Question 1:

A group of 12 first year and 12 second year master’s students were recruited for a study concerned with measuring nonverbal IQ (nvIQ).

1. Draw a boxplot to compare the distribution of values in the two groups. Assess whether there are any points you would want to exclude from further analysis?
2. Do an appropriate statistical test to determine if the mean nvIQ is the same for the two groups. State the null hypothesis for such a test and an alternative hypothesis.
3. Write a summary statement about your analysis, and what you can conclude from it.

Question 1 – Answer:

An independent sample’s t-test was conducted to ascertain whether or not a significant difference in measured nonverbal IQ exists between a group of 12 first year students and a group of 12 second year students.

H0: There is **no** difference in mean nonverbal IQ between the first and second year students recruited for this study.

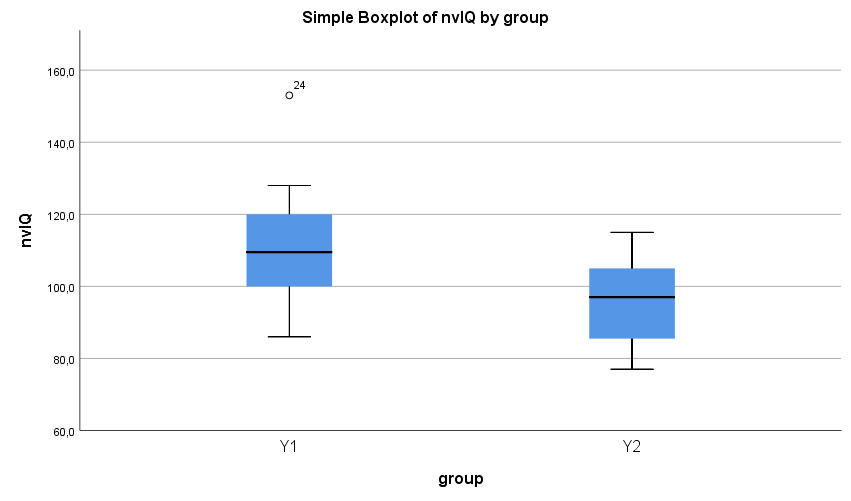
H1: There is **a difference** in mean nonverbal IQ between the first and second year students recruited for the study.

All assumptions of the independent samples t-test have been checked:

The data for both groups is normally distributed (Shapiro-Wilk, both p’s > 0.4 so well above 0.05)

The variance present in both groups is approximately equal (Levene’s test p=0.38)

The boxplot (below) suggests the presence of an outlier; however, upon further inspection this case equates to z-score of 2.29 and therefore falls within 3 standard deviations of the mean. As a result the data point was not excluded from the final subsequent analysis.



The results of the independent samples t-test reveal a significant difference in nonverbal IQ between the two groups tested *t*(22)=2.49, *p*=0.021, *cohen’s d* = 1.02. This result comes from the higher nonverbal IQ in the first year group (M = 111.2, S.D. = 18.24) compared to the second year group (M = 95.8, S.D. = 11.29).

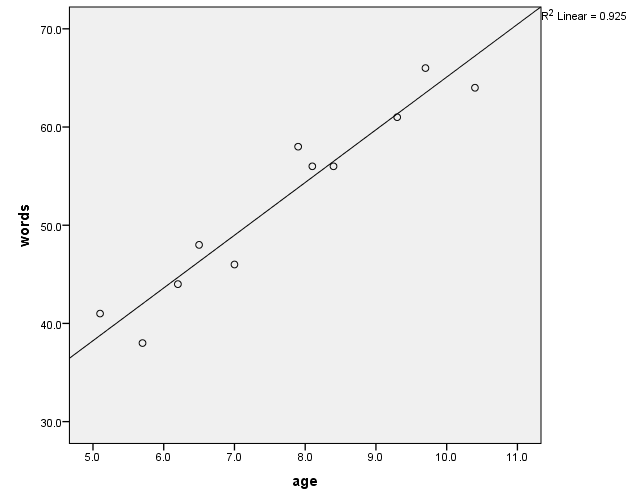
Question 2:

10 primary school-age children of varying ages are assessed on the number of words they can identify on a picture test of word recognition in which there are 100 possible words. The main question we are interested in is the way in which performance on this task changes with age. You can assume that the outcome variable is normally distributed in the appropriate way.

1. Make a plot that would be appropriate to indicate the way in which performance on this task changes with age. Also draw on it a best-fitting line.
2. Using an appropriate analysis, determine if performance changes with age.
3. Write a summary statement about your analysis, and what you can conclude from it, including the rate at which children learn new words, including the rate at which children learn new words (i.e., how many new words each child learns, on average, in 1 year), giving the equation that describes this relationship.

Question 2 – Answer:

Simple linear regression was used to assess whether the number of words correctly identified by children on a picture test of word recognition changed with age over the group of children tested.



All assumptions of a simple linear regression have been checked:

The data is of a continuous, scale measure.

