Psyc 250 – Statistics & Experimental Design

ANOVA Exercise

As we discussed in class, the "ANOVA family" has much more flexibility than the family of *t* tests. For today's exercises, we will demonstrate this flexibility by using an expanded version of the Anorexia dataset. There is now an additional group (Supportive Therapy) and an additional timepoint (6 month follow-up). Open the file as an SPSS file. If you like, you can enter the Value Labels for "Group" (1 = Family Therapy, 2 = Control, 3 = Supportive Therapy).

Context: In the context of testing the effectiveness of a particular treatment, it is not uncommon to find that some form of therapy (such as Family Therapy) is better than no therapy at all (i.e., control group). One could argue that any contact with a therapist is therapeutic in and of itself, regardless of the specific type of therapy. Therefore, it is also important to compare various types of therapies to each other. In today's example, we will include a second type of control group – Supportive Therapy. This therapy is designed to offer supportive counseling to the patient, but beyond this emotional support, no actual therapeutic techniques are utilized (i.e., this is essentially another version of a control group).

One-Way ANOVA

We will use ANOVA to answer the following question: Are there differences in pre-treatment weight across the Family Therapy, Supportive Therapy, and control conditions?

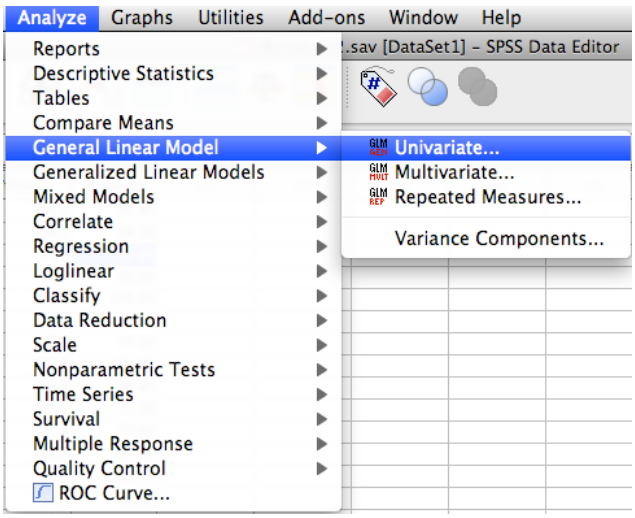
Concept Check

Before conducting the actual analysis…

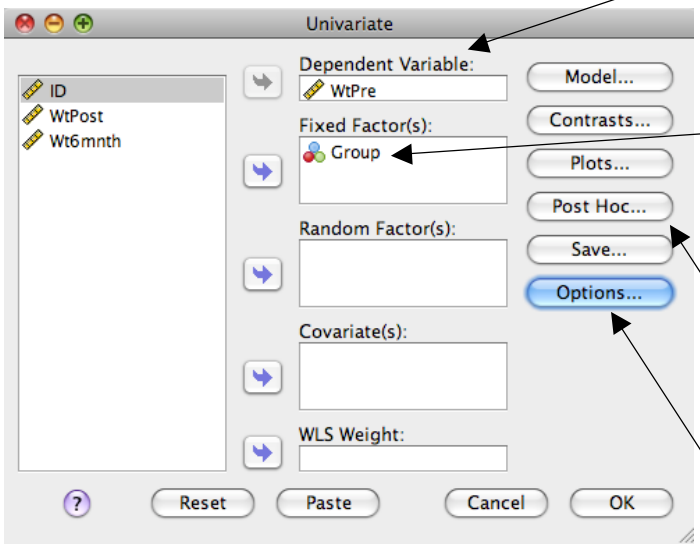
1. What is the Null Hypothesis (state in words and statistical notation)?
2. What do you expect to find?
3. Why is this analysis important?

