

# Answers to additional health exercises

## Chapter 21 MANOVA

Conduct a one-way MANOVA to see if there are gender differences in each of the individual items that make up the Sleepiness and Associated Sensations Scale. The variables that you will need as dependent variables are *fatigued*, *lethargic*, *tired*, *sleepy*, *energy*.

Between-Subjects Factors

|          | Value Label | N   |
|----------|-------------|-----|
| gender 0 | female      | 144 |
| 1        | male        | 107 |

Descriptive Statistics

|             | gender | Mean | Std. Deviation | N   |
|-------------|--------|------|----------------|-----|
| fatigued    | female | 5.30 | 2.444          | 144 |
|             | male   | 4.32 | 2.213          | 107 |
|             | Total  | 4.88 | 2.394          | 251 |
| lethargic   | female | 5.00 | 2.486          | 144 |
|             | male   | 4.38 | 2.153          | 107 |
|             | Total  | 4.74 | 2.365          | 251 |
| tired       | female | 5.66 | 2.333          | 144 |
|             | male   | 4.79 | 2.290          | 107 |
|             | Total  | 5.29 | 2.351          | 251 |
| sleepy      | female | 5.89 | 2.210          | 144 |
|             | male   | 5.21 | 2.198          | 107 |
|             | Total  | 5.60 | 2.225          | 251 |
| lack energy | female | 5.99 | 2.387          | 144 |
|             | male   | 4.93 | 2.171          | 107 |
|             | Total  | 5.54 | 2.353          | 251 |

Box's Test of Equality of Covariance Matrices<sup>a</sup>

|         |            |
|---------|------------|
| Box's M | 33.480     |
| F       | 2.183      |
| df1     | 15         |
| df2     | 208687.683 |
| Sig.    | .005       |

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

<sup>a</sup>. Design: Intercept+gender

**Multivariate Tests<sup>b</sup>**

| Effect    |                    | Value | F                    | Hypothesis df | Error df | Sig. | Partial Eta Squared |
|-----------|--------------------|-------|----------------------|---------------|----------|------|---------------------|
| Intercept | Pillai's Trace     | .875  | 343.069 <sup>a</sup> | 5.000         | 245.000  | .000 | .875                |
|           | Wilks' Lambda      | .125  | 343.069 <sup>a</sup> | 5.000         | 245.000  | .000 | .875                |
|           | Hotelling's Trace  | 7.001 | 343.069 <sup>a</sup> | 5.000         | 245.000  | .000 | .875                |
|           | Roy's Largest Root | 7.001 | 343.069 <sup>a</sup> | 5.000         | 245.000  | .000 | .875                |
| gender    | Pillai's Trace     | .068  | 3.566 <sup>a</sup>   | 5.000         | 245.000  | .004 | .068                |
|           | Wilks' Lambda      | .932  | 3.566 <sup>a</sup>   | 5.000         | 245.000  | .004 | .068                |
|           | Hotelling's Trace  | .073  | 3.566 <sup>a</sup>   | 5.000         | 245.000  | .004 | .068                |
|           | Roy's Largest Root | .073  | 3.566 <sup>a</sup>   | 5.000         | 245.000  | .004 | .068                |

a. Exact statistic

b. Design: Intercept+gender

**Levene's Test of Equality of Error Variances<sup>a</sup>**

|             | F     | df1 | df2 | Sig. |
|-------------|-------|-----|-----|------|
| fatigued    | 1.697 | 1   | 249 | .194 |
| lethargic   | 3.238 | 1   | 249 | .073 |
| tired       | .157  | 1   | 249 | .692 |
| sleepy      | .410  | 1   | 249 | .522 |
| lack energy | 1.451 | 1   | 249 | .229 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+gender

