

TWO-WAY ANOVA

To perform an ANOVA with two between-subjects factors, specify the dependent variable (here, *ach100*) and the two factors by which to break it down (here, *grp4* and *account*). The second line requests a post-hoc test for a factor with more than two levels (*grp4*); no post-hoc test is needed for a factor with only two levels (such as *account*). The third line requests descriptive statistics.

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unianova ach100 by grp4 account
  /posthoc grp4 (tukey)
  /print desc .
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Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Exp. group	1	4 SP	26
	2	2 SP	27
	3	2 SP, 3 WP	27
	4	2 SP, 6 WP	26
Social accountability	0	no	51
	1	yes	55

The first part of the output (above) shows the variable and value labels for each factor, plus the sample size of each level of each factor.

The second part of the output (below) shows the sample size, mean, and standard deviation of each cell in the design. Here, there are 8 cells in the 4 (exp. group) x 2 (social accountability) design.

Descriptive Statistics

Dependent Variable: Achievement, 100 cases

Exp. group	Social accountability	Mean	Std. Deviation	N
4 SP	no	.43723	4.5967E-02	12
	yes	.43932	8.5086E-02	14
	Total	.43835	6.8524E-02	26
2 SP	no	.42004	3.8517E-02	12
	yes	.39122	6.5338E-02	15
	Total	.40403	5.6030E-02	27
2 SP, 3 WP	no	.35427	7.6816E-02	13
	yes	.31608	.10008	14
	Total	.33447	9.0051E-02	27
2 SP, 6 WP	no	.34171	7.4845E-02	14
	yes	.34033	.10478	12
	Total	.34107	8.7998E-02	26
Total	no	.38582	7.3368E-02	51
	yes	.37323	9.9029E-02	55
	Total	.37929	8.7445E-02	106

Tests of Between-Subjects Effects

Dependent Variable: Achievement, 100 cases

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.215 ^a	7	3.069E-02	5.115	.000
Intercept	15.205	1	15.205	2534.039	.000
GRP4	.199	3	6.624E-02	11.040	.000
ACCOUNT	7.229E-03	1	7.229E-03	1.205	.275
GRP4 * ACCOUNT	7.892E-03	3	2.631E-03	.438	.726
Error	.588	98	6.000E-03		
Total	16.052	106			
Corrected Total	.803	105			

a. R Squared = .268 (Adjusted R Squared = .215)

The third part of the output provides a standard ANOVA summary table, including SS, df, MS, F, and p (labeled "Sig") for each main effect and the interaction. There is a reliable main effect across experimental conditions, $F(3, 98) = 11.04$, $p < .001$, which is explored further below. There is no reliable main effect for social accountability, $F(1, 98) = 1.21$, $p = .275$. There is no reliable interaction effect, $F(3, 98) = .44$, $p = .726$.

A Bar Graph or a Line Graph can be useful for visually inspecting group differences, particularly if there is a reliable interaction effect. Likewise, a table obtained with the Means procedure can provide the means relevant to interpreting any main effect or interaction term.

When a factor with a reliable main effect has more than two levels (e.g., grp4), a post-hoc test needs to be conducted to determine which levels differ from one another. Below, Tukey's test is illustrated. The results are presented in two ways, each of which provides the same information. (These results are identical to those in the illustrative example for One-Way ANOVA.)

In the "Multiple Comparisons" table, all possible pairs of groups are compared to one another. If you look at the p value for each comparison (labeled "Sig."), you can tell whether the two groups compared on that line differ reliably. In the example below, you could tell that all groups differ from one another with two exceptions: "4 SP" does not differ from "2 SP," and "2 SP, 3 WP" does not differ from "2 SP, 6 SP".

This information is presented in another form in the "Homogeneous Subsets" table. To read this table, any groups whose means appear in the same column do not differ reliably, whereas any groups whose means appear in different columns do differ reliably. This leads to the same conclusion as above: the "2 SP" and "4 SP" groups do not differ from one another, but each differs from the "2 SP, 3 WP" and "2 SP, 6 WP" groups, which in turn do not differ from one another. (It is a worthwhile exercise to verify for yourself that you reach identical conclusions using either table of post-hoc results.)

Post Hoc Tests

Exp. group

Multiple Comparisons

Dependent Variable: Achievement, 100 cases

Tukey HSD

(I) Exp. group	(J) Exp. group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
4 SP	2 SP	3.4324E-02	2.128E-02	.376	-2.13058E-02	8.9954E-02
	2 SP, 3 WP	.10389*	2.128E-02	.000	4.8257E-02	.15952
	2 SP, 6 WP	9.7281E-02*	2.148E-02	.000	4.1128E-02	.15343
2 SP	4 SP	-3.43242E-02	2.128E-02	.376	-8.99542E-02	2.1306E-02
	2 SP, 3 WP	6.9563E-02*	2.108E-02	.007	1.4460E-02	.12467
	2 SP, 6 WP	6.2957E-02*	2.128E-02	.020	7.3266E-03	.11859
2 SP, 3 WP	4 SP	-.10389*	2.128E-02	.000	-.15952	-4.82572E-02
	2 SP	-6.95630E-02*	2.108E-02	.007	-.12467	-1.44603E-02
	2 SP, 6 WP	-6.60641E-03	2.128E-02	.990	-6.22364E-02	4.9024E-02
2 SP, 6 WP	4 SP	-9.72808E-02*	2.148E-02	.000	-.15343	-4.11284E-02
	2 SP	-6.29566E-02*	2.128E-02	.020	-.11859	-7.32657E-03
	2 SP, 3 WP	6.6064E-03	2.128E-02	.990	-4.90236E-02	6.2236E-02

Based on observed means.

*. The mean difference is significant at the .050 level.

Homogeneous Subsets

Achievement, 100 cases

Tukey HSD^{a,b,c}

Exp. group	N	Subset	
		1	2
2 SP, 3 WP	27	.33447	
2 SP, 6 WP	26	.34107	
2 SP	27		.40403
4 SP	26		.43835
Sig.		.990	.376

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 6.000E-03.

a. Uses Harmonic Mean Sample Size = 26.491.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .050.