To compute an ANOVA in SPSS…

[Analyze] → [General Linear Model] → [Univariate]



…which will open a new window…



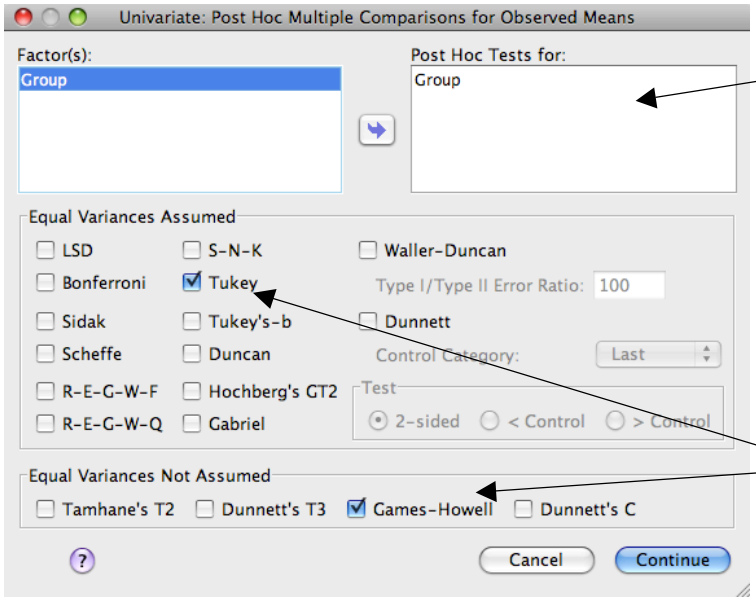
Dependent Variable: Move your continuous DV here.

Fixed Factors: Move your categorical IV(s) to this box.

Post Hoc: Here you can select Post Hoc analysis (see "Post Hoc" below).

Options: There are *many* different options, some of which are quite helpful (see "Options" below).

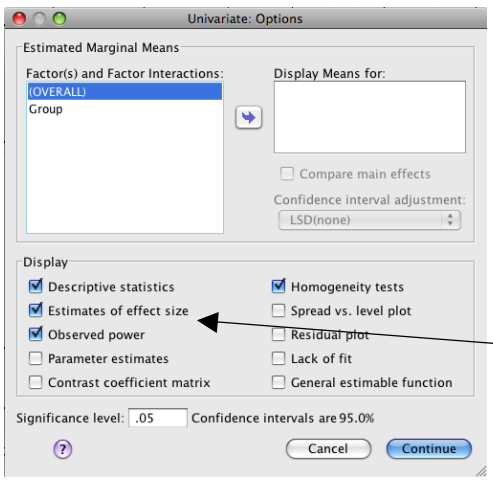
Post Hoc (select the "Post Hoc…" button to open the following window):



Post Hoc Tests for: Move any "Factors" that have more than 2 groups/levels to this box. In this case, there is only one IV. Remember, Post-Hocs will help us identify which groups are significant, *if the omnibus F-test is significant*.

The Tukey post-hoc has become the 'gold standard'. That is, it's commonly used, and it is easy to justify. You may notice that it's in a box called "Equal Variances Assumed". This term should sound familiar! In the event that we cannot assume equal variances, we should also select one under "Equal Variances Not Assumed" (the Games-Howell is common).

Options (Select the "Options…" button to open the following window):



I like to select "Descriptive Statistics", so that it's easy to reference the Means and Standard Deviations when reporting results. It's also a good idea to select "Homogeneity tests". If you'd like SPSS to estimate the effect size and/or power, select those options as well.

Below is selected Output for the options we selected above. You should know enough about SPSS and ANOVA to navigate this Output. A few notes…

- Start with Levene's Test (interpretation is the same as with a *t*-test)
- If Equal variances are assumed, you can use Tukey for the post-hoc; if not, you can use Games-Howell

Descriptive Statistics

Dependent Variable:WtPre

Group	Mean	Std. Deviation	N
Family Therapy	83.229	5.0167	17
Control	83.496	4.8352	26
Supportive Therapy	83.813	4.0803	16
Total	83.505	4.6232	59

Levene's Test of Equality of Error Variances

Dependent Variable:WtPre

F	df1	df2	Sig.
.239	2	56	.788

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

a. Design: Intercept + Group

The outlined section of this Output Box should look VERY familiar to you --- it is essentially the ANOVA Summary Table. Focus on this outlined portion when interpreting the results of a One-Way ANOVA. Beyond the summary table we computed by hand, this output also includes an estimate of effect size (eta-squared) and an estimate of observed power (Note: when differences are *expected*, we want power to be .80 or greater). Note: SPSS Partial Eta Squared is the same as the "eta-squared" that we discussed in class.

Tests of Between-Subjects Effects

Dependent Variable:WtPre

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	2.806	2	1.403	.064	.939	.002	.127	.059
Intercept	392835.971	1	392835.971	17785.408	.000	.997	17785.408	1.000
Group	2.806	2	1.403	.064	.939	.002	.127	.059
Error	1236.902	56	22.088					
Total	412652.560	59						b
Corrected Total	1239.708	58						

a. R Squared = .002 (Adjusted R Squared = -.033)

b. Computed using alpha = .05

Here are the post-hoc analyses – divided by Tukey and Games-Howell. In this case, there is nothing to interpret because the overall *F* test is not significant. However, notice the format: Family therapy is compared to the Control and then Supportive Therapy. In the next row, The control is the reference group, followed by Supportive Therapy.

Multiple Comparisons

Dependent Variable:WtPre

	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Family Therapy	Control	-.267	1.4659	.982	-3.796	3.262
		Supportive Therapy	-.583	1.6370	.933	-4.524	3.358
	Control	Family Therapy	.267	1.4659	.982	-3.262	3.796
		Supportive Therapy	-.316	1.4933	.976	-3.912	3.279
	Supportive Therapy	Family Therapy	.583	1.6370	.933	-3.358	4.524
		Control	.316	1.4933	.976	-3.279	3.912
Games-Howell	Family Therapy	Control	-.267	1.5426	.984	-4.050	3.516
		Supportive Therapy	-.583	1.5878	.929	-4.495	3.329
	Control	Family Therapy	.267	1.5426	.984	-3.516	4.050
		Supportive Therapy	-.316	1.3928	.972	-3.721	3.088
	Supportive Therapy	Family Therapy	.583	1.5878	.929	-3.329	4.495
		Control	.316	1.3928	.972	-3.088	3.721

Based on observed means.
The error term is Mean Square(Error) = 22.088.

Concept Check

4. The effect size (eta-squared) is extremely low --- why?
5. Write the results of this test in APA format.
6. What would you expect if you ran the results at post-test?...and at 6-month follow-up?
7. Examine Post-test and 6 month f/u weight across groups, and write the results in APA Format.

Repeated Measures ANOVA

We will use Repeated Measures ANOVA to answer the following questions: Do patients ***within a particular group*** gain weight throughout therapy, and is any weight gain maintained 6 months after therapy?

Concept Check

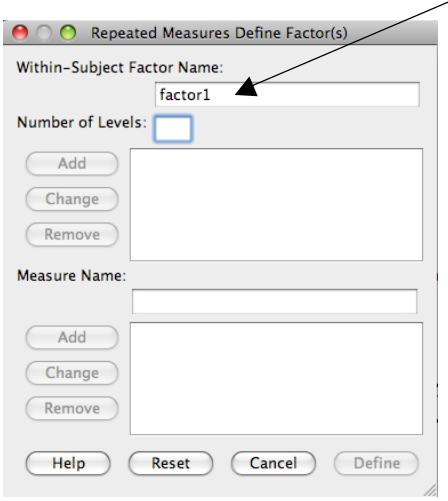
8. What is the Null Hypothesis for the Family Therapy Group (state the Null Hypotheses in words and statistical notation)?

