**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 | .034 | .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, ηp2 = .030 |
| main effect of technique | *F*(2,36) = .11, *p* >. 05, ηp2 = .006 |
| personality X technique | *F*(2,36) = 23.48, *p <* .001, ηp2 = .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 Matricesa** | | |
| 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 | | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Multivariate Testsa** | | | | | | | |
| Effect | | Value | F | Hypothesis df | Error df | Sig. | Partial Eta Squared |
| technique | Pillai's Trace | .012 | .104b | 2.000 | 17.000 | .902 | .012 |
| Wilks' Lambda | .988 | .104b | 2.000 | 17.000 | .902 | .012 |
| Hotelling's Trace | .012 | .104b | 2.000 | 17.000 | .902 | .012 |
| Roy's Largest Root | .012 | .104b | 2.000 | 17.000 | .902 | .012 |
| technique \* personality | Pillai's Trace | .716 | 21.379b | 2.000 | 17.000 | <.001 | .716 |
| Wilks' Lambda | .284 | 21.379b | 2.000 | 17.000 | <.001 | .716 |
| Hotelling's Trace | 2.515 | 21.379b | 2.000 | 17.000 | <.001 | .716 |
| Roy's Largest Root | 2.515 | 21.379b | 2.000 | 17.000 | <.001 | .716 |
| a. Design: Intercept + personality  Within Subjects Design: technique | | | | | | | |
| b. Exact statistic | | | | | | | |

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| **Mauchly's Test of Sphericitya** | | | | | | | |
| Measure: MEASURE\_1 | | | | | | | |
| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Epsilonb | | |
| 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. | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |  |  |  |

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| **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 |  |  |  |

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| --- | --- | --- | --- | --- | --- |
| **Levene's Test of Equality of Error Variancesa** | | | | | |
|  | | 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 | | | | | |

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| --- | --- | --- | --- | --- | --- | --- |
| **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 | .104a | 2.000 | 17.000 | .902 | .012 |
| Wilks' lambda | .988 | .104a | 2.000 | 17.000 | .902 | .012 |
| Hotelling's trace | .012 | .104a | 2.000 | 17.000 | .902 | .012 |
| Roy's largest root | .012 | .104a | 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 | | | | | | |

Chart, box and whisker chart

Description automatically generated

**Profile Plots**