One Way ANOVA

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Create Dataframe

```
foods<-data.frame(milk=c(25.40,26.31,24.10,23.74,25.10,
                         23.40,21.80,23.50,22.75,21.60,
                         20.00,22.20,19.75,20.60,20.40),
                  food=c("Food1","Food1","Food1","Food1","Food1",
                         "Food2","Food2","Food2","Food2","Food2",
                         "Food3","Food3","Food3","Food3","Food3"),
                  stringsAsFactors = TRUE)

print(foods) #See the Data
```

```
##     milk  food
## 1  25.40 Food1
## 2  26.31 Food1
## 3  24.10 Food1
## 4  23.74 Food1
## 5  25.10 Food1
## 6  23.40 Food2
## 7  21.80 Food2
## 8  23.50 Food2
## 9  22.75 Food2
## 10 21.60 Food2
## 11 20.00 Food3
## 12 22.20 Food3
## 13 19.75 Food3
## 14 20.60 Food3
## 15 20.40 Food3
```

ANOVA test

```
tm<-lm(milk ~ food, data = foods)   # Fit the linear model
summary(tm)                         # Linear Model Summary
```

```
##
## Call:
## lm(formula = milk ~ food, data = foods)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -1.19  -0.82   0.01   0.63   1.61
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  24.9300     0.4292  58.084 4.48e-16 ***
## foodFood2    -2.3200     0.6070  -3.822  0.00243 **
## foodFood3    -4.3400     0.6070  -7.150 1.16e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9597 on 12 degrees of freedom
## Multiple R-squared:  0.8101, Adjusted R-squared:  0.7785
## F-statistic:  25.6 on 2 and 12 DF,  p-value: 4.684e-05
```

```
fm<-aov(milk ~ food, data = foods)  # Fit the ANOVA
summary(fm)                         # ANOVA table SS I
```

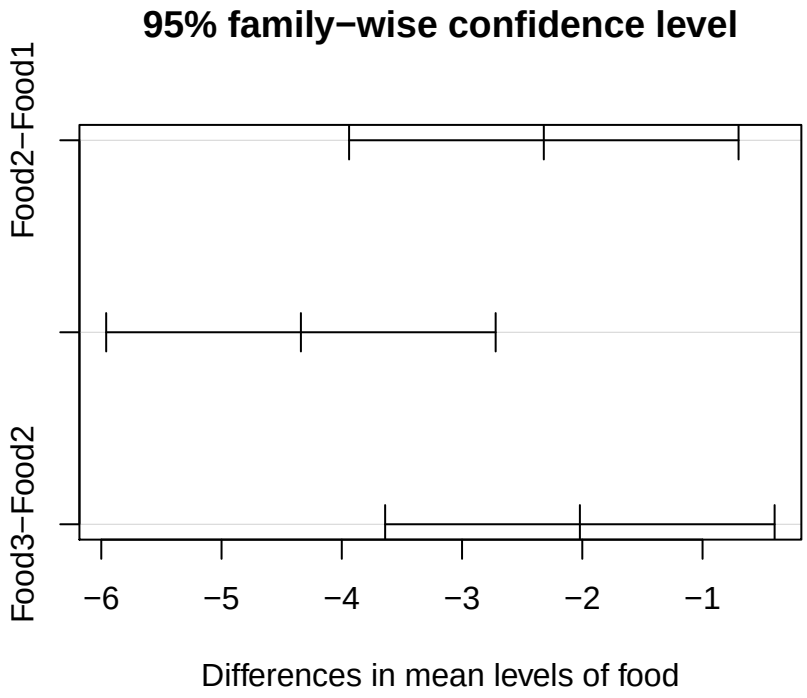
```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## food         2  47.16  23.582    25.6 4.68e-05 ***
## Residuals   12  11.05   0.921
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Multiple comparisons

```
TukeyHSD(fm)                    # Tukey test for multiple comparisons
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = milk ~ food, data = foods)
##
## $food
##               diff       lwr        upr     p adj
## Food2-Food1 -2.32 -3.939373 -0.7006265 0.0063517
## Food3-Food1 -4.34 -5.959373 -2.7206265 0.0000322
## Food3-Food2 -2.02 -3.639373 -0.4006265 0.0153900
```

```
plot(TukeyHSD(fm))              # Plot for tukey test
```




```
aggregate(foods$milk, by=list(foods$food), FUN = mean) # Means by group
```

```
##   Group.1     x
## 1   Food1 24.93
## 2   Food2 22.61
## 3   Food3 20.59
```

```r
#install.packages("multcomp")
library(multcomp)
par(mar=c(4,4,6,2))           # Change parameters for the plot margins
tuk <- glht(fm, linfct=mcp(food="Tukey")) # Fit the general Linear Hypotheses
plot(cld(tuk, level=0.05),col="lightgrey")   # Plot the mean differences
```