

How can I do ANOVA contrasts in SPSS?

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ANOVA contrasts in SPSS refer to a statistical analysis method used to compare the means of three or more groups. This technique allows researchers to determine if there are significant differences between the means of the groups being studied. To perform ANOVA contrasts in SPSS, one must first input the data into the software and specify the groups to be compared. Next, the appropriate ANOVA test must be selected and the desired contrast options must be specified. SPSS will then calculate the contrast values and provide the necessary statistical output for interpretation. This process can be useful in various research settings, such as comparing the effectiveness of different treatments or identifying significant differences between demographic groups. Overall, ANOVA contrasts in SPSS are a valuable tool for understanding and analyzing group differences in a systematic and rigorous manner.

How can I do ANOVA contrasts in SPSS? | SPSS FAQ

Let's use an example dataset, `crf24.sav`, adapted from Kirk (1968, First Edition).

```
get file 'c:tempcrf24.sav'.
```

These data are from a 2×4 factorial design but the same data can also be used for one-way ANOVA examples. The variable `y` is the dependent variable. The variable `a` is an independent variable with two levels, while `b` is an independent variable with four levels.

Using the contrast command in a one-way ANOVA

```
glm y by b.
```

N		
B	1	8

2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	194.500(a)	3	64.833	44.276	.000
Intercept	924.500	1	924.500	631.366	.000
B	194.500	3	64.833	44.276	.000
Error	41.000	28	1.464		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .826 (Adjusted R Squared = .807)					

means tables = y by b
/ cells mean.

Cases						
Included	Excluded	Total				
N	Percent	N	Percent	N	Percent	
Y * B	32	100.0%	0	.0%	32	100.0%

B	Y
1	2.75
2	3.50
3	6.25
4	9.00
Total	5.38

It is quite clear that there is a significant overall F for

the independent variable b

($F(3, 28) = 44.276, p = .000$). Now, let's devise some contrasts that we can test:

1) group 3 versus group 4

2) the average of groups 1 and 2 versus the average of groups 3 and 4

3) the average of groups 1, 2, and 3 versus group 4

glm y by b

/contrast(b)=special (0 0 1 -1).

N		
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	194.500(a)	3	64.833	44.276	.000
Intercept	924.500	1	924.500	631.366	.000
B	194.500	3	64.833	44.276	.000
Error	41.000	28	1.464		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .826 (Adjusted R Squared = .807)					

Dependent Variable		
B Special Contrast	Y	

L1	Contrast Estimate	-2.750
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-2.750	
Std. Error	.605	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-3.989
Upper Bound	-1.511	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	30.250	1	30.250	20.659	.000
Error	41.000	28	1.464		

**This contrast is statistically significant
($F(1, 28) = 20.659, p = .000$).**

glm y by b

/contrast(b)=special (1 1 -1 -1).

N		
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	194.500(a)	3	64.833	44.276	.000
Intercept	924.500	1	924.500	631.366	.000
B	194.500	3	64.833	44.276	.000
Error	41.000	28	1.464		
Total	1160.000	32			

Corrected Total	235.500	31			
a R Squared = .826 (Adjusted R Squared = .807)					

Dependent Variable		
B Special Contrast	Y	
L1	Contrast Estimate	-9.000
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-9.000	
Std. Error	.856	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-10.753
Upper Bound	-7.247	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	162.000	1	162.000	110.634	.000
Error	41.000	28	1.464		

This contrast is also statistically significant ($F(1, 28) = 110.634, p = .000$).

glm y by b

/contrast(b)=special (1 1 1 -3).

N		
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	194.500(a)	3	64.833	44.276	.000
Intercept	924.500	1	924.500	631.366	.000
B	194.500	3	64.833	44.276	.000
Error	41.000	28	1.464		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .826 (Adjusted R Squared = .807)					

Dependent Variable		
B Special Contrast	Y	
L1	Contrast Estimate	-14.500
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-14.500	
Std. Error	1.482	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-17.536
	Upper Bound	-11.464

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	140.167	1	140.167	95.724	.000
Error	41.000	28	1.464		

This contrast is also statistically significant ($F(1, 28) = 95.724, p = .000$).

Note that you can enter multiple contrasts in a single subcommand, as shown below. Each contrast

must be separated by a comma. While you get the significance

tests for each individual test,

you do not get the t-value. To obtain the t-value, you will have to divide the contrast estimate by the std. error in the Contrast Results (K Matrix)

table.

glm y by b

/contrast(b)=special (0 0 1 -1, 1 1 -1 -1, 1 1 1 -3).

N		
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	194.500(a)	3	64.833	44.276	.000
Intercept	924.500	1	924.500	631.366	.000
B	194.500	3	64.833	44.276	.000
Error	41.000	28	1.464		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .826 (Adjusted R Squared = .807)					

Dependent Variable		
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B Special Contrast		Y	
L1		Contrast Estimate	-2.750
Hypothesized Value		0	
Difference (Estimate - Hypothesized)		-2.750	
Std. Error		.605	
Sig.		.000	
95% Confidence Interval for Difference		Lower Bound	-3.989
Upper Bound		-1.511	
L2		Contrast Estimate	-9.000
Hypothesized Value		0	
Difference (Estimate - Hypothesized)		-9.000	
Std. Error		.856	
Sig.		.000	
95% Confidence Interval for Difference		Lower Bound	-10.753
Upper Bound		-7.247	
L3		Contrast Estimate	-14.500
Hypothesized Value		0	
Difference (Estimate - Hypothesized)		-14.500	
Std. Error		1.482	
Sig.		.000	
95% Confidence Interval for Difference		Lower Bound	-17.536
Upper Bound		-11.464	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	192.250	2	96.125	65.646	.000
Error	41.000	28	1.464		

Using the contrast command in a two-way ANOVA

Now let's try the same contrasts on b but in a two-way

ANOVA.

glm y by a b.

