Nested

First Example

```
#rm(list = ls())   # Clean the workspace
library(lsmeans)  # Call the library
library(lme4)     # Call the library
library(car)      # Call the library
# Read Data
mydata<-read.table(file = "C:/Users/toledo/Dropbox/UNIPD/Biostatistics Curse  R Spring 2018/curso STAT PhD 201
                     sep = "\t",header = TRUE,stringsAsFactors = TRUE)
mydata$Boar<-as.factor(mydata$Boar) # Set the variable as factor
str(mydata)                         # See the structure of my data
```

```
## 'data.frame':    20 obs. of  4 variables:
##  $ Boar     : Factor w/ 5 levels "1","2","3","4",..: 1 1 1 1 2 2 2 2 3 3 ...
##  $ Sow      : Factor w/ 10 levels "A","B","C","D",..: 1 1 2 2 3 3 4 4 5 5 ...
##  $ Replicate: int  1 2 1 2 1 2 1 2 1 2 ...
##  $ ADG      : num  2.77 2.38 2.58 2.94 2.28 2.22 3.01 2.61 2.36 2.71 ...
```

```
contrasts(mydata$Boar)<-contr.SAS   # Set the contrast as SAS
contrasts(mydata$Sow)<-contr.SAS    # Set the contrast as SAS
table(mydata$Sow,mydata$Boar)       # Frequencies for factors
```

```
##
##     1 2 3 4 5
##   A 2 0 0 0 0
##   B 2 0 0 0 0
##   C 0 2 0 0 0
##   D 0 2 0 0 0
##   E 0 0 2 0 0
##   F 0 0 2 0 0
##   G 0 0 0 2 0
##   H 0 0 0 2 0
##   I 0 0 0 0 2
##   L 0 0 0 0 2
```

```
mymodel<-lm(ADG ~ Boar + Sow%in%Boar, data = mydata )     # Fit the model with Nesting
summary(mymodel)                    # See the results
```

```
##
## Call:
## lm(formula = ADG ~ Boar + Sow %in% Boar, data = mydata)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.2050 -0.1113  0.0000  0.1113  0.2050
##
## Coefficients: (40 not defined because of singularities)
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.4900     0.1391  17.900 6.33e-09 ***
## Boar1         0.2700     0.1967   1.372   0.1999
## Boar2         0.3200     0.1967   1.627   0.1349
## Boar3         0.2400     0.1967   1.220   0.2505
## Boar4        -0.2150     0.1967  -1.093   0.3001
## Boar1:Sow1   -0.1850     0.1967  -0.940   0.3692
## Boar2:Sow1        NA         NA      NA       NA
## Boar3:Sow1        NA         NA      NA       NA
## Boar4:Sow1        NA         NA      NA       NA
```

```
## Boar5:Sow1        NA         NA      NA       NA
## Boar1:Sow2        NA         NA      NA       NA
## Boar2:Sow2        NA         NA      NA       NA
## Boar3:Sow2        NA         NA      NA       NA
## Boar4:Sow2        NA         NA      NA       NA
## Boar5:Sow2        NA         NA      NA       NA
## Boar1:Sow3        NA         NA      NA       NA
## Boar2:Sow3   -0.5600     0.1967  -2.847   0.0173 *
## Boar3:Sow3        NA         NA      NA       NA
## Boar4:Sow3        NA         NA      NA       NA
## Boar5:Sow3        NA         NA      NA       NA
## Boar1:Sow4        NA         NA      NA       NA
## Boar2:Sow4        NA         NA      NA       NA
## Boar3:Sow4        NA         NA      NA       NA
## Boar4:Sow4        NA         NA      NA       NA
## Boar5:Sow4        NA         NA      NA       NA
## Boar1:Sow5        NA         NA      NA       NA
## Boar2:Sow5        NA         NA      NA       NA
## Boar3:Sow5   -0.1950     0.1967  -0.991   0.3449
## Boar4:Sow5        NA         NA      NA       NA
## Boar5:Sow5        NA         NA      NA       NA
## Boar1:Sow6        NA         NA      NA       NA
## Boar2:Sow6        NA         NA      NA       NA
## Boar3:Sow6        NA         NA      NA       NA
## Boar4:Sow6        NA         NA      NA       NA
## Boar5:Sow6        NA         NA      NA       NA
## Boar1:Sow7        NA         NA      NA       NA
## Boar2:Sow7        NA         NA      NA       NA
## Boar3:Sow7        NA         NA      NA       NA
## Boar4:Sow7    0.3900     0.1967   1.982   0.0756 .
## Boar5:Sow7        NA         NA      NA       NA
## Boar1:Sow8        NA         NA      NA       NA
## Boar2:Sow8        NA         NA      NA       NA
## Boar3:Sow8        NA         NA      NA       NA
## Boar4:Sow8        NA         NA      NA       NA
## Boar5:Sow8        NA         NA      NA       NA
## Boar1:Sow9        NA         NA      NA       NA
## Boar2:Sow9        NA         NA      NA       NA
## Boar3:Sow9        NA         NA      NA       NA
## Boar4:Sow9        NA         NA      NA       NA
## Boar5:Sow9    0.1600     0.1967   0.813   0.4350
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1967 on 10 degrees of freedom
## Multiple R-squared:  0.6315, Adjusted R-squared:  0.2999
## F-statistic: 1.904 on 9 and 10 DF,  p-value: 0.1649
```

```
anova(mymodel)                    # ANOVA table SS type III
```

