Rucha Rane

MGS 9950: Homework 3

1. **Compare Type I and Type II SS for the variable 'horse' between orders 1 and 2 and explain your findings.**

**Order 1: Tests of Between-Subjects Effects**

Dependent Variable: mpg

| Source | Type I Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 5560.036[a] | 5 | 1112.007 | 189.194 | .000 |
| Intercept | 78269.461 | 1 | 78269.461 | 13316.591 | .000 |
| horse | 4383.197 | 1 | 4383.197 | 745.747 | .000 |
| accel | 171.630 | 1 | 171.630 | 29.201 | .000 |
| displace | 782.264 | 1 | 782.264 | 133.093 | .000 |
| cylinder | 30.555 | 1 | 30.555 | 5.198 | .024 |
| weight | 192.391 | 1 | 192.391 | 32.733 | .000 |
| Error | 1140.252 | 194 | 5.878 | | |
| Total | 84969.750 | 200 | | | |
| Corrected Total | 6700.289 | 199 | | | |

a. R Squared = .830 (Adjusted R Squared = .825)

**Order 1: Tests of Between-Subjects Effects**

Dependent Variable: mpg

| Source | Type II Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 5560.036[a] | 5 | 1112.007 | 189.194 | .000 |
| Intercept | 1509.207 | 1 | 1509.207 | 256.773 | .000 |
| horse | 4.884 | 1 | 4.884 | .831 | .363 |
| accel | 8.459 | 1 | 8.459 | 1.439 | .232 |
| displace | 23.531 | 1 | 23.531 | 4.004 | .047 |
| cylinder | 5.098 | 1 | 5.098 | .867 | .353 |
| weight | 192.391 | 1 | 192.391 | 32.733 | .000 |
| Error | 1140.252 | 194 | 5.878 | | |
| Total | 84969.750 | 200 | | | |
| Corrected Total | 6700.289 | 199 | | | |

a. R Squared = .830 (Adjusted R Squared = .825

**Order 2: Tests of Between-Subjects Effects**

Dependent Variable: mpg

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| Source | Type I Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 5560.036[a] | 5 | 1112.007 | 189.194 | .000 |
| Intercept | 78269.461 | 1 | 78269.461 | 13316.591 | .000 |
| weight | 5446.173 | 1 | 5446.173 | 926.600 | .000 |
| cylinder | 72.433 | 1 | 72.433 | 12.324 | .001 |
| displace | 32.719 | 1 | 32.719 | 5.567 | .019 |
| accel | 3.829 | 1 | 3.829 | .651 | .421 |
| horse | 4.884 | 1 | 4.884 | .831 | .363 |
| Error | 1140.252 | 194 | 5.878 | | |
| Total | 84969.750 | 200 | | | |
| Corrected Total | 6700.289 | 199 | | | |

a. R Squared = .830 (Adjusted R Squared = .825)

**Order 2: Tests of Between-Subjects Effects**

Dependent Variable: mpg

| Source | Type II Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 5560.036[a] | 5 | 1112.007 | 189.194 | .000 |
| Intercept | 1509.207 | 1 | 1509.207 | 256.773 | .000 |
| weight | 192.391 | 1 | 192.391 | 32.733 | .000 |
| cylinder | 5.098 | 1 | 5.098 | .867 | .353 |
| displace | 23.531 | 1 | 23.531 | 4.004 | .047 |
| accel | 8.459 | 1 | 8.459 | 1.439 | .232 |
| horse | 4.884 | 1 | 4.884 | .831 | .363 |
| Error | 1140.252 | 194 | 5.878 | | |
| Total | 84969.750 | 200 | | | |
| Corrected Total | 6700.289 | 199 | | | |

a. R Squared = .830 (Adjusted R Squared = .825)

The SS for 'horse' is the same for order 1 Type II, order 2 Type II, and order 2 Type II (4.884). It is larger for order 1 Type I (4383.197). The Type II values are the same because they are independent of the order in which the independent variables are entered into the model. The Type I SS is larger than for the other SS values because 'horse' was entered first into the model and given the most weight.

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2. **Calculate Type I and Type II semi-partial and partial R-square according to order 1. What is the mathematical relationship between semi-partial and partial R-square. Discuss and explain your findings.**

Type I:

