# MAT 303 Module Two Problem Set Report

Interaction Terms and Qualitative Predictors

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Note: Replace the bracketed text on page one (the cover page) with your personal information.

## 1. Introduction

*Discuss the statement of the problem with regard to the statistical analyses that are being performed. Address the following questions in your analysis:*

* *What is the data set that you are exploring?*
* *How might your results be used?*
* *What type of analyses will you be running in this problem set?*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

## 2. Data Preparation

*There are some important variables that you have been asked to analyze in this problem set. Identify and explain these variables. Address the following questions in your analysis:*

* *What are the important variables in this data set?*
* *How many rows and columns are present in this data set?*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

## 3. Model with Interaction Term

### Correlation Analysis

*Describe the relationships between variables in the data set. Address the following questions in your analysis:*

* *Calculate Pearson Correlation Coefficients between fuel economy (mpg) and horsepower (hp); fuel economy and quarter mile time (qsec); and fuel economy and rear axle ratio (drat). Comment on the strength and direction of these correlation coefficients.*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

### Reporting Results

*Report the results of the regression model. Address the following questions in your analysis:*

* *Write the general form and the prediction equation of the regression model for fuel economy using horsepower, quarter mile time, and rear axle ratio as predictors. Include interaction terms for horsepower and quarter mile time; horsepower and rear axle ratio.*
* *Create the regression model for fuel economy using horsepower, quarter mile time, and rear axle ratio as predictors. Include interaction terms for horsepower and quarter mile time; horsepower and rear axle ratio.* *Write the prediction model equation using outputs obtained from your R script.*
* *What are the values of (R-squared) and (Adjusted R-squared) for the model? Provide your interpretation of these statistics.*
* *For this model, estimate the change in fuel economy of a car with 160 horsepower for each unit increase in quarter mile time. Explain your answer.*
* *Now estimate the change in fuel economy of a car with 160 horsepower for each unit increase in rear axle ratio. Explain your answer.*
* *Obtain fitted values and residuals using the model for the data set and create the following plots:* 
  + *Residuals against Fitted Values*
  + *Normal Q-Q plot*
* *Based on these plots, what can you say about the assumptions of homoscedasticity and normality of the residuals? Be detailed in your response.*

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### Evaluating Model Significance

*Evaluate model significance for the regression model. Address the following questions in your analysis:*

* *Is the model significant at a 5% level of significance? Carry out the overall F-test by identifying the null hypothesis, the alternative hypothesis, the P-value, and the conclusion of the test.*
* *Which terms in the model are significant at a 5% level of significance? Carry out individual beta tests by identifying the null hypothesis, the alternative hypothesis, the P-value, and the conclusion of the test.*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

### Making Predictions Using the Model

*Make predictions using the regression model. Address the following questions in your analysis:*

* *What is the predicted fuel economy for a car that has 175 horsepower, 14.2 quarter mile time and 3.91 rear-axle ratio?*
* *What is the 95% prediction interval for the fuel economy of this car? Interpret the interval.*
* *What is the 95% confidence interval for the fuel economy of this car? Interpret the interval.*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

## 4. Model with Interaction Term and Qualitative Predictor

### Reporting Results

*Report the results of the regression model. Address the following questions in your analysis:*

* *Write the general form and the prediction equation of the regression model for fuel economy using horsepower, quarter mile time, interaction term for horsepower and quarter mile time, and number of cylinders. Note that number of cylinders is a qualitative predictor.*
* *Create the regression model for fuel economy using horsepower, quarter mile time, interaction term for horsepower and quarter mile time, and number of cylinders. Note that number of cylinders is a qualitative predictor. Write the prediction model equation using outputs obtained from your R script. Let us call this model 2.*
* *What are the values of (R-squared) and (adjusted R-squared) for the model? Provide your interpretation of these statistics.*
* *Obtain fitted values and residuals for the data set using model 2 and create the following plots:* 
  + *Residuals against Fitted Values*
  + *Normal Q-Q plot*
* *Based on these plots, what can you say about the assumptions of homoscedasticity and normality of the residuals? Be detailed in your response.*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

### Evaluating Model Significance

*Evaluate model significance for the regression model. Address the following questions in your analysis:*

* *Is the model significant at a 5% level of significance? Carry out the overall F-test by identifying the null hypothesis, the alternative hypothesis, the P-value, and the conclusion of the test.*
* *Which terms in the model are significant at a 5% level of significance? Carry out individual beta tests by identifying the null hypothesis, the alternative hypothesis, the P-value, and the conclusion of the test.*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

### Making Predictions Using the Model

*Make predictions using the regression model. Address the following questions in your analysis:*

* *Using the second model, what is the predicted fuel economy for a car that has 175 horsepower, 14.2 quarter mile time and 6 cylinders? Note that the number of cylinders is a qualitative variable. Therefore, set it equal to '6' (using single quotes).*
* *What is the 95% prediction interval for the fuel economy of this car? Interpret the interval.*
* *What is the 95% confidence interval for the fuel economy of this car? Interpret the interval.*
* *Why are prediction intervals wider than confidence intervals?*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

## 5. Conclusion

*Describe the results of the statistical analyses and address the following questions:*

* *Based on the analysis that you have performed here and assuming that the sample size is sufficiently large, which model would you recommend?*
* *Fully describe what these results mean for your scenario using proper descriptions of statistical terms and concepts.*
* *What is the practical importance of the analyses that were performed?*

Caution sign icon Answer the questions in a paragraph response. Remove all questions and this note before submitting! Do not include R code in your report.

## 6. Citations

*You are not required to use external resources for this report. If none were used, remove this entire section. However, if you used any resources to help you with your interpretation, you must cite them. Use proper APA format for citations.*

*Insert references here in the following format:*

Author's Last Name, First Initial. Middle Initial. (Year of Publication). Title of book: Subtitle of book, edition. Place of Publication: Publisher.