

One way – Between groups Anova

Research Question: Is there a difference in high school students level of satisfaction with school based on their family's socio-economic status?

The independent variable – is Social Economic Status of the high school students – Three Levels – **Low, Medium, High (Groups)**.

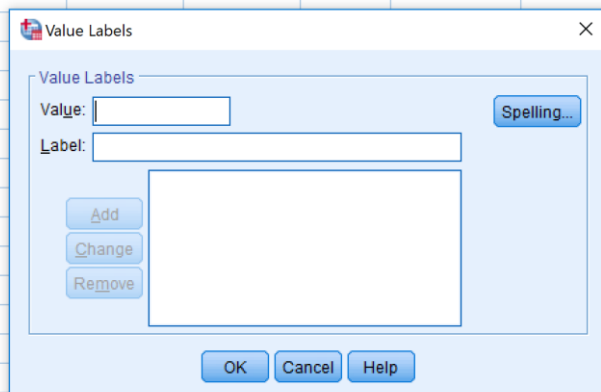
The Dependent variable – Scores on a satisfaction scale - The higher the score the more satisfied they are.

The Data Set.....

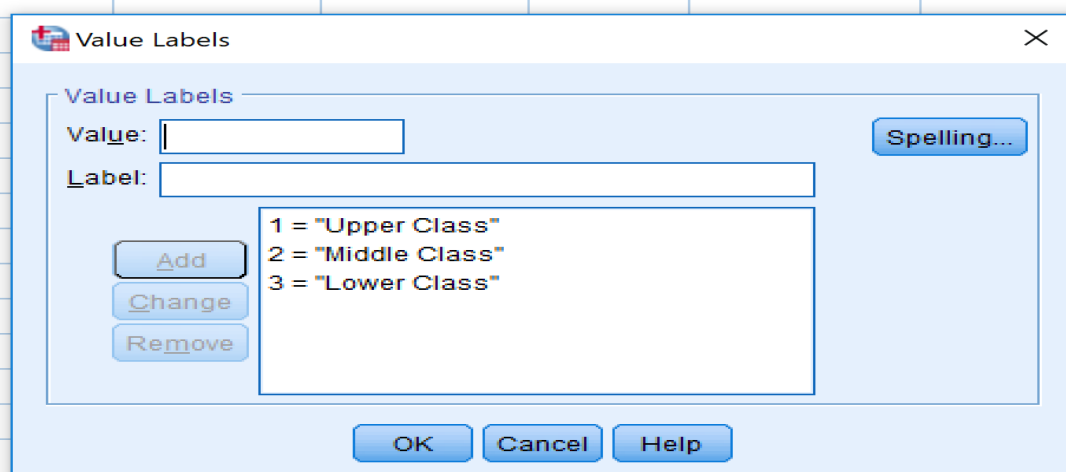
Between anova (data set to accompany powerpoint) (6).sav [DataSet1] - IBM SPSS Statistics Data Editor

	satisfacti on	SES	var	var	var	var	var	var	var
1	24	1							
2	23	1							
3	20	1							
4	26	1							
5	25	1							
6	27	1							
7	28	1							
8	29	1							
9	26	1							
10	27	1							
11	27	1							
12	27	1							
13	28	1							
14	24	1							
15	26	1							
16	20	2							
17	19	2							
18	18	2							
19	17	2							
20	17	2							
21	17	2							
22	18	2							
23	19	2							
24	16	2							
25	15	2							
26	18	2							
27	17	2							
28	18	2							
29	19	2							

First we need to make sure the groups are labelled into spss: So go into **Variable View** go the **values** box in the SES row and click on the three dots.



