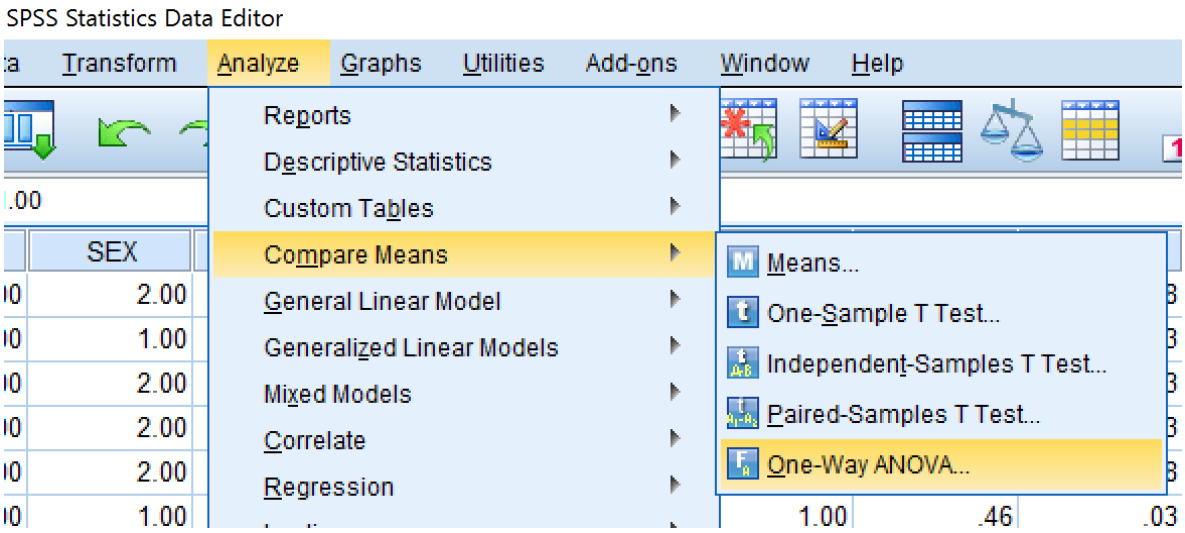
60080079 Introduction to Statistical Methods
Semester 2 2023-2024
Handout 11

A Brief Introduction to One-Way ANOVA in SPSS

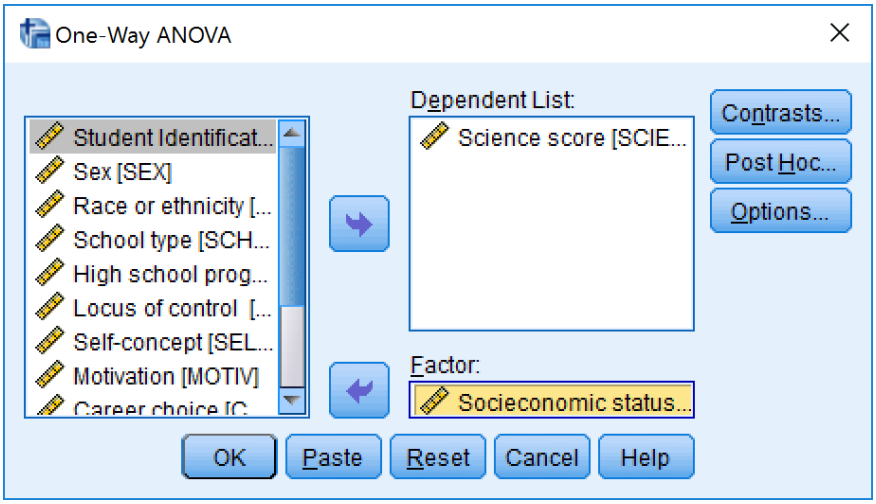
A. *Overall F-Test*

1. Set up the **hsb.sav** data, which require one variable (e.g., Science) to be quantitative, and the other variable (e.g., SES) to be categorical.

2. From the menu, choose **Analyze → Compare Means → One-Way ANOVA**.



3. In the One-Way ANOVA dialog box, click in Science in the **Dependent List** box, and SES in the **Factor** box.



4. If no additional option in needed, hit **OK**.

   You should get the following output:

