Research Methods

Mixed Design ANOVA

In this workshop you will practice a procedure for using SPSS to analyse data from studies where more than one IV has been studied for their effect upon the DV. You will be using a 2 x 2 x 3 mixed between-within ANOVA analysis to test for differences between two or more independent groups whilst subjecting participants to repeated measures.

We will use the example of *end of year grades* (DV). For this study, you are interested in looking at the following IV's:

Gender - between-subjects with two levels [male / female]
Subject of study – between-subjects with two levels [psychology / art]
Year of study – within-subjects with three levels [year one / year two / year three]

Step 1)
Input the variables into the 'variable view' as shown below, making sure to give your **between-subjects** variables appropriate values.

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
1	Gender	Numeric	8	2		{1.00, male}...	None	8	Right	Nominal
2	Study	Numeric	8	2		{1.00, Psyc...	None	8	Right	Nominal
3	Year1	Numeric	8	2		None	None	8	Right	Scale
4	Year2	Numeric	8	2		None	None	8	Right	Scale
5	Year3	Numeric	8	2		None	None	8	Right	Scale

Step 2)
Click back to the 'Data view' tab and enter the data as shown below, which represents data from males and females (IV) studying two different subjects (IV). The end of year grades (DV) is recorded as a continuous number across the three different years (IV).

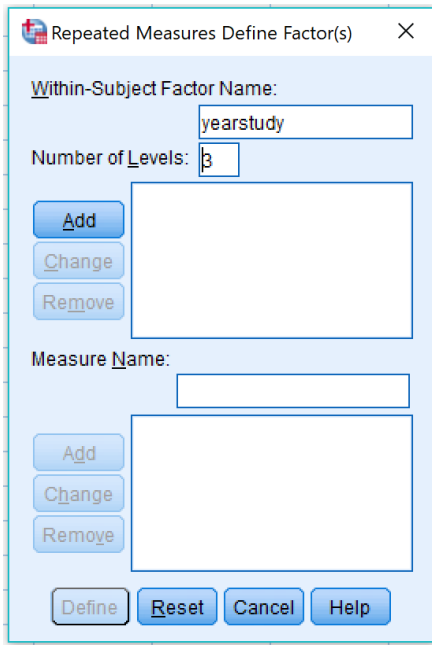
	Gender	Study	Year1	Year2	Year3
1	1.00	1.00	60.00	59.00	68.00
2	1.00	2.00	56.00	52.00	60.00
3	1.00	1.00	63.00	68.00	68.00
4	1.00	2.00	44.00	48.00	50.00
5	1.00	1.00	59.00	60.00	60.00
6	1.00	2.00	40.00	45.00	47.00
7	1.00	1.00	75.00	74.00	76.00
8	1.00	2.00	59.00	59.00	62.00
9	1.00	1.00	80.00	83.00	89.00
10	1.00	2.00	58.00	59.00	60.00
11	2.00	1.00	69.00	68.00	62.00
12	2.00	2.00	70.00	71.00	75.00
13	2.00	1.00	70.00	70.00	78.00
14	2.00	2.00	60.00	62.00	63.00
15	2.00	1.00	62.00	69.00	70.00
16	2.00	2.00	51.00	53.00	58.00
17	2.00	1.00	60.00	62.00	63.00
18	2.00	2.00	35.00	42.00	45.00
19	2.00	1.00	74.00	75.00	79.00
20	2.00	2.00	48.00	49.00	52.00
21					

Remember: one row of data = one participant (this includes both within- and between-subjects variables!)

Step 3)

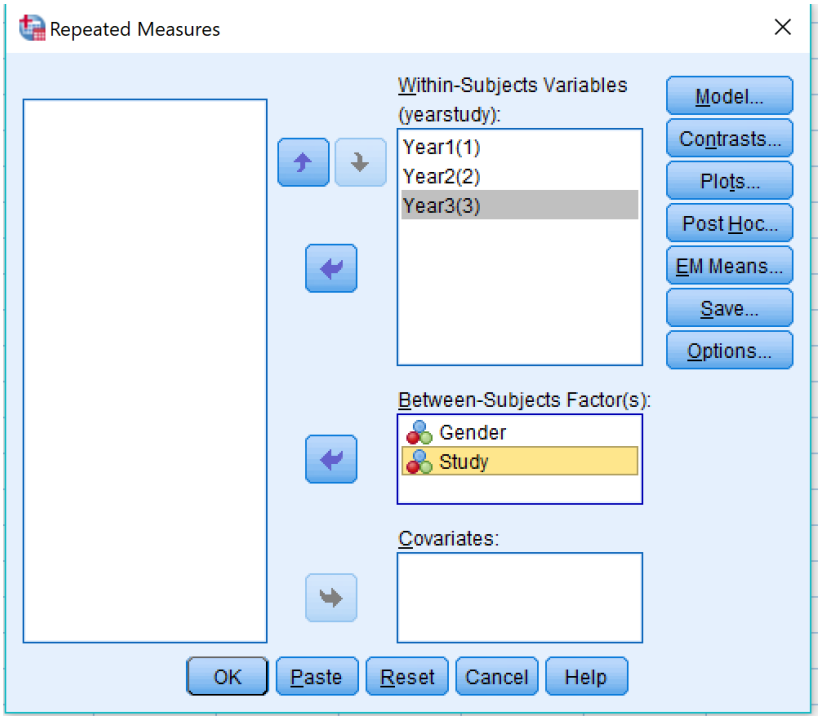
Now you can start to run the ANOVA analysis. On the 'Analyze' menu, selection the option for 'General linear model' and then the option for 'Repeated measures'.

You will see the following dialogue box. You will need to define your repeated measures variable (year of study) and tell SPSS that there are 3 levels/conditions for this variable as shown. Press the 'Add' button and then the 'Define' button to continue defining this variable.



Next, move the three conditions of the variable across into the 'Within-subjects variables' box.

You also have to include the 'Between-subjects factors' at this stage.

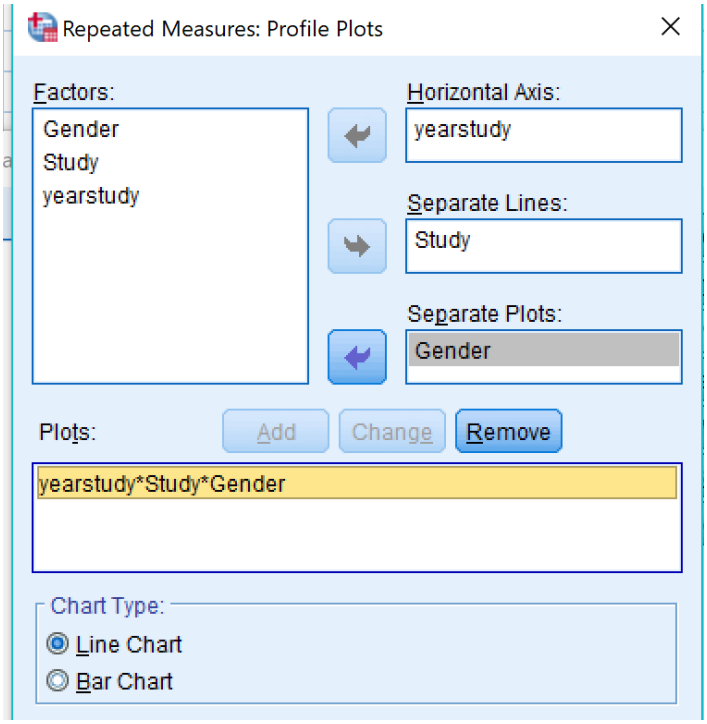


Step 4)

Click on the 'Plots' button. You will be presented with the 'Repeated measures: Profile plots' dialogue box.

Transfer the IV **yearstudy** from the Factors box into the 'Horizontal axis' box, transfer the IV **Study** to the 'Separate lines' box, and transfer the IV **Gender** to the 'Separate plots' box.

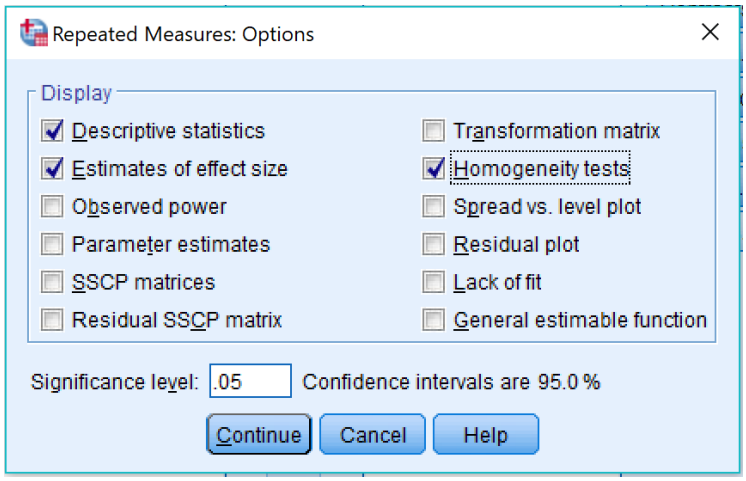
Click 'Add' and then 'Continue'.



Step 5)
Next, click on the 'Options' button. This will present you with the 'Repeated measures: Options' dialogue box.