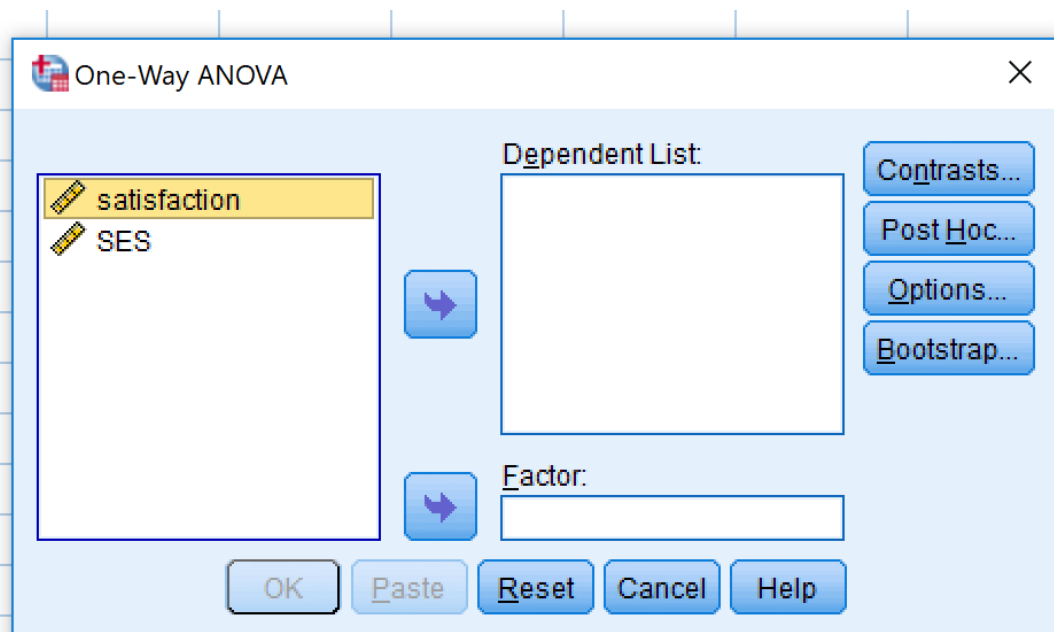
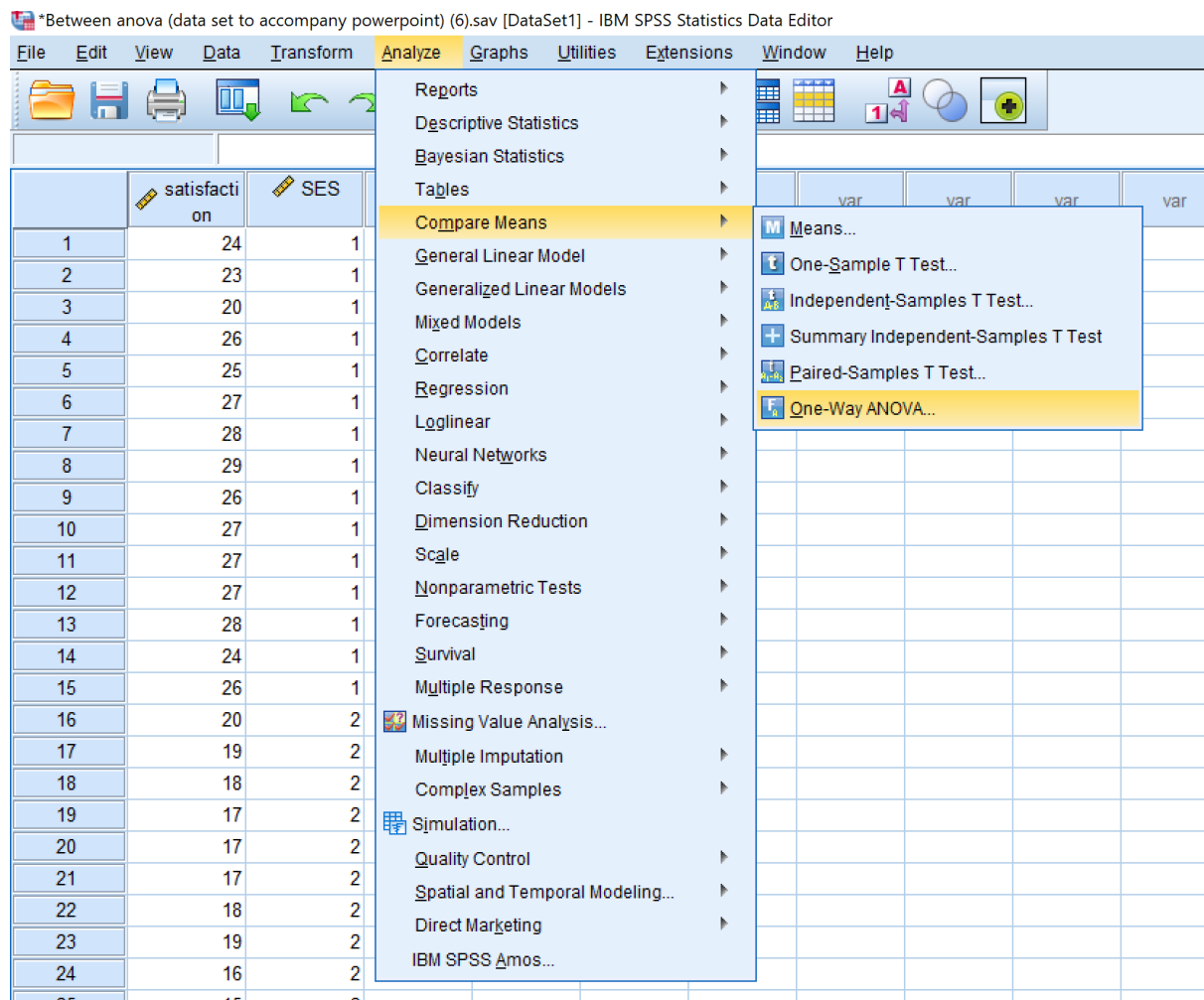
Group 1 is the Upper class group, Group 2 is the Middle Class Group and Group 3 is the Lower Class Group. So input these values in –Value type 1 in Label type Upper Class (then click add); 2 Value type 2 in Label type Middle Class (then click add); 3 Value type 3 in Label type Lower Class (then click add).