ANOVA

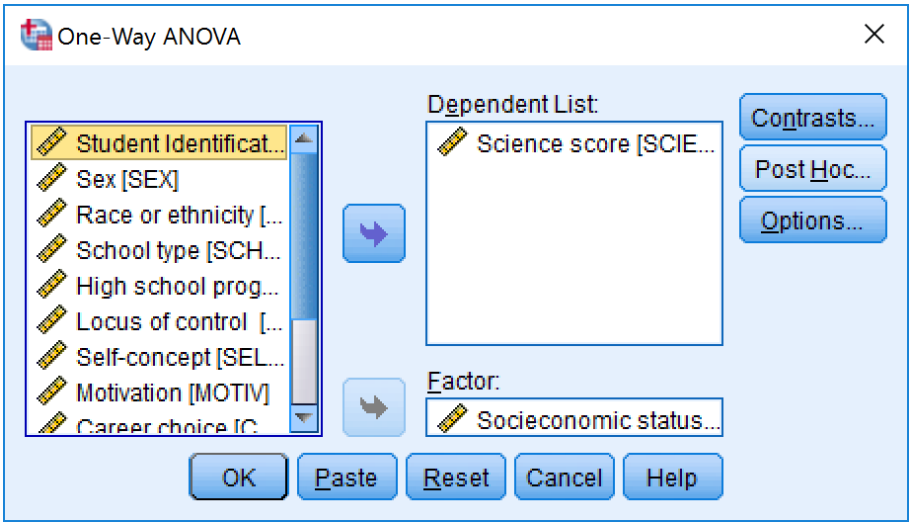
Science score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4773.972	2	2386.986	27.586	.000
Within Groups	51657.761	597	86.529		
Total	56431.733	599			

The computed F is 27.586 and the p-value is close to zero so we reject H_0: $\mu_L = \mu_M = \mu_H$, and conclude that at least two groups are not equal.

B. (Planned) Contrasts

1. In the **One-Way ANOVA** dialog box, click the **Contrast** button.



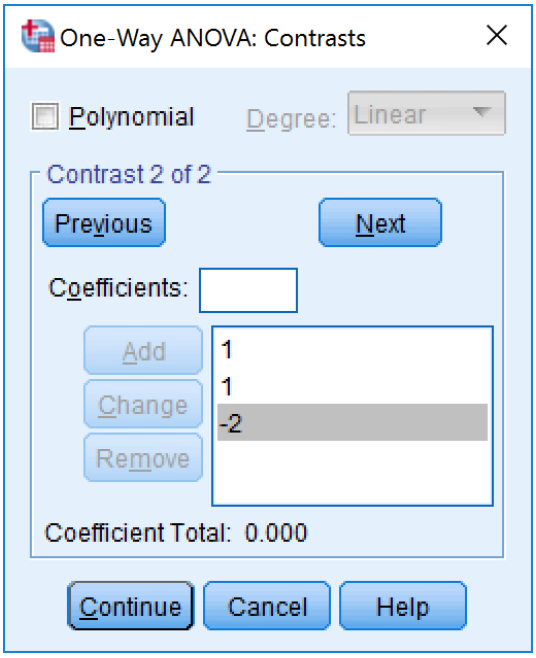
2. You can create your own contrast by entering the one coefficient at a time in the **Coefficients** box.

   Suppose we are interested in comparing whether the:

   a) Low and Medium SES groups have the same mean science score; and

   b) The mean science score of Low and Medium SES groups is the same that of the High SES.

   The appropriate coefficients for these contrasts are: (1, -1, 0) and (1, 1, -2).



Use the **Add**, **Change**, and **Remove** buttons to enter/modify the contrast coefficients.

If more than one contrast is involved, you can move between contrasts using the **Previous** and **Next** buttons.

3. Click Continue, then OK.

For the contrasts we created, in addition to the ANOVA table, we also get the table of coefficients we specified, as well as the tests for the contrasts.

Contrast Coefficients

	Socieconomic status		
Contrast	Low	Medium	High
1	1	-1	0
2	1	1	-2

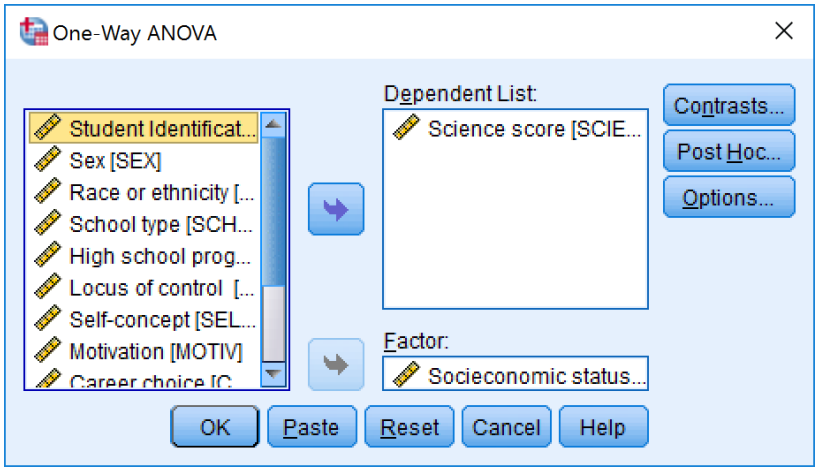
Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Science score	Assume equal variances	1	-4.6243	.95494	-4.843	597	.000
		2	-11.3246	1.74597	-6.486	597	.000
	Does not assume equal variances	1	-4.6243	.96788	-4.778	265.487	.000
		2	-11.3246	1.72682	-6.558	303.641	.000