Semi Partial R-square= SSR/SST

= 5560.036/6700.289

=0.829820326

Partial R-Square = SSR/SSE

=5560.036/1140.252

= 4.87614668

**Order 1: Regression ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4383.197 | 1 | 4383.197 | 374.553 | .000[b] |
| | Residual | 2317.092 | 198 | 11.702 | | |
| | Total | 6700.289 | 199 | | | |
| 2 | Regression | 4554.827 | 2 | 2277.413 | 209.116 | .000[c] |
| | Residual | 2145.462 | 197 | 10.891 | | |
| | Total | 6700.289 | 199 | | | |
| 3 | Regression | 5337.091 | 3 | 1779.030 | 255.788 | .000[d] |
| | Residual | 1363.198 | 196 | 6.955 | | |
| | Total | 6700.289 | 199 | | | |
| 4 | Regression | 5367.645 | 4 | 1341.911 | 196.356 | .000[e] |
| | Residual | 1332.644 | 195 | 6.834 | | |
| | Total | 6700.289 | 199 | | | |
| 5 | Regression | 5560.036 | 5 | 1112.007 | 189.194 | .000[f] |
| | Residual | 1140.252 | 194 | 5.878 | | |
| | Total | 6700.289 | 199 | | | |

a. Dependent Variable: mpg

b. Predictors: (Constant), horse

c. Predictors: (Constant), horse, accel

d. Predictors: (Constant), horse, accel, displace

e. Predictors: (Constant), horse, accel, displace, cylinder

f. Predictors: (Constant), horse, accel, displace, cylinder, weight

Mathematical relationship between partial and semi partial R-square: They differ in the base to which they relate the unique variance as a proportion: Semi-partial takes as its base the total variance of Y, whereas the partial takes as its base that proportion of Y variance not accounted for by the other sets. Inevitably, with its base smaller than (at most equal to) 1, partial will be larger than or at least equal to semi partial for any given set.

3. **Conduct a hypothesis test to achieve the following goal: does the performance index (horse, accel) still contribute to explain variation of mpg after controlling the impact of physical characteristics (display, cylinder, weight)?**

   $F(3),(194)=$

**Order 2: Regression ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5446.173 | 1 | 5446.173 | 859.843 | .000[b] |
| | Residual | 1254.116 | 198 | 6.334 | | |
| | Total | 6700.289 | 199 | | | |
| 2 | Regression | 5518.605 | 2 | 2759.303 | 460.007 | .000[c] |
| | Residual | 1181.683 | 197 | 5.998 | | |
| | Total | 6700.289 | 199 | | | |
| 3 | Regression | 5551.324 | 3 | 1850.441 | 315.664 | .000[d] |
| | Residual | 1148.965 | 196 | 5.862 | | |
| | Total | 6700.289 | 199 | | | |
| 4 | Regression | 5555.153 | 4 | 1388.788 | 236.490 | .000[e] |
| | Residual | 1145.136 | 195 | 5.872 | | |
| | Total | 6700.289 | 199 | | | |
| 5 | Regression | 5560.036 | 5 | 1112.007 | 189.194 | .000[f] |
| | Residual | 1140.252 | 194 | 5.878 | | |
| | Total | 6700.289 | 199 | | | |

a. Dependent Variable: mpg

b. Predictors: (Constant), weight

c. Predictors: (Constant), weight, cylinder

d. Predictors: (Constant), weight, cylinder, displace

e. Predictors: (Constant), weight, cylinder, displace, accel

f. Predictors: (Constant), weight, cylinder, displace, accel, horse

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**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 37.720 | .637 | | 59.208 | .000 |
| | weight | -.006 | .000 | -.902 | -29.323 | .000 |
| 2 | (Constant) | 38.019 | .626 | | 60.740 | .000 |
| | weight | -.004 | .000 | -.673 | -9.297 | .000 |
| | cylinder | -.824 | .237 | -.251 | -3.475 | .001 |
| 3 | (Constant) | 35.787 | 1.130 | | 31.682 | .000 |
| | weight | -.004 | .001 | -.571 | -6.838 | .000 |
| | cylinder | -.251 | .337 | -.077 | -.744 | .458 |
| | displace | -.014 | .006 | -.280 | -2.362 | .019 |
| 4 | (Constant) | 36.902 | 1.784 | | 20.680 | .000 |
| | weight | -.003 | .001 | -.553 | -6.401 | .000 |
| | cylinder | -.261 | .338 | -.080 | -.772 | .441 |
| | displace | -.016 | .006 | -.315 | -2.494 | .013 |
| | accel | -.067 | .083 | -.033 | -.807 | .420 |
| 5 | (Constant) | 38.355 | 2.394 | | 16.024 | .000 |
| | weight | -.003 | .001 | -.525 | -5.721 | .000 |
| | cylinder | -.321 | .344 | -.098 | -.931 | .353 |
| | displace | -.014 | .007 | -.271 | -2.001 | .047 |
| | accel | -.127 | .106 | -.063 | -1.200 | .232 |
| | horse | -.011 | .012 | -.081 | -.912 | .363 |

a. Dependent Variable: mpg

Hypothesis Test:

Ho : Beta 4 = Beta 5 =0

Ha : Either Beta 4 or Beta 5 is not equal to 0

From the table, both the p value for performance index is significant (checking the p-value for the F-test)

This implies that we reject Ho and Accept Ha. This implies that controlling for the impact of physical characteristics, the performance index still contributes to explain the variation of mpg.