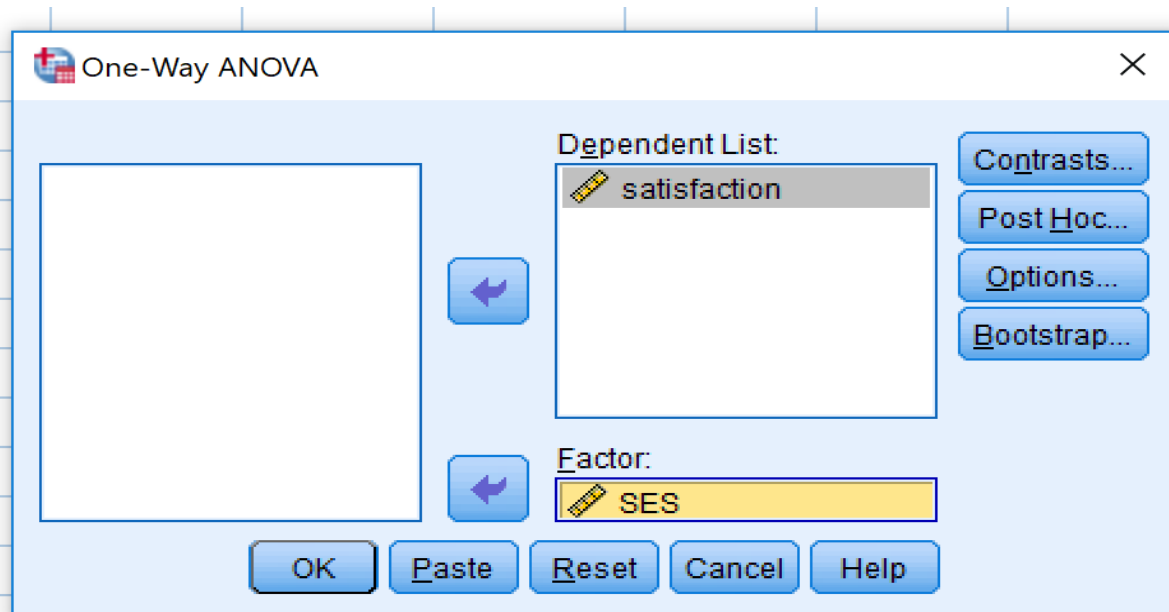
Then click OK and then go back to data view.

We are now ready to run our one way between groups anova.