Recall from repeated measures *t* that we must first select cases that we want included in our analysis! (See notes from previous SPSS Lab). Let's start with the Family Therapy Group (Group = 1).

To compute a Repeated Measures ANOVA in SPSS…

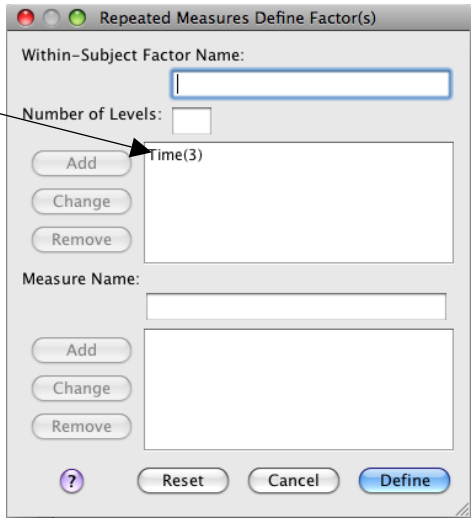
[Analyze] → [General Linear Model] → [Repeated Measures]

…which will open a new window…

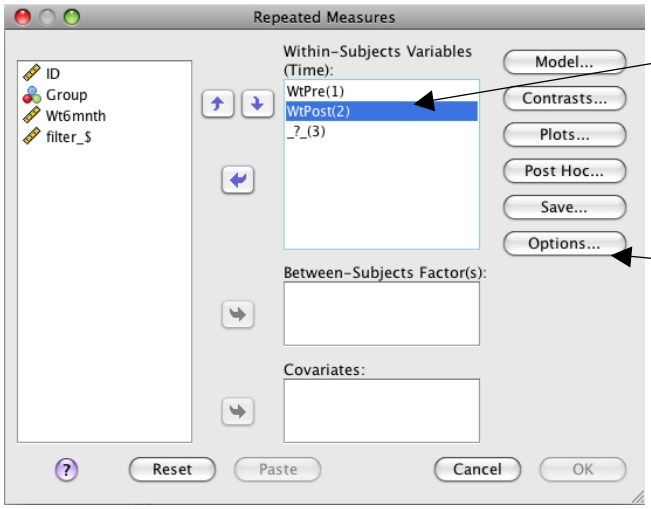


Within-Subject Factor Name: Rename "factor1" to something that carries more meaning for your data (such as "Time"). Then, enter the "Number of Levels". In this case there is pre, post, and 6-month follow-up (i.e., 3 levels). (That is, we have 1 IV [Time] with 3 levels [pre, post, f/u]; the relation between groups is dependent, so we are using a Repeated Measures ANOVA). Then click "Add".

After adding the unique factor name and levels, your box should look like this…



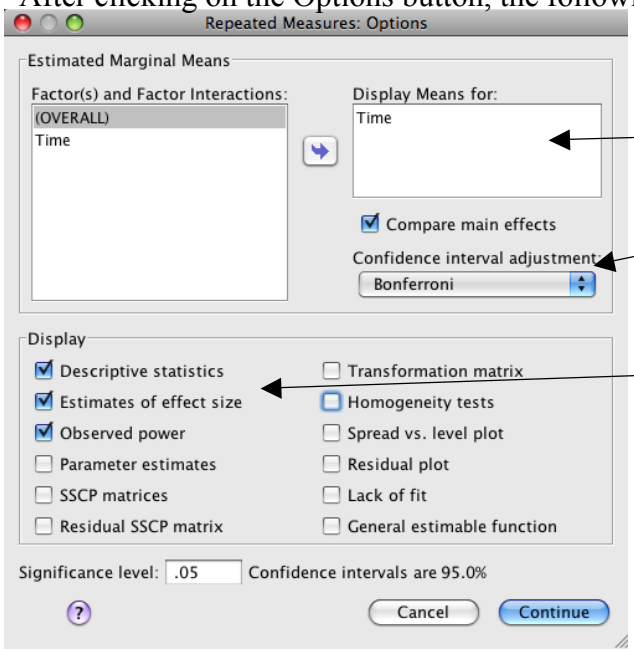
Next, Click "Define", which opens yet another window (see next page)…



Within-Subjects Variables (Time): You informed SPSS that there would be 3 levels in the previous step. Now, you can define each level with the specific variable. Select level 1 and move it into this box using the toggle switch. Do this for the other variables as well.

