Example #1: using the data in HO#30, originally from Kirk, p. 353

```r
> your.data=read.table(pipe("pbpaste"),header=T)
> your.data
subject B A  Y
 1   1 1 1 7
 2   1 2 2 14
 3   1 3 3 12
 4   2 1 1 3
 5   2 3 2 11
 6   2 2 3 5
 7   3 2 1 7
 8   3 3 2 11
 9   3 1 3 6
10  4 3 1 9
11  4 1 2 12
12  4 2 3 13
13  5 2 1 9
14  5 1 2 7
15  5 3 3 8
16  6 3 1 9
17  6 2 2 13
18  6 1 3 8
> attach(your.data)
> A=factor(A)
> B=factor(B)
> subj=factor(subject)
> model1=aov(Y~A+B+subj)
> summary(model1,intercept=T)

Df Sum Sq Mean Sq  F value    Pr(>F)
(Intercept)  1 1494.22 1494.22 773.9856 3.008e-09 ***
A            2   49.78   24.89  12.8921  0.003144 **
B            2   34.11   17.06   8.8345  0.009435 **
subj         5   58.44   11.69   6.0547  0.013098 *
Residuals    8   15.44    1.93
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

>
Note: we should ignore the test of ‘subj’

Find group means and so forth, can use ‘tapply’ or ‘model.tables’

```
> B.means=tapply(Y,B,mean)
> B.means
1    2    3
7.166667 10.166667 10.000000

> model.tables(model1,"means",se=T)
Tables of means
Grand mean
9.111111

A
A
1   2   3
7.333 11.333  8.667

B
B
1   2   3
7.167 10.167 10.000

subj
subj
1   2   3   4   5   6
11.000  6.333  8.000 11.333  8.000 10.000

Standard errors for differences of means
   A    B    subj
0.8022 0.8022 1.1345
replic.       6    6    3

Now do the analysis *incorrectly*, ignoring factor B, and analyzing only
factor A, as a one-way within.
> model2=aoV(Y~A+Error(subj)) # can use ‘aoV’, but it doesn’t give us the Huynh-
Feldt adjusted p’s for sphericity violations. See below for that
> summary(model2,intercept=T)

Error: subj
            Df Sum Sq Mean Sq F value Pr(>F)
Residuals    5 58.444 11.689

Error: Within
            Df Sum Sq Mean Sq F value Pr(>F)
A            2 49.778 24.889  5.0224 0.0309 *
Residuals 10 49.556  4.956
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

>
Note that the Error for A is SS-B + SS-Residual from the correct Latin Square analysis above.

Example #2: Data are from Maxwell & Delaney, p. 541

```
> your.data=read.table(pipe("pbpaste"),header=T)
> your.data
  subject Treatment Time  Y
  1        1         2    1  9
  2        1         3    2  3
  3        1         1    3  6
  4        2         1    1 18
  5        2         2    2  6
  6        2         3    3 12
  7        3         3    1 12
  8        3         1    2 15
  9        3         2    3  5
10       4         3    1 14
11       4         1    2 11
12       4         2    3  8
13       5         1    1 17
14       5         2    2  9
15       5         3    3  9
16       6         2    1  7
17       6         3    2  7
18       6         1    3  7
> attach(your.data)
> A=factor(Treatment)
> time=factor(Time)
> subj=factor(subject)
> model1=aov(Y~A+time+subj)
> summary(model1,intercept=T)

Df  Sum Sq Mean Sq  F value    Pr(>F)
(Intercept)  1 1701.39 1701.39 345.0704 7.274e-08 ***
A            2   75.44   37.72   7.6507   0.01389 *
time         2   88.44   44.22   8.9690   0.00905 **
subj         5   98.28   19.66   3.9865   0.04115 *
Residuals    8   39.44    4.93
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Next I show the INCORRECT repeated measures anova that does NOT take order into account. I rearranged the data in the excel sheet rather than doing it in R. Notice the advantage of
removing the effect of ‘time’ from the SSError. The SSError for A below is SStime + SSresiduals in the correct analysis. This time I carry it out with Anova (capital ‘A’) in the ‘car’ package.

> library(car)  # set up for repeated measures
> options(contrasts=c("contr.sum","contr.poly"))
> your.data=read.table(pipe("pbpaste"),header=T)
> your.data
    subj   A1   A2   A3
  1     1   6   9   3
  2     2  18   6  12
  3     3  15   5  12
  4     4  11   8  14
  5     5  17   9   9
  6     6   7   7   7
> attach(your.data)
> multmod1=lm(cbind(A1,A2,A3)~1)  # model the intercept first
> Trials=factor(c("A1","A2","A3"),ordered=F)
> Trials
[1] A1 A2 A3
Levels: A1 A2 A3
> model1=Anova(multmod1,idata=data.frame(Trials),idesign=~Trials,type="III")
> summary(model1,multivariate=F)

Univariate Type III Repeated-Measures ANOVA Assuming Sphericity

                      SS num Df Error SS den Df       F    Pr(>F)
(Intercept)     1701.39      1    98.28      5 86.5602 0.0002414 ***
Trials          75.44      2  127.89     10  2.9496 0.0984286 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Mauchly Tests for Sphericity

    Test statistic  p-value
Trials            0.80753  0.65210

Greenhouse-Geisser and Huynh-Feldt Corrections
for Departure from Sphericity

    GG  eps  Pr(>F[GG])
Trials  0.83859  0.1119

    HF  eps  Pr(>F[HF])
Trials  1.2133  0.09843 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Warning message:
In summary.Anova.mlm(model1, multivariate = F) : HF eps > 1 treated as 1