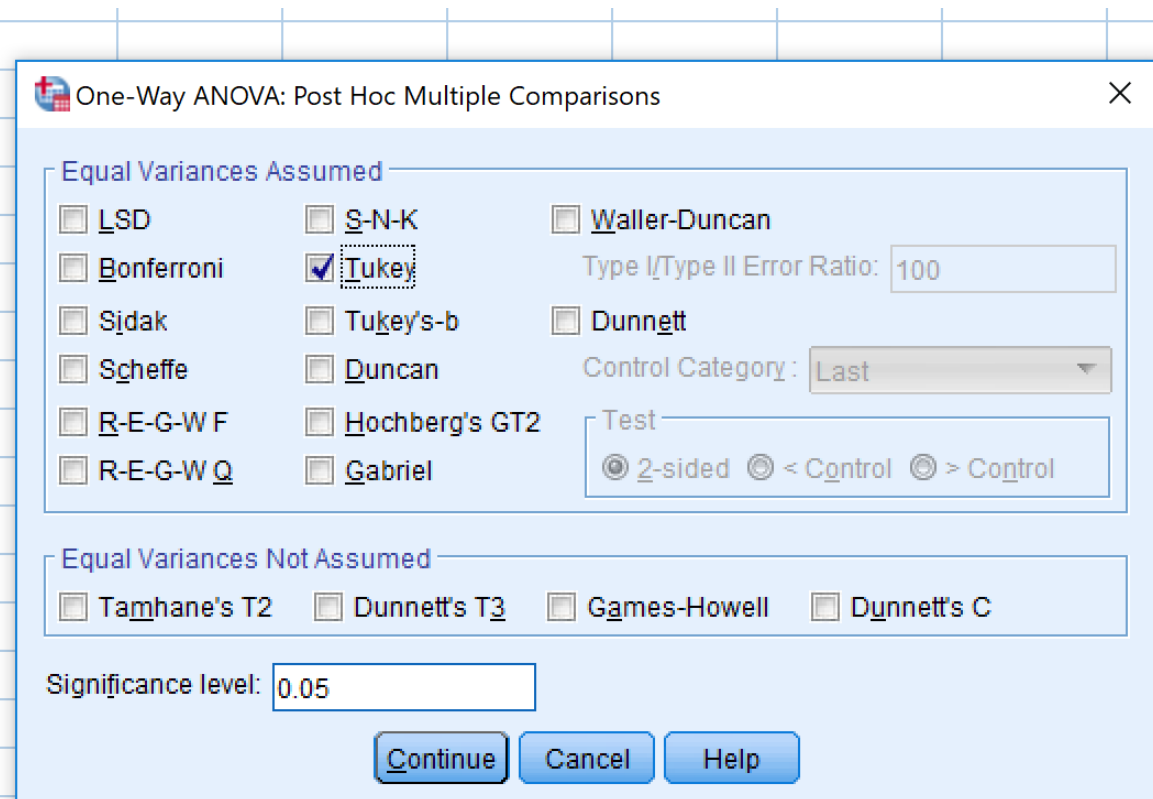
Go to Analyze..... Compare Means..... One Way Anova.



Drag-and-drop (or use the arrow buttons) to transfer the dependent variable (satisfaction) into the Dependent List: box and the independent variable (SES) into the Factor: box as indicted in the diagram below:

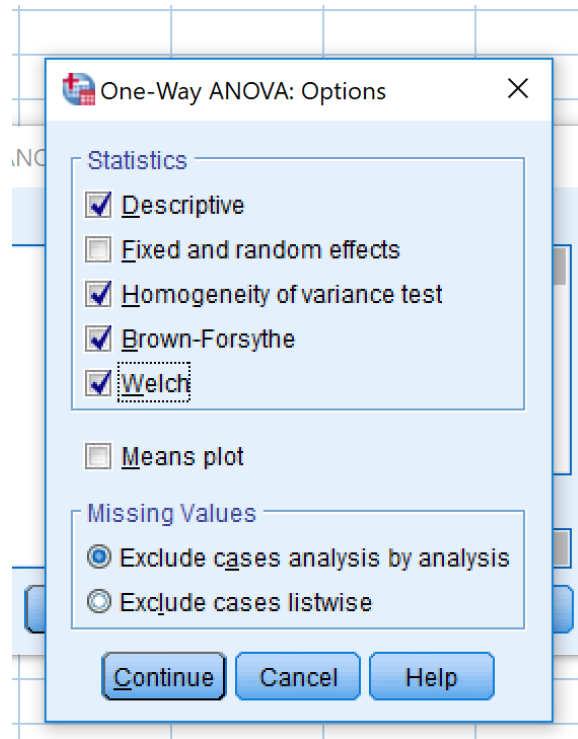


Click the **Post Hoc** button. Tick the "**Tukey**" checkbox as shown below:



Click Continue..... Then Click Options.

Then tick – “Descriptive”, "Homogeneity of variance test", “Brown-Forsythe” and "Welch" checkboxes in the Statistics area as shown below:



Then click Continue and then OK.