Options & Post Hoc: Unfortunately, running a repeated measures ANOVA in SPSS is like slicing bread with a chainsaw. That is, the Repeated Measures option under General Linear Model was designed to do MUCH more than a simple repeated measures ANOVA with 3 levels. Therefore, the Post Hoc option doesn't offer much (click on the button and see what happens). However, post-hocs can still be generated under **Options** (see window below).

After clicking on the Options button, the following window will open…



Display Means For: Move the "Time" factor to this box.

Check this box, and then select "Bonferroni" under "Confidence Interval Adjustment".

I also like to select "Descriptive Statistics" to facilitate the writing of the final APA Write-up. If you like, you can also select "estimates of effect size" (or any other options of interest). Note: "Homogeneity tests" will not produce any results unless you also include a "between subjects" factors, as we did in the between groups ANOVA).

Next, Click Continue, and then run the analysis. Selected and annotated output can be found on the following page…

Once again, you should know enough about SPSS by now to navigate most of this Output (though do note the annotations below).

Descriptive Statistics

	Mean	Std. Deviation	N
WtPre	83.229	5.0167	17
WtPost	90.494	8.4751	17
Wt6mnth	91.6471	8.63576	17

The details of this test are beyond the scope of this class. However, know that it is very sensitive. Therefore, this test is often ignored, and you can proceed below by interpreting the **"Tests of Within-Subjects Effects"** using the **"Sphericity Assumed"** results.

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.177	26.015	2	.000	.548	.558	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept
Within Subjects Design: Time

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	708.118	2	354.059	19.357	.000	.547	38.715	1.000
	Greenhouse-Geisser	708.118	1.097	645.621	19.357	.000	.547	21.231	.990
	Huynh-Feldt	708.118	1.117	633.993	19.357	.000	.547	21.621	.991
	Lower-bound	708.118	1.000	708.118	19.357	.000	.547	19.357	.985
Error(Time)	Sphericity Assumed	585.302	32	18.291					
	Greenhouse-Geisser	585.302	17.549	33.353					
	Huynh-Feldt	585.302	17.871	32.752					
	Lower-bound	585.302	16.000	36.581					

a. Computed using alpha =

Pairwise Comparisons

Measure:MEASURE_1

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	-7.265*	1.736	.002	-11.905	-2.625
	3	-8.418*	1.800	.001	-13.228	-3.607
2	1	7.265*	1.736	.002	2.625	11.905
	3	-1.153	.451	.063	-2.359	.053
3	1	8.418*	1.800	.001	3.607	13.228
	2	1.153	.451	.063	-.053	2.359

Based on estimated marginal means

*. The mean difference is significant at the

a. Adjustment for multiple comparisons: Bonferroni.

Here are the post-hoc tests using the Bonferroni correction (see Note "a" below this box). Unfortunately, SPSS doesn't present the variable name, so you need to remember that 1 was defined as Pretest weight, 2 as Posttest weight, and 3 as six-month follow-up. The first row compares time 1 to time to 2, followed by time 1 to time 3. Next, time 2 is compared to times 1 and 3.

Concept Check

9. Write the results of this test in APA format (for only the "Family Therapy" group)
10. Examine changes in weight for the control and Supportive Therapy Groups, and write the results in APA Format.
11. Offer a descriptive (words only, no numbers) summary of all results. (Convince me that you hear music!!!)