single_dose-placebo     -9.709139 -14.4155544 -5.00272442 0.0000110
```

```
plot(TukeyHSD(ANOVA1))
```



the best significant diffrence is between single dose & placebo

2nd case : phase III factorial trial to assess the efficacy of single & double dosing of an oral hypoglycemic with or without vitamen B

primary endpoint :acheving normal FBS

```
ANOVA2 <- aov(formula = FBS ~ Treatment + `vitamin B` , data = HW8)
summary(ANOVA2)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Treatment    2   1556   777.8  11.989 2.28e-05 ***
## `vitamin B`  1     27    27.4   0.423    0.517
## Residuals   95   6164    64.9
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#there is significant diff by treatment on FBS
#Vit.B  not  has any effect ( no significant diff)
```

if Age is a prospected covariate in 1st case :

```
ANCOVA1 <- aov(FBS ~ Treatment + Age , data = HW8)
summary(ANCOVA1)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Treatment    2   1556   777.8  11.971 2.31e-05 ***
## Age          1     18    17.9   0.276    0.601
## Residuals   95   6173    65.0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#there is significant diff by treatment on FBS
#Age  not  has any effect ( no significant diff)
```

if Age is a prospected covariate in 2nd case :

```
ANCOVA2 <- aov(FBS ~ Treatment + `vitamin B` + Age , data = HW8)
summary(ANCOVA2)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Treatment    2   1556   777.8  11.908 2.46e-05 ***
## `vitamin B`  1     27    27.4   0.420    0.519
## Age          1     23    23.4   0.359    0.551
## Residuals   94   6140    65.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#there is significant diff by treatment on FBS
#Age, vit.B  not  have  any effect ( no significant diff)
```

3rd case : phase III trial to assess the efficacy of single & double dosing of an oral hypoglycemic

(one way MANOVA)

primary endpoint : acheving normal FBS & HbA1c

```
MANOVA1 <- manova(cbind(FBS,HbA1c)~Treatment , data = HW8)
summary(MANOVA1)
```

```
##           Df  Pillai approx F num Df den Df    Pr(>F)
## Treatment  2 0.23185    6.294      4    192 8.847e-05 ***
## Residuals 96
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## there is significant diff , but I want to know the effect of treatment on each vari
able :
summary.aov(MANOVA1)
```

```
##  Response FBS :
##             Df Sum Sq Mean Sq F value    Pr(>F)
## Treatment    2 1555.7  777.85  12.062 2.123e-05 ***
## Residuals   96 6191.0   64.49
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##  Response HbA1c :
##             Df  Sum Sq   Mean Sq F value Pr(>F)
## Treatment    2 0.01540 0.0076980  1.7034 0.1875
## Residuals   96 0.43384 0.0045191
```

```
# there is significant diff (treatment , FBS), Drug has an effect on FBS
# But Drug Not affect HbA1C
```

4th case : phase III factorial trial to assess the efficacy of single & double dosing of an oral hypoglycemic with or without vitamin B :

(two way MANOVA)

primary endpoint : acheving normal FBS & HbA1c

```
MANOVA2 <- manova(cbind(FBS,HbA1c)~Treatment + `vitamin B` , data = HW8)
summary(MANOVA2)
```

```
##             Df   Pillai approx F num Df den Df    Pr(>F)
## Treatment    2 0.232494   6.2481      4    190 9.598e-05 ***
## `vitamin B`  1 0.004432   0.2092      2     94    0.8116
## Residuals   95
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## to know the effect separately:
summary.aov(MANOVA2)
```

```
##  Response FBS :
##             Df Sum Sq Mean Sq F value    Pr(>F)
## Treatment    2 1555.7  777.85 11.9891 2.276e-05 ***
## `vitamin B`  1   27.4   27.42  0.4226    0.5172
## Residuals   95 6163.6   64.88
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##  Response HbA1c :
##             Df  Sum Sq   Mean Sq F value Pr(>F)
## Treatment    2 0.01540 0.0076980  1.6857 0.1908
## `vitamin B`  1 0.00002 0.0000177  0.0039 0.9505
## Residuals   95 0.43382 0.0045665
```

```
#Treatment has an effect on FBS only
#Vit B not has any effect on FBS or HbA1c
```

if Age is a prospected covariate in 3rd case :

```
MANCOVA1 <- manova(cbind(FBS,HbA1c)~Treatment + Age , data = HW8)
summary(MANCOVA1)
```

```
##           Df   Pillai approx F num Df den Df    Pr(>F)
## Treatment  2 0.231904   6.2301      4    190 9.884e-05 ***
## Age        1 0.027461   1.3271      2     94    0.2702
## Residuals 95
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## to know the effect separately:
summary.aov(MANCOVA1)
```

```
##  Response FBS :
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Treatment    2 1555.7  777.85 11.9706 2.31e-05 ***
## Age          1   17.9   17.91  0.2756   0.6008
## Residuals   95 6173.1   64.98
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##  Response HbA1c :
##             Df  Sum Sq   Mean Sq F value Pr(>F)
## Treatment    2 0.01540 0.0076980  1.7300 0.1828
## Age          1 0.01113 0.0111255  2.5004 0.1171
## Residuals   95 0.42271 0.0044496
```

```
#Treatment has an effect on FBS only
#Age  not has any effect on FBS or HbA1c
```

if Age is a prospected covariate in 4th case :

```
MANCOVA2 <- manova(cbind(FBS,HbA1c)~Treatment + `vitamin B`+Age , data = HW8)
summary(MANCOVA2)
```

```
##             Df   Pillai approx F num Df den Df    Pr(>F)
## Treatment    2 0.232522   6.1831      4    188 0.0001074 ***
## `vitamin B`  1 0.004452   0.2079      2     93 0.8126463
## Age          1 0.028738   1.3759      2     93 0.2577146
## Residuals   94
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## to know the effect separately:
summary.aov(MANCOVA2)
```

```
##  Response FBS :
##             Df Sum Sq Mean Sq F value    Pr(>F)
## Treatment    2 1555.7  777.85 11.9082 2.457e-05 ***
## `vitamin B`  1   27.4   27.42  0.4198    0.5186
## Age          1   23.4   23.44  0.3588    0.5506
## Residuals   94 6140.1   65.32
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##  Response HbA1c :
##             Df  Sum Sq   Mean Sq F value Pr(>F)
## Treatment    2 0.01540 0.0076980  1.7129 0.1859
## `vitamin B`  1 0.00002 0.0000177  0.0039 0.9501
## Age          1 0.01136 0.0113633  2.5284 0.1152
## Residuals   94 0.42246 0.0044942
```

```
#Treatment has an effect on FBS only
#Both Vit.B & Age  not have any effect on FBS or HbA1c
```