```
## Analysis of Variance Table
##
## Response: ADG
##           Df  Sum Sq  Mean Sq F value  Pr(>F)
## Boar       4 0.09973 0.024932  0.6443 0.64332
## Boar:Sow   5 0.56355 0.112710  2.9124 0.07067 .
## Residuals 10 0.38700 0.038700
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#ref.grid(mymodel)
lsmeans(mymodel,"Boar")             # LSM for factor
```

```
##  Boar lsmean         SE df lower.CL upper.CL
##  1    2.6675 0.09836158 10 2.448337 2.886663
##  2    2.5300 0.09836158 10 2.310837 2.749163
##  3    2.6325 0.09836158 10 2.413337 2.851663
##  4    2.4700 0.09836158 10 2.250837 2.689163
##  5    2.5700 0.09836158 10 2.350837 2.789163
##
## Results are averaged over the levels of: Sow
## Confidence level used: 0.95
```

```r
lsmeans(mymodel,"Sow")              # LSM for factor
```

```
##  Sow Boar lsmean        SE df lower.CL upper.CL
##  A   1     2.575 0.1391043 10 2.265056 2.884944
##  B   1     2.760 0.1391043 10 2.450056 3.069944
##  C   2     2.250 0.1391043 10 1.940056 2.559944
##  D   2     2.810 0.1391043 10 2.500056 3.119944
##  E   3     2.535 0.1391043 10 2.225056 2.844944
##  F   3     2.730 0.1391043 10 2.420056 3.039944
##  G   4     2.665 0.1391043 10 2.355056 2.974944
##  H   4     2.275 0.1391043 10 1.965056 2.584944
##  I   5     2.650 0.1391043 10 2.340056 2.959944
##  L   5     2.490 0.1391043 10 2.180056 2.799944
##
## Confidence level used: 0.95
```

```r
mymodel.1<-aov(ADG ~ Boar + Error(Sow), data = mydata)    # Set the factor as an error term
summary(mymodel.1)                  # See the results
```

```
##
## Error: Sow
##           Df Sum Sq Mean Sq F value Pr(>F)
## Boar       4 0.0997 0.02493   0.221  0.916
## Residuals  5 0.5636 0.11271
##
## Error: Within
##           Df Sum Sq Mean Sq F value Pr(>F)
## Residuals 10  0.387  0.0387
```

```r
#### Random Model

mymodel.3<-lmer(ADG ~ Boar + (1|Sow), data = mydata ) # Fit a model with Random effect
summary(mymodel.3)                  # See the results
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: ADG ~ Boar + (1 | Sow)
##    Data: mydata
##
## REML criterion at convergence: 6.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.1527 -0.5563 -0.1764  0.6277  1.5054
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  Sow      (Intercept) 0.03701  0.1924
##  Residual             0.03870  0.1967
## Number of obs: 20, groups:  Sow, 10
```

```
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)   2.5700     0.1679  15.310
## Boar1         0.0975     0.2374   0.411
## Boar2        -0.0400     0.2374  -0.168
## Boar3         0.0625     0.2374   0.263
## Boar4        -0.1000     0.2374  -0.421
##
## Correlation of Fixed Effects:
##       (Intr) Boar1  Boar2  Boar3
## Boar1 -0.707
## Boar2 -0.707  0.500
## Boar3 -0.707  0.500  0.500
## Boar4 -0.707  0.500  0.500  0.500
```

```
Anova(mymodel.3,type = 3,test.statistic = "F") # Anova table SS Type III
```

```
## Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
##
## Response: ADG
##                     F Df Df.res    Pr(>F)
## (Intercept) 234.4033  1      5 2.156e-05 ***
## Boar          0.2212  4      5    0.9155
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
lsmeans(mymodel.3,"Boar")           # LSM for factor
```

```
##  Boar lsmean        SE df lower.CL upper.CL
##  1    2.6675 0.1678616  5 2.235998 3.099002
##  2    2.5300 0.1678616  5 2.098498 2.961502
##  3    2.6325 0.1678616  5 2.200998 3.064002
##  4    2.4700 0.1678616  5 2.038498 2.901502
##  5    2.5700 0.1678616  5 2.138498 3.001502
##
## Degrees-of-freedom method: satterthwaite
## Confidence level used: 0.95
```

Second Example

```
#### Second Example ####

#rm(list = ls())      # Clean the workspace
library(lsmeans)     # Call the library
library(lme4)
# Read Data
mydata<-read.table(file = "../Dropbox/UNIPD/Biostatistics Curse  R Spring 2018/curso STAT PhD 2018 ExpDesign/d
                   sep = "\t",header = TRUE,stringsAsFactors = TRUE)
mydata$Boar<-as.factor(mydata$Boar) # Set the variable as factor
str(mydata)                         # See the structure of my data
contrasts(mydata$Boar)<-contr.SAS   # Set the contrast as SAS
contrasts(mydata$Sow)<-contr.SAS    # Set the contrast as SAS
table(mydata$Sow,mydata$Boar)       # Frequencies for factors

#### Random Model in a for loop
# To store the results directly in a file use:
sink("../Dropbox/UNIPD/Biostatistics Curse  R Spring 2018/curso STAT PhD 2018 ExpDesign/data/results.txt",
     append = FALSE)
# For loop to do the analysis for several variables
for (i in 4:5){    # For the 4 and 5 column
   y <- mydata[,i] # Select the column i
   print(paste0("Results for ",colnames(mydata)[i]))  # Print the number of the variable
   print("########################################")    #
   mymodel<-lmer(y ~ mydata$Boar + (1|mydata$Sow))    # Fit the random model
   print(summary(mymodel))                            # See the results
   print(Anova(mymodel,type = 3,test.statistic = "F"))# Anova table SS type III
   print(lsmeans(mymodel,"mydata$Boar"))              # LSM for factor
   print("########################################")

}
sink() # Return the result to the R console
```