SPSS Output of the one-way ANOVA

SPSS generates quite a few tables in its one-way ANOVA analysis. We will go through each table in turn. Descriptives Table The descriptives table (see below) provides some very useful descriptive statistics including the mean, standard deviation and 95% confidence intervals for the dependent variable (Satisfaction) for each separate group (Upper Class, Middle Class & Lower Class) as well as when all groups are combined (Total). These figures are useful when you need to describe your data.

Descriptives

satisfaction	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Upper Class	15	25.80	2.305	.595	24.52	27.08	20	29
Middle Class	15	17.87	1.407	.363	17.09	18.65	15	20
Lower Class	15	11.47	2.066	.533	10.32	12.61	8	15
Total	45	18.38	6.231	.929	16.51	20.25	8	29

Homogeneity of Variances Table

One of the assumptions of the one-way ANOVA is that the variances of the groups you are comparing are similar. The table Test of Homogeneity of Variances (see below) shows the result of Levene's Test of Homogeneity of Variance, which tests for similar variances. If the significance value is greater than 0.05 (found in the Sig. column) then you have homogeneity of variances. We can see from this example that Levene's F Statistic has a significance value of 0.236 and, therefore, the assumption of homogeneity of variance has not been violated. What does this mean? This would mean that you do have similar variances and you will need to refer to the ANOVA Table. Had this Sig. value been less than 0.05 then we would needed to have refer to the Robust Tests of Equality of Means

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
satisfaction	Based on Mean	1.497	2	42	.236
	Based on Median	.975	2	42	.385
	Based on Median and with adjusted df	.975	2	36.235	.387
	Based on trimmed mean	1.349	2	42	.271

ANOVA Table

This is the table that shows the output of the ANOVA analysis and whether we have a statistically significant difference between our group means. We can see that in this example the significance level is 0.000 (P = .000), which is below 0.05 and, therefore, there is a statistically significant difference in the mean satisfaction scores between the different levels of socio economic status. This is great to know but we do not know which of the specific groups differed. Luckily, we can find this out in the Multiple Comparisons Table which contains the results of post-hoc tests

ANOVA

satisfaction

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1546.711	2	773.356	200.665	.000
Within Groups	161.867	42	3.854		
Total	1708.578	44			

Robust Tests of Equality of Means Table

We discussed earlier that even if there was a violation of the assumption of homogeneity of variances we could still determine whether there were significant differences between the groups by not using the traditional ANOVA but using the Welch or Brown-Forsythe test. Like the ANOVA test, if the significance value is less than 0.05 then there are statistically significant differences between groups. However, in this example there was homogeneity of variances, so for this example we can ignore this table. However, it is important to know what to do if homogeneity of variances has been violated.

Robust Tests of Equality of Means

satisfaction

	Statistic ^a	df1	df2	Sig.
Welch	156.897	2	26.641	.000
Brown-Forsythe	200.665	2	37.155	.000

a. Asymptotically F distributed.

Multiple Comparisons Table

From the results so far we know that there are significant differences between the groups as a whole. The table below, Multiple Comparisons, shows which groups differed from each other. The Tukey post-hoc test is generally the preferred test for conducting post-hoc tests on a one-way ANOVA but there are many others. We can see from the table below that there is a significant difference in satisfaction scores between the upper class group and the middle class group ($P = .000$) as well as between the upper class group and lower class group ($P = .000$) and between the lower and middle class groups ($P = .000$).

Multiple Comparisons

Dependent Variable: satisfaction

Tukey HSD

(I) SES	(J) SES	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
		(I-J)			Lower Bound	Upper Bound
Upper Class	Middle Class	7.933*	.717	.000	6.19	9.67
	Lower Class	14.333*	.717	.000	12.59	16.07
Middle Class	Upper Class	-7.933*	.717	.000	-9.67	-6.19
	Lower Class	6.400*	.717	.000	4.66	8.14
Lower Class	Upper Class	-14.333*	.717	.000	-16.07	-12.59
	Middle Class	-6.400*	.717	.000	-8.14	-4.66

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

The final table - Homogeneous Subsets can be ignored.

Reporting the Output of the one-way ANOVA

There was a statistically significant difference between groups as determined by one-way ANOVA ($F(2,44) = 200.665$, $p < .001$). A Tukey post-hoc test revealed that satisfaction scores was statistically lower in the lower class group (11.47, $P < .001$) compared to the middle class group (17.87, $P < .001$) and was statistically significantly highest in the upper class group (25.80, $P < .001$).