In the 'Display' section, make sure there is a tick for
Descriptive statistics, Estimates of effect size, Homogeneity tests.

Then click 'Continue'.



Step 6)
Click on EM Means and transfer the factor yearstudy to the Display Means For: box.

Back in the Repeated Measures dialogue box, select OK to run the analysis.

SPSS Output

Descriptive statistics:

In this table, the descriptives are shown for the three different conditions of your study (end of year grades for the three years). This is useful for referring back to in order to understand where differences have been shown to be significant or non-significant. (N = number of scores in the grouping where shown).

Tests of within-subjects effects:

This table shows the outcome of any part of the mixed ANOVA that incorporates a within-subjects factor.

Before we look at the main effects of the IV's, we need to assess the interaction effects. This is indicated in the rows of **Tests of Within-Subjects Effects** table that you see a * between variables; (yearstudy * gender * study) – (yearstudy * gender) – (yearstudy * study). The values that you are interested in are Sphericity assumed and the associated probability given in in the **Sig.** column.

After assessing whether there is a significant or non-significant interaction effect, we can now move on to assess the main effects for each of our independent variables.

> *Tip: If the interaction effect is significant, be very careful in interpreting the main effects. A significant interaction means that the impact of one variable is influenced*

by the level or the others; therefore general conclusions (as in main effects) are usually not appropriate. If you get a significant interaction, always check your plot to guide your interpretation and perform simple main effects analyses.

In the tests of within-subjects effects table, we can look at the main effect of *yearstudy*. You are interested in the Sphericity assumed row again here; you are going to be reporting the degrees of freedom, *F*-value and significance value.

Tests of between-subjects effects:

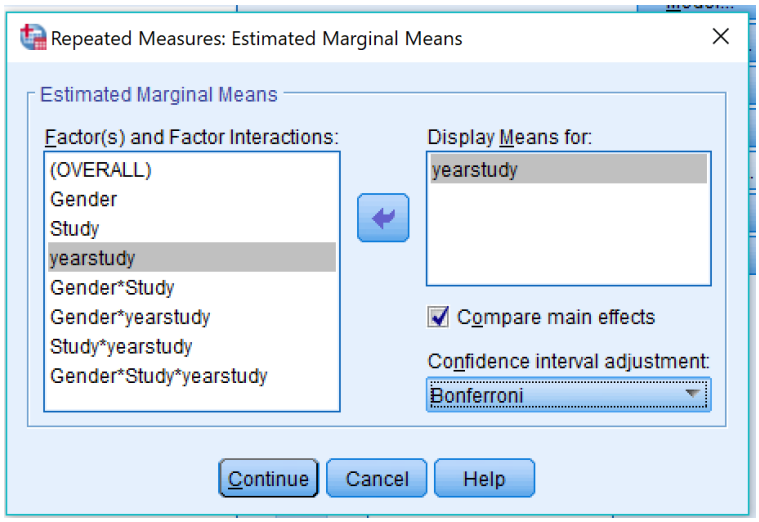
This table shows the outcome of any part of the mixed ANOVA that incorporates only between-subjects factor(s). In the example above, we have two between-subjects factors: gender and subject of study. The results for these are shown in this table.

Write out the necessary output data (using the output tables you have now produced) in the correct format (as shown below). This should include an analysis of the interaction effects, the effect of the within variables, and the effects of the between variables. The format for reporting all of these is the same:

F(df, df) = F-value, $p < 0.05$ or $p > 0.05$

Comparing the differences across the three conditions of your within-subjects variable:

Refer back to **Step 6)** on this worksheet – repeat the same steps up to this point but once you get here, tick the 'Compare main effects' option for your *yearstudy* variable, and select the BONFERRONI confidence interval adjustment.



Click 'Continue' followed by 'OK' in the 'repeated measures' dialogue box to run the analysis again.

This time you will see that your output includes an additional table – the **Pairwise comparisons** table.

Pairwise Comparisons

Measure: MEASURE_1

(I) yearstudy	(J) yearstudy	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	-1.750	.666	.055	-3.531	.031
	3	-4.600*	.898	.000	-7.000	-2.200
2	1	1.750	.666	.055	-.031	3.531
	3	-2.850*	.806	.008	-5.005	-.695
3	1	4.600*	.898	.000	2.200	7.000
	2	2.850*	.806	.008	.695	5.005

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Looking at the table above, we need to remember the labels associated with the conditions from the **Within-Subjects factors** table. This table will show us the significance level for differences between individual time points.

We can see that there was a significant difference in end of year grades between year 1 and year 3 ($p < .001$) and between year 2 and year 3 ($p < .01$), but no significant difference between years 1 and 2 ($p > .05$).

Now, write the **full results section** of the entire analysis for this study (using your SPSS books for guidance)!!