

Model Answers to ANCOVA and MANOVA worksheet**1. ANCOVA:**

A one-way between-groups analysis of covariance (ANCOVA) was conducted to compare the effectiveness of three different teaching methods (traditional, interactive, and group work) on students' test scores to assess which group had retained the most information from the one-hour session. The independent variable was the group of teaching method the students were assigned and the dependant variable was student scores on a test. IQ level was used as the covariate in this analysis to ensure that any potential differences that may emerge from the study are due to the difference in teaching method and not any pre-existing differences in students' ability. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variance, and homogeneity of regression slopes. After adjusting for IQ scores, there was a statistically significant difference in test scores between students in the three different teaching style methods groups, $F(2, 11) = 16.18, p < 0.01$, partial eta squared = 0.75. The adjusted mean scores for the three teaching style method groups were as follows: Traditional = 17.71, Interactive = 11.95, and Group work = 9.15. Follow-up tests between the three groups revealed that scores were significantly better following the traditional teaching method compared to the interactive and group work teaching methods ($p < 0.01$, and $p < 0.001$, respectively). However, there was no significant differences in scores between the interactive and group work teaching methods ($p = 0.28$). These findings suggest that when taking student IQ in to consideration, the traditional teaching style worked best.

2. MANOVA:

A one-way between-groups multivariate analysis of variance (MANOVA) was conducted to assess which of two new manufactured fuels that are compatible with petrol engine cars is better in terms of how much damage they cause to the engine and the number of miles that can be travelled per litre of fuel. The between-groups factor was the two different fuel types (carrot juice and water), and the two dependent variables were engine condition rating and miles per litre. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was a statistically significant difference found between the two fuel types (carrot juice and water) on the combined dependant variable (best type of new fuel) $F(2, 21) = 6.60, p < 0.01$; Wilks' Lambda = 0.61, partial eta squared = 0.39. When the results for the dependent variables were considered separately, the only difference to reach statistical significance, using a Bonferroni adjusted alpha level of 0.025, was the amount of miles per litre $F(1, 22) = 13.75, p < 0.01$, partial eta squared = 0.39. An inspection of the mean scores indicated that the water fuel was capable of running for significantly more miles per litre ($M=13.33, SD=2.35$) than the carrot juice fuel ($M=10.00, SD=2.05$). The engine condition ratings did not significantly differ between the two fuel types $F(1, 22) = 0.42, p = 0.52$, partial eta squared = 0.02. Based on these results, the oil company may wish to consider marketing the water-based fuel as an alternative to petrol.