

**SPSS Test Practice Problem 1**

**2 way Mixed ANOVA**

**ANSWER KEY**

Which factor is within subjects? stress management technique

Which factor is between subjects? personality

**PART A Assumptions**

Explain why Mauchly's test of sphericity was tested in this example.

because the within-subjects factor had 3 levels

W value	prob	signif (y/n)	assumption holds true (y/n)
1.00	.965	n	y

To test for HOV, look at the Levene's test results:

	F value	prob	signif (y/n)	assumption holds true (y/n)
meditation	1.35	.260	n	y
PMR	.03	.856	n	y
kickboxing	1.04	.322	n	y

## PART B Inferential Statistics

Effect tested	df , df	F value	Sig value	Partial eta sq	Signif? y/n
main effect personality	1, 18	.56	.464	.030	n
main effect of technique	2, 36	.11	.895	.006	n
personality x technique	2, 36	23.48	<.001	.566	y

Write down all 3 effects using correct APA statistical notation format.

main effect of personality	$F(1,18) = .56, p > .05, \eta_p^2 = .030$
main effect of technique	$F(2,36) = .11, p > .05, \eta_p^2 = .006$
personality X technique	$F(2,36) = 23.48, p < .001, \eta_p^2 = .566$

## PART C Post hoc tests

Was a post hoc test on the within-subjects factor necessary? Explain why or why not.

A post hoc test was NOT necessary because although the within-subjects factor (technique) had more than two levels, the main effect was not significant.

Was a post hoc test necessary for the between-subjects factor? Explain your answer.

A post hoc test for the between-subjects factor (personality) was not necessary because it has only two levels and the main effect was not significant.

### **PART D Understanding the Interaction Effect**

Look at your graph to help answer the questions below. Use the “refined” overlapping nonoverlapping error bar rule you learned about to see which mean is probably different from which.

Describe the effect of personality in the **meditation condition** and specify the direction of the differences, if any.

When meditating, introverts have lower SC than extraverts – probably.

Describe the effect of personality in the **PMR condition** and specify the direction of the differences, if any.

When doing PMR, introverts have lower SC than extraverts – probably.

Describe the effect of personality in the **kickboxing condition** and specify the direction of the differences, if any.

When kickboxing, extraverts have lower SC than introverts – probably

Describe the effect of stress management technique for **introverts** and specify the direction of the differences, if any.

Compared to kick boxing, SC was lower for both meditation and PMR, which did not differ from each other - probably

Describe the effect of stress management technique for **extraverts** and specify the direction of the differences, if any.

SC for kick boxing was lower compared to both meditation and PRM, which did not differ from each other - probably

## General Linear Model

### Within-Subjects Factors

Measure: MEASURE\_1

technique	Dependent Variable
1	meditation
2	PMR
3	kickboxing

### Between-Subjects Factors

	Value Label	N	
personality	1.00	extravert	10
	2.00	introvert	10

### Descriptive Statistics

	personality	Mean	Std. Deviation	N
meditation	extravert	20.3000	6.92901	10
	introvert	11.0000	4.16333	10
	Total	15.6500	7.32893	20
PMR	extravert	17.9000	5.38413	10
	introvert	11.9000	4.97661	10
	Total	14.9000	5.91074	20
kickboxing	extravert	9.0000	3.97213	10
	introvert	21.1000	6.26188	10
	Total	15.0500	8.03594	20

**Box's Test of  
Equality of  
Covariance Matrices<sup>a</sup>**

Box's M	5.428
F	.739
df1	6
df2	2347.472
Sig.	.618

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + personality

Within Subjects Design:  
technique

**Multivariate Tests<sup>a</sup>**

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
technique	Pillai's Trace	.012	.104 <sup>b</sup>	2.000	17.000	.902	.012
	Wilks' Lambda	.988	.104 <sup>b</sup>	2.000	17.000	.902	.012
	Hotelling's Trace	.012	.104 <sup>b</sup>	2.000	17.000	.902	.012
	Roy's Largest Root	.012	.104 <sup>b</sup>	2.000	17.000	.902	.012