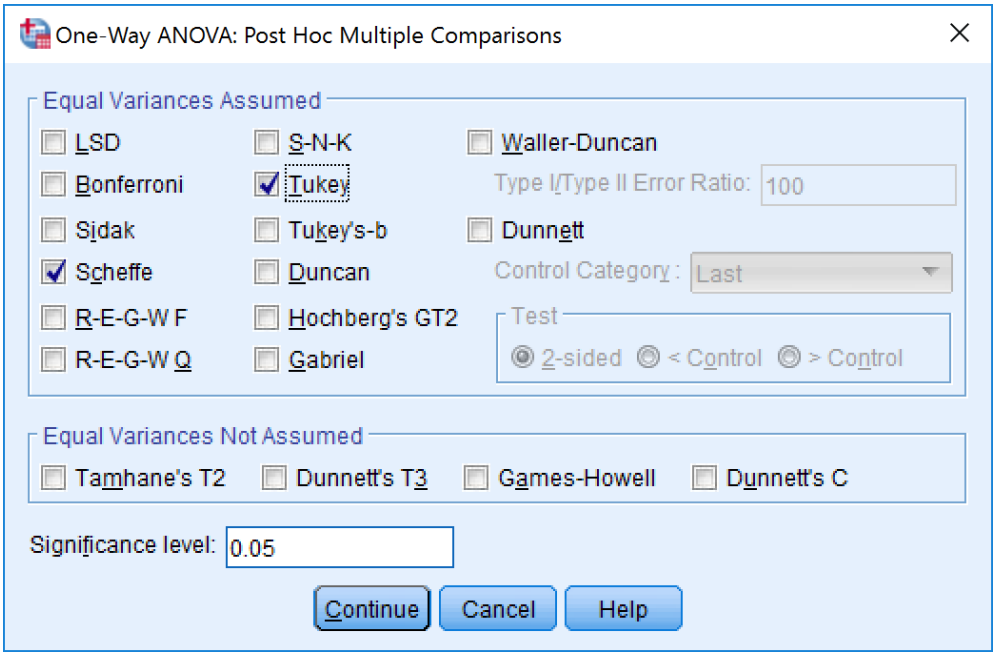
The tests for contrast indicate that we should reject H_0: $\mu_L = \mu_M$ and H_0: $\mu_L + \mu_M = 2\mu_H$.

C. (Post-Hoc) Pairwise Comparisons

1. To request an analysis of the possible pairwise comparisons that account for multiple tests, we can use the **Post-hoc** button in the **One-Way ANOVA** dialog box.



2. In the **Post-Hoc Multiple Comparisons** dialog box, check **Scheffe** and **Tukey**.



3. Click **Continue** and then **OK**.

We should get the following output.

Multiple Comparisons

Dependent Variable: Science score

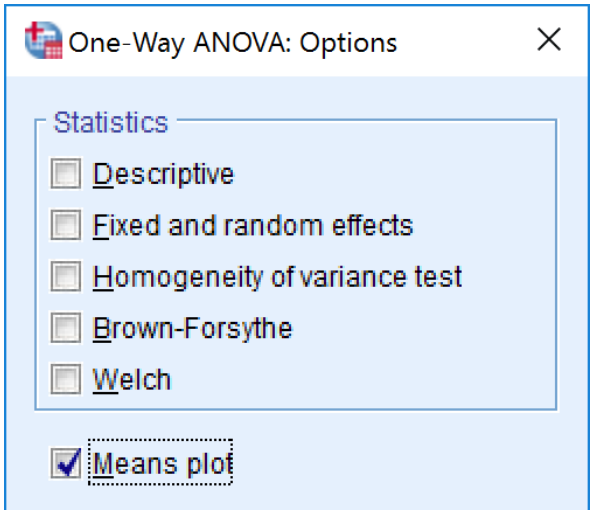
	(I) Socieconomic status	(J) Socieconomic status	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Low	Medium	-4.62434*	.95494	.000	-6.8680	-2.3807
		High	-7.97449*	1.07547	.000	-10.5014	-5.4476
	Medium	Low	4.62434*	.95494	.000	2.3807	6.8680
		High	-3.35015*	.90748	.001	-5.4823	-1.2180
	High	Low	7.97449*	1.07547	.000	5.4476	10.5014
		Medium	3.35015*	.90748	.001	1.2180	5.4823
Scheffe	Low	Medium	-4.62434*	.95494	.000	-6.9677	-2.2810
		High	-7.97449*	1.07547	.000	-10.6136	-5.3354
	Medium	Low	4.62434*	.95494	.000	2.2810	6.9677
		High	-3.35015*	.90748	.001	-5.5770	-1.1233
	High	Low	7.97449*	1.07547	.000	5.3354	10.6136
		Medium	3.35015*	.90748	.001	1.1233	5.5770

*. The mean difference is significant at the 0.05 level.

At $\alpha = .05$, we reject the null hypotheses $\mu_L = \mu_M$, $\mu_L = \mu_H$, and $\mu_M = \mu_H$.

We arrive at the same conclusions using either Tukey's or Scheffé's method.

Aside: There are various **Options** available under One-Way ANOVA. For now, we are only interested in Means plot.



We should get the following plot: