The MANOVA for Independent Groups -- Analysis of k-Between Group Data with Two or More Qualtitative DVs

Application: To compare means of two or more quantitative variables obtained from 2 or more independent groups.

Research Hypothesis: In a previous study the researcher hypothesized and found that students who has eaten food that included additives would exhibit greater activity both at school and at home. In this follow-up study, the researcher has added an IV condition that involves eating foods with a second type of additives and has also added a DV -- activity level in public. It is the researcher's hypothesis that those who have taken Type 2 additives and Type 1 additives will have the same level of school activity, and that both of these will be greater than those who have not taken any additives. For activity at home, it is expected that Type 2 additives will lead to the most activity, no additives to the least, and Type 1 additives will produce an intermediate level of activity, Finally, for public activity, it is expected that those who have taken Type 1 additives will have a higher activity level than either those who have taken Type 2 additives or those who have taken none.

SPSS Code -- Step 1   Multivariate Analysis

```
data list free /   cond    schlact    homeact  pubact.

variable labels   schlact 'activity level at school - DV'
                / homeact 'activity level at school - DV'
                / pubact  'activity level in public - DV'
                / cond     'treatment condition  - IV'.

value labels     cond 1 'no additives'  2 'Type 1 additives'
                      3 'Type 2 additives'.

begin data.
1 30 42 26    2 30 44 28    3 29 54 31
1 31 38 24    2 28 45 31    3 34 49 31
1 25 32 23    2 36 42 26    3 27 52 29
1 26 36 27    2 41 52 22    3 37 54 33
1 24 29 29    2 29 38 31    3 32 48 29
1 30 34 25    2 32 41 25    3 40 46 28
1 31 38 26    2 27 37 28    3 30 41 32
1 26 34 21    2 35 51 32    3 29 43 40
1 28 41 29    2 36 53 27    3 38 55 30
end data.

manova schlact homeact pubact by cond (1,3)
       /print cellinfo(means) signif(multiv).
```

Research Hypotheses:

DV = School activity:

none vs. Type 1	none vs. Type 2	Type 1 vs. Type2
<	**<**	**=**

DV = Activity at Home:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

DV = Public Activity

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

Output:

```
 EFFECT .. COND
 Multivariate Tests of Significance (S = 2, M = 0, N = 10 )

 Test Name          Value    Approx. F Hypoth. DF    Error DF   Sig. of F
 Pillais           .76223     4.72118       6.00       46.00        .001
 Hotellings       2.42054     8.47190       6.00       42.00        .000
 Wilks             .28000     6.52525       6.00       44.00        .000
 Roys              .70207
```

There is a multivariate effect -- some combination of the DVs produces a mean difference smong the three IV conditions.

Step 2 Obtain an ANOVA with pairwise follow-ups for each DV.

```
oneway schlact by cond (1,3) / ranges = lsd / ranges   = tukey.
```

```
         Variable   SCHLACT      activity level at school - DV
       By Variable  COND         treatment condition  - IV

                              Analysis of Variance

                     Sum of           Mean         F        F
          Source   D.F.   Squares        Squares     Ratio    Prob.
Between Groups    2      143.6296        71.8148    4.3113   .0251
Within Groups    24      399.7778        16.6574
Total            26      543.4074
```

```
LSD  Procedure


                          G G G
                          r r r
                          p p p
       Mean      Group    1 2 3

      27.8889    Grp 1
      32.6667    Grp 2      *
      32.8889    Grp 3      *


Tukey-HSD  Procedure

                          G G G
                          r r r
                          p p p
       Mean      Group    1 2 3

      27.8889    Grp 1
      32.6667    Grp 2
      32.8889    Grp 3      *
```

There is an effect for school activity.

The hypothesized pattern for School activity:

none vs. Type 1	none vs. Type 2	Type 1 vs. Type2
<	<	=

The LSD results show:

none vs. Type 1	none vs. Type 2	Type 1 vs. Type2
<	<	=

The HSD results show:

none vs. Type 1	none vs. Type 2	Type 1 vs. Type2
<	=	=

Reporting the Results (so far)

The activity levels of the students are summarized in Table 1. There was a multivariate difference among the treatment conditions (Wilks = .280, F(6,44) = 6.53, p < .001). There was a difference in mean levels of school activity among the conditions (F(2,24) = 4.31, p = .0251, MSe = 16.66). Pairwise follow-ups using LSD revealed that as hypothesized those had additives exhibited higher levels of activity than those who had not, but that there was not mean difference between the two types of additives. However, results using the more conservative HSD revealed that there was no mean difference between those to took Type 1 additives and those who took no additives.

```
oneway homeact by cond (1,3) / ranges = lsd / ranges  = tukey.


                    Analysis of Variance

                   Sum of        Mean        F      F
          Source  D.F.   Squares      Squares    Ratio  Prob.
Between Groups   2     803.1852     401.5926  15.1916  .0001
Within Groups   24     634.4444      26.4352
Total           26    1437.6296


LSD  Procedure
                        G G G
                        r r r
                        p p p
      Mean       Group  1 2 3

      36.0000    Grp 1
      44.7778    Grp 2      *
      49.1111    Grp 3      *

Tukey-HSD  Procedure
                        G G G
                        r r r
                        p p p
      Mean       Group  1 2 3

      36.0000    Grp 1
      44.7778    Grp 2      *
      49.1111    Grp 3      *


        Write it up:
```

The hypothesized pattern for Home activity:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

The LSD results show:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

The HSD results show:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

Support for the RH was: complete   partial   none

```
oneway pubact by cond (1,3) / ranges = lsd / ranges  = tukey.


                        Analysis of Variance

                    Sum of        Mean        F      F
        Source    D.F.  Squares      Squares    Ratio  Prob.
Between Groups     2    159.1852     79.5926   7.8935  .0023
Within Groups     24    242.0000     10.0833
Total             26    401.1852


LSD  Procedure
                       G G G
                       r r r
                       p p p
     Mean       Group  1 2 3

    25.5556     Grp 1
    27.7778     Grp 2
    31.4444     Grp 3   * *


Tukey-HSD  Procedure
                       G G G
                       r r r
                       p p p
     Mean       Group  1 2 3

    25.5556     Grp 1
    27.7778     Grp 2
    31.4444     Grp 3   *
```

The hypothesized pattern for Public activity:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

The LSD results show:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

The HSD results show:

none vs. Type 1   none vs. Type 2   Type 1 vs. Type2

Support for the RH was: complete   partial   none

        Write it up: