Regression Models Project - Motor Trend Data 'mtcars' Miles Per Gallon Analysis

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EXECUTIVE SUMMARY

Add after completion of analysis

Problem Statement & Question(s) to be answered

Assuming you work for Motor Trend, a magazine about the automobile industry. Looking at the data set of a collection of cars ("mtcars") you know that;

They are interested in exploring the relationship between a set of variables and the miles per gallon (mpg) outcome.

They are particularly interested in the following two questions:

```
## Q1 "Is an automatic or manual transmission better for 'mpg'"
## Q2 "Quantify the MPG difference between automatic and manual transmissions"
```

Planned Approach

Experimental Design Considerations

```
Correlation
Deviance
Descriptive
        is.na
        str
        summary
Exploratory
Simple linear comparisons
Multivariate
        Additive
        Multiplicative
        Missing
        Steped
Coefficients
Residuals
        Influence
        Leverage
Inferential
        Null Hypothesis
```

```
            Alternative Hypothesis
            Power or Alpha
            Confidence Interval = .95, one or two sided?
            pValue
            R^2
    Predictive ~ NA
    Causal ~ NA
    Mechanistic ~ NA
```

Software Environment

System / session Info:

```
## R version 3.3.1 (2016-06-21)
## Platform: x86_64-apple-darwin13.4.0 (64-bit)
## Running under: OS X 10.11.6 (El Capitan)
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## loaded via a namespace (and not attached):
##  [1] magrittr_1.5    formatR_1.4     tools_3.3.1     htmltools_0.3.5
##  [5] yaml_2.1.13     Rcpp_0.12.7     stringi_1.1.1   rmarkdown_1.0
##  [9] knitr_1.14      stringr_1.1.0   digest_0.6.10   evaluate_0.9
```

Access the Data:

Raw Data overview:

Motor Trend 'mtcars' data set

```
rm(list = ls())
data("mtcars")
any(is.na(mtcars))
```

```
## [1] FALSE
```

```
head(mtcars,5)
```

```
##                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
```

Process data:

    Transformations;
            1 factor variables 8:11;
            2 change variable labels in columns 8 & 9;
                    a Note for column header 8 = vs; V = V block motor, & S = Straight block motor;
                    b Note for column header 9 = am; A = automatic transmission = A, & M = manual transs

```
data("mtcars")
mtcars$vs <- factor(mtcars$vs, labels = c("V", "S")); mtcars$am <- factor(mtcars$am, labels = c("A", "M
str(mtcars)
```

```
## 'data.frame':    32 obs. of  11 variables:
##  $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
##  $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
##  $ disp: num  160 160 108 258 360 ...
##  $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
##  $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
##  $ wt  : num  2.62 2.88 2.32 3.21 3.44 ...
##  $ qsec: num  16.5 17 18.6 19.4 17 ...
##  $ vs  : Factor w/ 2 levels "V","S": 1 1 2 2 1 2 1 2 2 2 ...
##  $ am  : Factor w/ 2 levels "A","M": 2 2 2 1 1 1 1 1 1 1 ...
##  $ gear: Factor w/ 3 levels "3","4","5": 2 2 2 1 1 1 1 2 2 2 ...
##  $ carb: Factor w/ 6 levels "1","2","3","4",..: 4 4 1 1 2 1 4 2 2 4 ...
```

```
head(mtcars)
```

```
##                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  V  M    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  V  M    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  S  M    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  S  A    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  V  A    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  S  A    3    1
```

Exploratory Analysis

    Histograms
    Boxplots
    Rug
    Barplots
    Scatterplots
    Multiple plots
    Graphing - base, lattice, ggpplot2
    ABline (h/v)
    Confidence intervals
    Standard error
    Variance
    Fitted lines

```
State the H0 & Ha hypothesis here
        Comparisons
        Causality?
        Multivariate
        Nested Analysis
        Summaries
        Boxplots
        Histograms
        Rug
        Barplot
        ABline (h/v)
        Scatterplot
        Multiple scatter plots
        Graphing - base, lattice, ggpplot2
        Heatmap
        K-Means
        Dimension Reduction
                PCA
                SVD
        Figures: Exploratory
```

Statistical Modeling, Regression & Model Fit

```
Simple Linear Regression
Multivariate Linear Regression
        lm - simple
        lm - multivariate
        lm - nested
        lm - remove the intercept (-1)
        lm - step function
Coefficients / Slope
Standard Error
T-Vales
pValues
Residuals
        Leverage
        Influence
Confidence Intervals
Residuals
Hatvalues
dfbetas
Influence Measures
Anova
        Chisq
Ancova
GLM
        ?
        ?
```

Assumptions Main:

```
A
B
C
```

Preliminary Findings: Quesions of Interest: & Interpretation of Results;

```
        A
        B
        C
```

Inference

```
Hypothesis testing
Set Seed, if required
One or Two Sided Test
Power / Alpha
Beta = (1 - Alpha)
Confidence Intervals (.95 one sided, .975 two sided)
Standard Error
Variance
student's T-score
Z-score
p-Values
Residual Plots with diagnostics see Appendix
```

Conclusions / Recommendations

```
A
B
C
        Challenge the results ?
        Measures of uncertainty 'e'
```

What are some possible alternative analyses?

```
???
```

Appendix A

```
Plots with Code
        Pairs
        Histograms
```

```
            Box Plots
            QQ Plots
            Fitted
            Residuals
            Residuals vs Fitted
```

=== END ===