

## EXERCISE 13

## One-factor within subjects (repeated measures) ANOVA

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### Before you start

Before proceeding with this Exercise, we suggest that you study Chapter 9.

### A comparison of the efficacy of statistical packages

Table 1 shows the results of an experiment in which the dependent variable was the time taken for ten participants to perform a statistical analysis using three statistical computer packages Pack1, Pack2 and Pack3. During the course of the experiment, each participant used every package and the order of use was counterbalanced across participants. Did the packages differ in their efficacy?

Table 1. Times taken by participants to carry out an analysis with different computing packages							
Case	Pack1	Pack2	Pack3	Case	Pack1	Pack2	Pack3
1	12	15	18	6	10	12	14
2	18	21	19	7	18	17	21
3	15	16	15	8	18	17	21
4	21	26	32	9	23	27	30
5	19	23	22	10	17	25	21

### Opening SPSS

Open SPSS and select the **Type in data** radio button in the opening window. If **Data View** appears first, click the **Variable View** tab to open **Variable View**.

### Preparing the SPSS data set

Prepare the SPSS data set as described in Section 9.2.1. Since there is just one group of participants, there is no grouping variable. Add suitable variable labels in the **Label** column such as Case Number, Package 1, Package 2, Package 3. Remember to save the data set as a data file with a suitable filename.

## Exploring the data

Use the methods described in Section 9.2.2 to check for any distribution problems. Remember that outliers represented by O are not as problematic as extreme values represented by \*.

## Procedure for the within subjects (repeated measures) ANOVA

The within subjects ANOVA (SPSS refers to it as Repeated Measures) is selected by choosing **Analyze** → **General Linear Model** → **Repeated Measures...** to open the **Repeated Measures Define Factor(s)** dialog box. Follow the procedure described in Section 9.2.3, naming the **Within-subject Factor Name** as *Package* and the **Measure Name** as *Time*. Name the **Measure Name** as *Time*. Remember to click **Plots...** and complete the **Repeated Measures: Profile Plots** dialog box by transferring *Package* to the **Horizontal Axis:** box, clicking **Add** and then **Continue** to return to the original dialog box. Remember, too, to select **Options...** and click **Bonferroni** as the measure for comparisons and to click the check boxes for **Descriptive statistics** and for **Estimates of effect size**.

## Output for the within subjects (repeated measures) ANOVA

When answering the bullet point relating to effect size, use the following ranges of partial eta-squared ( $\eta_p^2$ ) for deciding whether its value is Small, Medium or Large: Small:  $.01 \leq \eta_p^2 < .06$ ; Medium:  $.06 \leq \eta_p^2 < .14$ ; Large:  $\eta_p^2 \geq .14$ . Note that these are the ranges of values given for omega squared in Table 5 on page 236. While omega squared corrects for positive bias, there are problems with that statistic in experiments of mixed factorial design and we must use eta squared as an equivalent measure of effect size.

Section 9.2.4 offers some guidelines for the interpretation of the output. First, there is a **Table of Within-Subjects Factors**, which lists the levels of the *Package* factor. Then there is a table of **Multivariate Tests**, which can be deleted by clicking its icon in the left-hand pane of the **SPSS Viewer** and pressing the **Delete** key. Next comes **Mauchly's Test of Sphericity**. Check that the result does not show significance. If not, you need only read the row labelled **Sphericity Assumed** in the **Table of Within-Subjects Effects** below, in which case you should delete the other rows by double-clicking anywhere in the table, highlighting the material to be deleted and pressing the **Delete** key. The remaining two tables can be ignored.

- **What is the value of the *F* ratio and its associated p-value (tail probability) for the *Package* factor? Is *F* significant? What are the implications for the experimental hypothesis?**
- **Edit the Tests of Within-Subjects Effects table to remove the extra rows of statistics which are not needed in the light of the Mauchly test result.**
- **What is the value of Partial Eta Squared? Is this a small, medium or large effect?**

Inspect the **Profile Plots** showing the means of the three packages.

- **Is the appearance of the plot consistent with the finding from the ANOVA that there is a significant main effect?**

Finally with reference to Section 9.2.4, inspect the **Pairwise Comparisons** table to ascertain which pairs of statistical packages are significantly different.

- **List which packages differ significantly.**

## **Finishing the session**

Close down SPSS and any other windows before logging out of the computer.