technique * personality	Pillai's Trace	.716	21.379 <sup>b</sup>	2.000	17.000	<.001	.716
	Wilks' Lambda	.284	21.379 <sup>b</sup>	2.000	17.000	<.001	.716
	Hotelling's Trace	2.515	21.379 <sup>b</sup>	2.000	17.000	<.001	.716
	Roy's Largest Root	2.515	21.379 <sup>b</sup>	2.000	17.000	<.001	.716

a. Design: Intercept + personality

Within Subjects Design: technique

b. Exact statistic

### Mauchly's Test of Sphericity<sup>a</sup>

Measure: MEASURE\_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon <sup>b</sup>		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
technique	.996	.072	2	.965	.996	1.000	.500

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

a. Design: Intercept + personality

Within Subjects Design: technique

b. 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.

### Tests of Within-Subjects Effects

Measure: MEASURE\_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
technique	Sphericity Assumed	6.300	2	3.150	.111	.895	.006
	Greenhouse-Geisser	6.300	1.992	3.163	.111	.894	.006
	Huynh-Feldt	6.300	2.000	3.150	.111	.895	.006
	Lower-bound	6.300	1.000	6.300	.111	.742	.006
technique * personality	Sphericity Assumed	1327.433	2	663.717	23.481	<.001	.566
	Greenhouse-Geisser	1327.433	1.992	666.518	23.481	<.001	.566
	Huynh-Feldt	1327.433	2.000	663.717	23.481	<.001	.566
	Lower-bound	1327.433	1.000	1327.433	23.481	<.001	.566
Error(technique)	Sphericity Assumed	1017.600	36	28.267			
	Greenhouse-Geisser	1017.600	35.849	28.386			
	Huynh-Feldt	1017.600	36.000	28.267			
	Lower-bound	1017.600	18.000	56.533			

### Tests of Within-Subjects Contrasts

Measure: MEASURE\_1

Source	technique	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
technique	Linear	3.600	1	3.600	.120	.733	.007
	Quadratic	2.700	1	2.700	.102	.753	.006
technique * personality	Linear	1144.900	1	1144.900	38.058	<.001	.679
	Quadratic	182.533	1	182.533	6.901	.017	.277



Error(technique)	Linear	541.500	18	30.083		
	Quadratic	476.100	18	26.450		

### Levene's Test of Equality of Error Variances<sup>a</sup>

		Levene Statistic	df1	df2	Sig.
meditation	Based on Mean	1.352	1	18	.260
	Based on Median	.758	1	18	.396
	Based on Median and with adjusted df	.758	1	12.320	.401
	Based on trimmed mean	1.268	1	18	.275
PMR	Based on Mean	.034	1	18	.856
	Based on Median	.025	1	18	.875
	Based on Median and with adjusted df	.025	1	17.756	.876
	Based on trimmed mean	.031	1	18	.862
kickboxing	Based on Mean	1.037	1	18	.322
	Based on Median	.971	1	18	.337
	Based on Median and with adjusted df	.971	1	14.661	.340
	Based on trimmed mean	1.019	1	18	.326

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

a. Design: Intercept + personality

Within Subjects Design: technique

### Tests of Between-Subjects Effects

Measure: MEASURE\_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	13862.400	1	13862.400	454.339	<.001	.962
personality	17.067	1	17.067	.559	.464	.030
Error	549.200	18	30.511			

### Estimated Marginal Means

technique

#### Estimates

Measure: MEASURE\_1

technique	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	15.650	1.278	12.965	18.335
2	14.900	1.159	12.464	17.336
3	15.050	1.172	12.587	17.513

### Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.012	.104 <sup>a</sup>	2.000	17.000	.902	.012
Wilks' lambda	.988	.104 <sup>a</sup>	2.000	17.000	.902	.012
Hotelling's trace	.012	.104 <sup>a</sup>	2.000	17.000	.902	.012
Roy's largest root	.012	.104 <sup>a</sup>	2.000	17.000	.902	.012

Each F tests the multivariate effect of technique. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

### Profile Plots