The regression model was highly significant [F(1,9)=110.56, p<0.001] and a good fit for the data with the model accounting for about 92.5% of the variance.

The number of words correctly identified by children improves by ~5.37 words per year.

The regression for predicting performance of a “new” child would be:   
words = (5.37 \* age)+11.395.

Question 3:

You want to test the efficacy of a new six-month reading comprehension intervention for people with aphasia. You recruit two groups of people with aphasia, one of which participates in the intervention (treated), and one of which does not (control). You test reading performance before the trial begins and when it finishes. From the data set given in the file DataForPracticeExam.xlsx:

1. Generate an appropriate graph of the results.
2. Run an appropriate statistical test in order to assess whether or not the treatment has been effective, whilst making sure you perform all the appropriate checks on the data that allow the use of the particular statistic you choose.
3. Write an appropriate summary statement about your conclusions.

Question 3 – Answers:

A 2 way Mixed Design Analysis of Variance (ANOVA) was conducted to investigate efficacy of a new one-week intervention for aphasia. The Within subjects factor is Time (pre vs post) and the between subjects factor is Group (Control vs Treated).

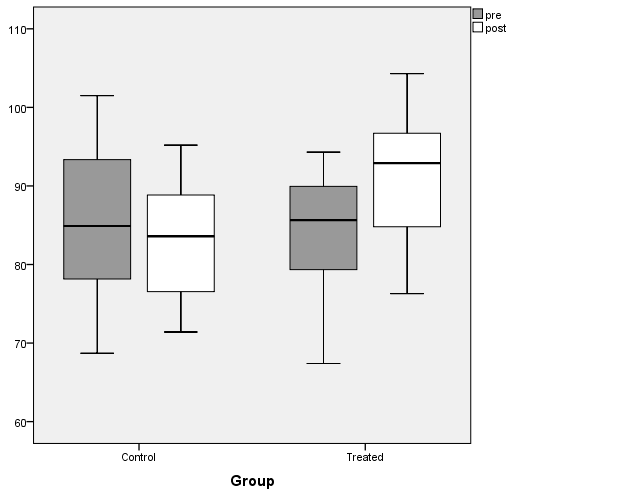
All assumptions of a 2 way Mixed Design ANOVA have been checked:

The data for both groups is normally distributed (Shapiro-Wilk, all 4 p values > 0.1).

The variance present in all groups is approximately equal (Levene’s test, both p’s > 0.1).

Mauchleys test of Sphericity does not apply as there are only 2 levels to the within-subject factor and is therefore assumed.

The boxplot (below) suggests no outliers are present in the data. All z-scores fall between -3 and +3.



Results of a 2 way mixed design ANOVA with within subjects factor Time (pre vs post) and between subjects factor Group (control vs treated) revealed a non-significant main effect of Time (F(1,38)=1.88, p=0.179, ƞp²=0.047).

Additionally the ANOVA also revealed a non-significant main effect of Group F(1,38)=3.3, p=0.078, ƞp²=0.08.

Most importantly however the ANOVA did reveal a significant interaction between Group and Time point of measurement F(1,38)=7.5, p=0.009, ƞp²=0.166. A successful intervention would require an increase in performance that was greater in the treated than in the control group, which would result in a significant interaction between group and time. This appears to be the case as can be seen in the boxplots, and the descriptive statistics.

Follow-up paired samples t-tests show that the control group did not differ in reading performance at the two time periods t(19)=1.02, p=0.322, Cohen’s d = 0.22. The mean score at the PRE-time point was 85.6 (S.D.=9.2) whilst the POST-time point was 83.3 (S.D.=7.5).

However, paired samples t-tests show that the treated group did improve in reading performance after the intervention t(19)=2.8, p=0.012, Cohen’s d = 0.63 (large effect). The PRE-time point mean in the treated group was 84.5 (S.D. = 7.0) with children improving to an average of 91.2 (s.d.=7.5) after treatment. Thus, the treated group appears to have made significant gains in reading performance from the intervention, whereas the control participants did not change.

**Question 4: Part one**

A sample of first and second year SLT students were asked which modules they thought were most fun. The resulting data are in the table here:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Phonetics | Management of communication disorders | Statistics |
| Y1 | 20 | 35 | 24 |
| Y2 | 12 | 53 | 15 |

1. Write a short description of the results of an appropriate statistical analysis, in order to determine whether first and second year students differ in the modules they think are the most fun.
   1. Try to make a summary statement about what differences are leading to statistically significant results, if any. You may find that generating and including a bar chart might be useful for this.