N		
A	1	16
2	16	
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	217.000(a)	7	31.000	40.216	.000
Intercept	924.500	1	924.500	1199.351	.000
A	3.125	1	3.125	4.054	.055
B	194.500	3	64.833	84.108	.000
A * B	19.375	3	6.458	8.378	.001
Error	18.500	24	.771		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .921 (Adjusted R Squared = .899)					

glm y by a b

/contrast(b)=special (0 0 1 -1).

N		
A	1	16
2	16	

B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	217.000(a)	7	31.000	40.216	.000
Intercept	924.500	1	924.500	1199.351	.000
A	3.125	1	3.125	4.054	.055
B	194.500	3	64.833	84.108	.000
A * B	19.375	3	6.458	8.378	.001
Error	18.500	24	.771		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .921 (Adjusted R Squared = .899)					

Dependent Variable		
B Special Contrast	Y	
L1	Contrast Estimate	-2.750
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-2.750	
Std. Error	.439	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-3.656
Upper Bound	-1.844	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	30.250	1	30.250	39.243	.000
Error	18.500	24	.771		

glm y by a b

/contrast(b)=special (1 1 -1 -1).

N		
A	1	16
2	16	
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	217.000(a)	7	31.000	40.216	.000
Intercept	924.500	1	924.500	1199.351	.000
A	3.125	1	3.125	4.054	.055
B	194.500	3	64.833	84.108	.000
A * B	19.375	3	6.458	8.378	.001
Error	18.500	24	.771		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .921 (Adjusted R Squared = .899)					

Dependent Variable		
B Special Contrast	Y	
L1	Contrast Estimate	-9.000
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-9.000	
Std. Error	.621	
Sig.	.000	

95% Confidence Interval for Difference	Lower Bound	-10.281
Upper Bound	-7.719	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	162.000	1	162.000	210.162	.000
Error	18.500	24	.771		

glm y by a b
/contrast(b)=special (1 1 1 -3).

N		
A	1	16
2	16	
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	217.000(a)	7	31.000	40.216	.000
Intercept	924.500	1	924.500	1199.351	.000
A	3.125	1	3.125	4.054	.055
B	194.500	3	64.833	84.108	.000
A * B	19.375	3	6.458	8.378	.001
Error	18.500	24	.771		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .921 (Adjusted R Squared = .899)					

Dependent Variable		
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B Special Contrast	Y	
L1	Contrast Estimate	-14.500
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-14.500	
Std. Error	1.075	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-16.719
Upper Bound	-12.281	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	140.167	1	140.167	181.838	.000
Error	18.500	24	.771		

Note that the F-ratios in these contrasts are larger than the F-ratios in the one-way ANOVA example. This is because the two-way ANOVA has a smaller mean square residual than the one-way ANOVA.

SPSS has a number of built-in contrasts that you can use, of which special (used in the above examples) is only one. Below is a table listing those contrasts with an explanation of the contrasts that they make and an example of how the syntax works. The repeated contrast compares group 1 with 2, 2 with 3, and 3 with 4 as shown in the Contrast Results (K Matrix)

table in the results.

Name of contrast	Comparison made
Simple	Compares each level of a variable to the last level (or whichever level is specified)
Deviation	Compares deviations from the grand mean
Difference	Compares levels of a variable with the mean of the previous levels of the variable
Helmert	Compare levels of a variable with the mean of the subsequent levels of the variable
Polynomial	Orthogonal polynomial contrasts
Repeated	Adjacent levels of a variable
Special	User-defined contrast

glm y by a b

/contrast(b)=repeated.

N		
A	1	16
2	16	
B	1	8
2	8	
3	8	
4	8	

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	217.000(a)	7	31.000	40.216	.000
Intercept	924.500	1	924.500	1199.351	.000
A	3.125	1	3.125	4.054	.055
B	194.500	3	64.833	84.108	.000
A * B	19.375	3	6.458	8.378	.001

Error	18.500	24	.771		
Total	1160.000	32			
Corrected Total	235.500	31			
a R Squared = .921 (Adjusted R Squared = .899)					

Dependent Variable		
B Repeated Contrast	Y	
Level 1 vs. Level 2	Contrast Estimate	-0.750
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-0.750	
Std. Error	.439	
Sig.	.100	
95% Confidence Interval for Difference	Lower Bound	-1.656
Upper Bound	.156	
Level 2 vs. Level 3	Contrast Estimate	-2.750
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-2.750	
Std. Error	.439	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-3.656
Upper Bound	-1.844	
Level 3 vs. Level 4	Contrast Estimate	-2.750
Hypothesized Value	0	
Difference (Estimate - Hypothesized)	-2.750	
Std. Error	.439	
Sig.	.000	
95% Confidence Interval for Difference	Lower Bound	-3.656
Upper Bound	-1.844	

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	194.500	3	64.833	84.108	.000
Error	18.500	24	.771		

For more information on coding contrasts, please see How can I use the Imatrix subcommand to understand a three-way interaction in ANOVA? .

References

Kirk, Roger E. (1968) Experimental Design: Procedures for the Behavioral Sciences. Monterey, California: Brooks/Cole Publishing.