Practical "Analysis of numerical data"
P4

1. Dataset *azt.sav* contains data on the response of serum antigen level to AZT in 20 AIDS patients (Makutch and Parks, 1988).

   (a) We are interested in the difference between pre- and post-treatment serum antigen levels. Create a variable with the difference postazt-preazt. Do an exploratory analysis of this variable. How could we test whether there is a difference between mean pre-treatment and post-treatment antigen levels? Are the samples independent or paired? Why? What assumptions are required? Are these satisfied?

   (b) Run the Wilcoxon signed-rank test. What is the hypothesis being tested? Interpret the results. If you run a sign test instead, what would you conclude? Compare results from both tests. NOTE: If you go to *Analyze* $\rightarrow$ *Nonparametric tests* $\rightarrow$ *Related Samples*, select the two samples to compare within *Fields*, and in *Settings* click on the *Sign test (2 samples)* and the *Wilcoxon matched-pair signed-rank (2 samples)* checkboxes. For small samples sizes, exact p-values, instead of asymptotic ones, are also displayed if you go to *Analyze* $\rightarrow$ *Nonparametric tests* $\rightarrow$ *Legacy dialogs* $\rightarrow$ *2 Related Samples* and click on the *Exact* button to select the *Exact* option.

2. Dataset *bp.sav* contains data on diastolic blood pressure (mm Hg) measured in 4 treated subjects and 11 controls.

   (a) We wish to test whether there are differences in diastolic blood pressure (mm Hg) between treatment and control groups. Are these samples paired or independent? Explore the data. Would you run a parametric or a nonparametric test? What are your null and alternative hypotheses?

   (b) Run the test you considered most appropriate. What is your conclusion? NOTE (in case you run a nonparametric test): If you go to *Analyze* $\rightarrow$ *Nonparametric tests* $\rightarrow$ *Independent Samples* the output will only show the asymptotic p-values. Since we have small samples sizes, obtain the exact p-values. For this, as in the paired samples example, go to *Analyze* $\rightarrow$ *Nonparametric tests* $\rightarrow$ *Legacy dialogs* $\rightarrow$ *2 Independent samples*. You have to define the groups being tested with their numerical values. Click on *Exact* and select the *Exact* option.

3. Dataset *pudendal.sav* contains data on pudendal nerve terminal motor latency (ms) before and after hyperbaric oxygen therapy (Bland and Altman, 2009). Is the pre-therapy pudendal nerve terminal motor latency different from the post-therapy one? Compare results using a parametric and a nonparametric test.

4. Dataset *antibody.sav* contains the concentration of antibody (μg/ml) to type II group B Streptococcus in 20 volunteers before and after immunization (Bland and Altman 2009).

   (a) Do the antibody concentrations differ before and after immunization? Create variable after-before and do an exploratory analysis. By looking at this, would you say the difference is normally distributed? Why? If deemed appropriate, run the corresponding parametric test.

   (b) Would a Wilcoxon signed rank test be appropriate? Why? If deemed appropriate, run the test.

(c) And a sign test? Would it be appropriate? Why? Compare results from the paired-samples t-test, the Wilcoxon signed ranks test and the sign test, even when not applicable. Would choosing a wrong test have led to a different conclusion?

5. Dataset *galactose.sav* contains measurements of galactose binding for three independent groups of patients.

(a) Use an ANOVA to test whether the mean galactose binding is the same in the three patient groups. What is your conclusion? NOTE: Go to *Analyze* $\rightarrow$ *Compare means* $\rightarrow$ *One-way ANOVA*. In *Options*, click on the checkbox for the *Homogeneity of variance test* and a *Means plot*.

(b) Since we have rejected that the populations of patients have the same mean, we can proceed to examine pairs of groups. We are only interested in the differences between each patient group and the control group, not between patients. What post hoc test would be more adequate? Look at results for Bonferroni, LSD, Tuckey HSD, Scheffe or Dunnett t (Click on their checkboxes within the *Post Hoc* window within the ANOVA). What do you observe? Is there enough evidence to reject that the population means for Crohn disease and control are the same? And for ulcerative colitis and control? If strong evidence is found for one of these comparisons, run a two independent samples t-test between the two and compare results.

(c) Explain the results of the corresponding nonparametric test.
NOTE: Go to *Analyze* $\rightarrow$ *Nonparametric tests* $\rightarrow$ *Legacy dialogs* $\rightarrow$ *K Independent samples.*

6. Dataset *btgdiabet.sav* contains data on urinary β-thromboglobulin (beta-TG) excretion in 12 normal subjects and in 12 diabetic patients (Kirkwood 2003).

(a) What parametric test would be appropriate to compare the mean β-TG of the two groups? Are the assumptions for this test satisfied?

(b) Would a transformation of the data help to meet the assumptions? Transform the data and check whether this helps.

(c) With the transformed data, use an independent samples t-test to compare the two groups. How would you interpret the results? Note that the data have been transformed.