**Question 4 Part One – Answer:**

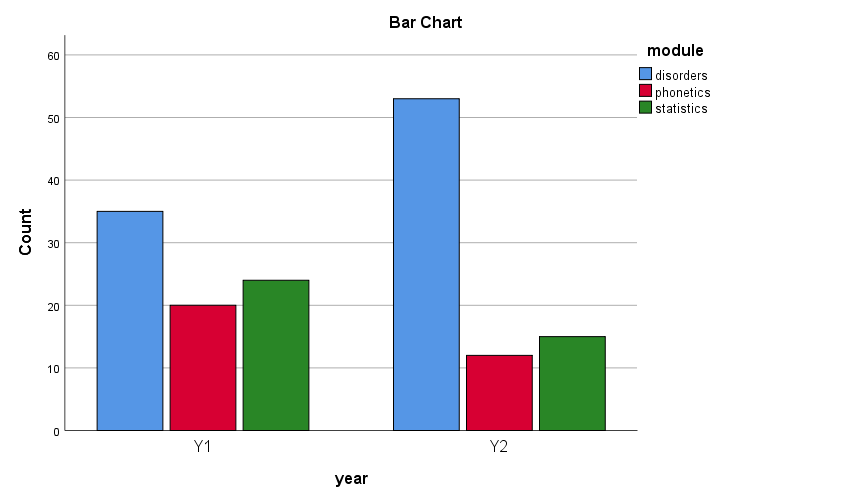
A sample of first and second year students were asked which module they found most fun. A chi-square test of association was conducted in order to determine if the preferred module differed between first and second years.

*Here is the table you can see in your output but you don’t need to include this:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **year \* module Crosstabulation** | | | | | | |
|  | | | module | | | Total |
| disorders | phonetics | statistics |
| year | Y1 | Count | 35 | 20 | 24 | 79 |
| Expected Count | 43,7 | 15,9 | 19,4 | 79,0 |
| Y2 | Count | 53 | 12 | 15 | 80 |
| Expected Count | 44,3 | 16,1 | 19,6 | 80,0 |
| Total | | Count | 88 | 32 | 39 | 159 |
| Expected Count | 88,0 | 32,0 | 39,0 | 159,0 |

All expected cell frequencies were greater than 5. There was a significant association between the study year of the respondent and the module preferred, χ2(2)=7.75, p=0.021, Cramer’s V = 0.22.

This appears (from the bar chart) to arise primarily from second year students preferring Management of Communication Disorders to a greater degree than first years, over other modules. Equivalently, first years do not prefer Management of Communication Disorders over the other modules to the same degree as second years do.



*You could also request Fisher's Exact Test from SPSS, and then would report:*

Fisher's Exact Test showed a significant association between the study year of the respondent and the module preferred (p=0.022) , Cramer’s V = 0.22.

**Question 4: Part 2**

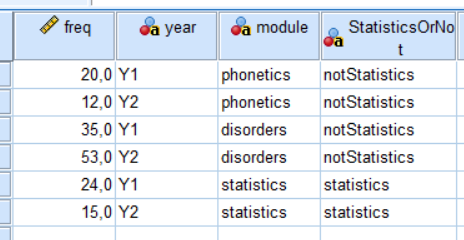
1. Suppose we were only interested in the question of whether first and second years differed in the frequency with which they thought *statistics* was the most fun, as opposed to other modules (phonetics and management of communication disorders). Construct the contingency table you would need to analyse in order to answer this question from the data set given above. Then do the appropriate analysis and report your conclusions.

**Question 4: Part 2 – Answer:**

To specifically investigate whether first and second years differed in the frequency with which they thought statistics was the most fun module compared to any other module we would collapse across (i.e. add together) the total number of votes for phonetics and communication disorders for each year group. This would result in the creation of the contingency table shown below:

|  |  |  |
| --- | --- | --- |
|  | Non-Statistics | Statistics |
| Y1 | 55 | 24 |
| Y2 | 65 | 15 |

It turns out that there is a cleverer way to get SPSS to do this tabulation for you. All you need do is define a new variable (I have called it *StatisticsOrNot*) with the value *notStatistics* instead of *phonetics* and *disorders*, and *statistics*. So the data in SPSS could look like this:



Now you can do the chi-square test using *year* and *StatisticsOrNot*, which will give the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **year \* StatisticsOrNot Crosstabulation** | | | | | |
|  | | | StatisticsOrNot | | Total |
| notStatistics | statistics |
| year | Y1 | Count | 55 | 24 | 79 |
| Expected Count | 59,6 | 19,4 | 79,0 |
| Y2 | Count | 65 | 15 | 80 |
| Expected Count | 60,4 | 19,6 | 80,0 |
| Total | | Count | 120 | 39 | 159 |
| Expected Count | 120,0 | 39,0 | 159,0 |

Going on to the test:

A chi-square test of association was conducted in order to determine if first and second year students differed in their preference of Statistics vs Non-Statistics.

All expected cell frequencies were greater than 5. There was a non-significant association between the study year of the respondent and the module preferred, χ2(2)=2.9, p=0.088, Cramer’s V = 0.14.

The preference between statistics and non-statistics appears to be approximately equal across the two year groups (as shown in the bar chart below).

*Note that because this is a 2x2 contingency table, SPSS gives you Fisher’s exact test results automatically. So you could report:*

Fisher's Exact Test showed a non-significant association between the study year of the respondent and the module preferred (p=0.1), Cramer’s V = 0.14.