Tests of Between-Subjects Effects

| Source          | Dependent Variable | Type III Sum of Squares | df  | Mean Square | F        | Sig. | Partial Eta Squared |
|-----------------|--------------------|-------------------------|-----|-------------|----------|------|---------------------|
| Corrected Model | fatigued           | 59.058 <sup>a</sup>     | 1   | 59.058      | 10.708   | .001 | .041                |
|                 | lethargic          | 23.356 <sup>b</sup>     | 1   | 23.356      | 4.229    | .041 | .017                |
|                 | tired              | 46.964 <sup>c</sup>     | 1   | 46.964      | 8.764    | .003 | .034                |
|                 | sleepy             | 27.881 <sup>d</sup>     | 1   | 27.881      | 5.736    | .017 | .023                |
|                 | lack energy        | 69.996 <sup>e</sup>     | 1   | 69.996      | 13.260   | .000 | .051                |
| Intercept       | fatigued           | 5676.684                | 1   | 5676.684    | 1029.226 | .000 | .805                |
|                 | lethargic          | 5404.710                | 1   | 5404.710    | 978.538  | .000 | .797                |
|                 | tired              | 6696.845                | 1   | 6696.845    | 1249.652 | .000 | .834                |
|                 | sleepy             | 7568.662                | 1   | 7568.662    | 1557.160 | .000 | .862                |
|                 | lack energy        | 7317.820                | 1   | 7317.820    | 1386.294 | .000 | .848                |
| gender          | fatigued           | 59.058                  | 1   | 59.058      | 10.708   | .001 | .041                |
|                 | lethargic          | 23.356                  | 1   | 23.356      | 4.229    | .041 | .017                |
|                 | tired              | 46.964                  | 1   | 46.964      | 8.764    | .003 | .034                |
|                 | sleepy             | 27.881                  | 1   | 27.881      | 5.736    | .017 | .023                |
|                 | lack energy        | 69.996                  | 1   | 69.996      | 13.260   | .000 | .051                |
| Error           | fatigued           | 1373.356                | 249 | 5.515       |          |      |                     |
|                 | lethargic          | 1375.290                | 249 | 5.523       |          |      |                     |
|                 | tired              | 1334.382                | 249 | 5.359       |          |      |                     |
|                 | sleepy             | 1210.278                | 249 | 4.861       |          |      |                     |
|                 | lack energy        | 1314.395                | 249 | 5.279       |          |      |                     |
| Total           | fatigued           | 7411.000                | 251 |             |          |      |                     |
|                 | lethargic          | 7031.000                | 251 |             |          |      |                     |
|                 | tired              | 8397.000                | 251 |             |          |      |                     |
|                 | sleepy             | 9114.000                | 251 |             |          |      |                     |
|                 | lack energy        | 9082.000                | 251 |             |          |      |                     |
| Corrected Total | fatigued           | 1432.414                | 250 |             |          |      |                     |
|                 | lethargic          | 1398.645                | 250 |             |          |      |                     |
|                 | tired              | 1381.347                | 250 |             |          |      |                     |
|                 | sleepy             | 1238.159                | 250 |             |          |      |                     |
|                 | lack energy        | 1384.390                | 250 |             |          |      |                     |

a. R Squared = .041 (Adjusted R Squared = .037)

b. R Squared = .017 (Adjusted R Squared = .013)

c. R Squared = .034 (Adjusted R Squared = .030)

d. R Squared = .023 (Adjusted R Squared = .019)

e. R Squared = .051 (Adjusted R Squared = .047)

*The results presented in the table 'Box's Test of Equality of Covariance Matrices' indicate that we have not violated the assumption of homogeneity of variance-covariance matrices (we use  $p < .001$  as the cut off because of the sensitivity of this test). The value in the table is  $p = .005$  which is not less than the cut off of  $p = .001$ .*

*The Multivariate Tests table shows that there is a significant difference overall between the sexes on the set of dependent variables representing sensations of sleepiness (Wilks Lambda = .932;  $F(5, 245) = 3.57$ ,  $p = .004$ , partial eta squared = .068).*

*Given that we have a significant result overall we can now look at the results for each of the dependent variables separately. The Tests of Between Subjects Effect table indicate that the significance value for all dependent variables are below  $p = .05$ .*

*However if we apply the Bonferroni adjustment to control for Type 1 errors we need to divide the original  $p$  value of .05 by the number of dependent variables (5). This gives us a new  $p$  value of .01 to use as the cut off value. The only dependent variables with a significance value of less than .01 are fatigued, tired, and lacking energy.*

*Comparison of the mean scores for each of the significant dependent variables suggests that females have higher scores than males (eg., fatigued: females  $M=5.30$ ,  $SD=2.44$ ; males  $M=4.32$ ,  $SD=2.2$ ).*