Comprehensive Analysis of Vehicle Data: Linear and Logistic Regression Models

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Introduction

In this analysis, we delve into the complexities of vehicle data with the goal of understanding the intricacies of vehicle pricing and the predictive factors that classify vehicle categories. By employing linear and logistic regression models, we extract meaningful insights and contribute to the strategic decision-making process in the automotive industry.

```r
# Load the dataset from a previous deliverable.
load("Cars_Data_Del2.RData")

# Remove rows containing missing values (NA) to ensure the data is clean.
df <- na.omit(df)
```

Linear Regression Analysis

```r
# Display the structure of the dataframe.
str(df)
```

```
## 'data.frame':    4828 obs. of  10 variables:
##  $ model       : chr  " A1" " A1" " Q3" " A3" ...
##  $ year        : int  2016 2016 2016 2014 2014 2017 2016 2017 2017 2014 ...
##  $ price       : num  11000 13900 15700 13900 17000 17300 20000 19500 16500 15000 ...
##  $ transmission: chr  "Manual" "Automatic" "Automatic" "Automatic" ...
##  $ mileage     : num  29946 32260 28396 30516 34110 ...
##  $ fuelType    : chr  "Petrol" "Petrol" "Diesel" "Petrol" ...
##  $ tax         : int  30 30 145 30 145 145 200 145 125 205 ...
##  $ mpg         : num  55.4 58.9 53.3 56.5 47.9 67.3 47.1 61.4 51.4 47.9 ...
##  $ engineSize  : num  1.4 1.4 2 1.4 1.4 2 2 2 1.4 2 ...
##  $ manufacturer: chr  "Audi" "Audi" "Audi" "Audi" ...
##  - attr(*, "na.action")= 'omit' Named int [1:172] 77 83 88 170 178 198 225 277 306 363 ...
##   ..- attr(*, "names")= chr [1:172] "596" "633" "678" "1544" ...
```

```r
# Convert pricing and other features to numeric types for regression analysis.
df$price <- as.numeric(df$price)
df$year <- as.numeric(df$year)
df$mpg <- as.numeric(df$mpg)
df$mileage <- as.numeric(df$mileage)
```

```r
df$engineSize <- as.numeric(df$engineSize)

# Create a binary target variable for the logistic regression model based on vehicle pricing.
threshold <- median(df$price, na.rm = TRUE) # Determine the classification threshold.
df$y <- ifelse(df$price > threshold, 1, 0) # Classify vehicles based on the threshold.
df$y <- as.factor(df$y) # Convert the binary target variable into a factor.

# Convert model attributes to factors for categorical analysis.
df$model <- as.factor(df$model)
df$transmission <- as.factor(df$transmission)
df$fuelType <- as.factor(df$fuelType)
df$manufacturer <- as.factor(df$manufacturer)
```

The initial linear regression models assess the impact of various numerical features on vehicle pricing. The following steps include model fitting, multicollinearity checks, and diagnostic plotting to ensure model accuracy and reliability.

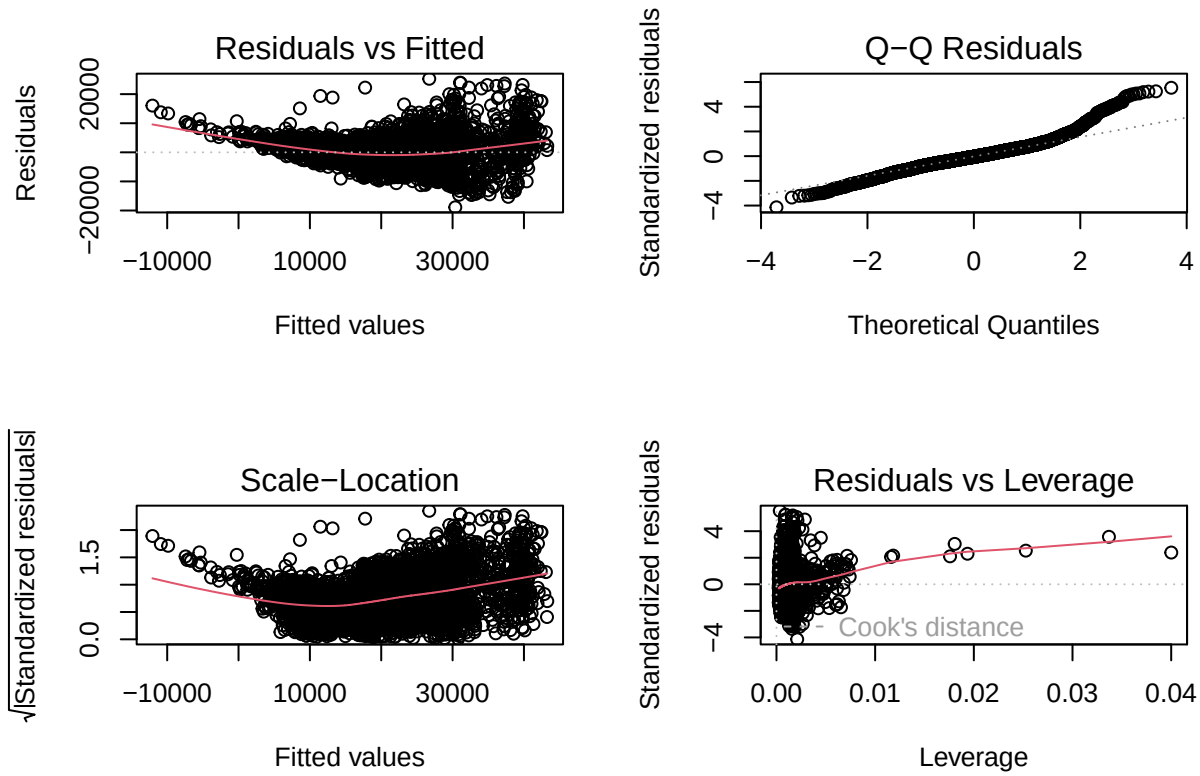
```r
# Fit the initial linear model to predict vehicle pricing.
model_1 <- lm(price ~ mpg + year + engineSize + mileage, data = df)
summary(model_1)
```

```
##
## Call:
## lm(formula = price ~ mpg + year + engineSize + mileage, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18894.9  -2523.1   -250.2   2316.1  25271.4
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -3.713e+06  1.012e+05  -36.69   <2e-16 ***
## mpg         -1.895e+02  6.773e+00  -27.98   <2e-16 ***
## year         1.848e+03  5.011e+01   36.88   <2e-16 ***
## engineSize   9.261e+03  1.389e+02   66.68   <2e-16 ***
## mileage     -9.420e-02  4.976e-03  -18.93   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4566 on 4823 degrees of freedom
## Multiple R-squared:  0.7648, Adjusted R-squared:  0.7646
## F-statistic:  3921 on 4 and 4823 DF,  p-value: < 2.2e-16
```

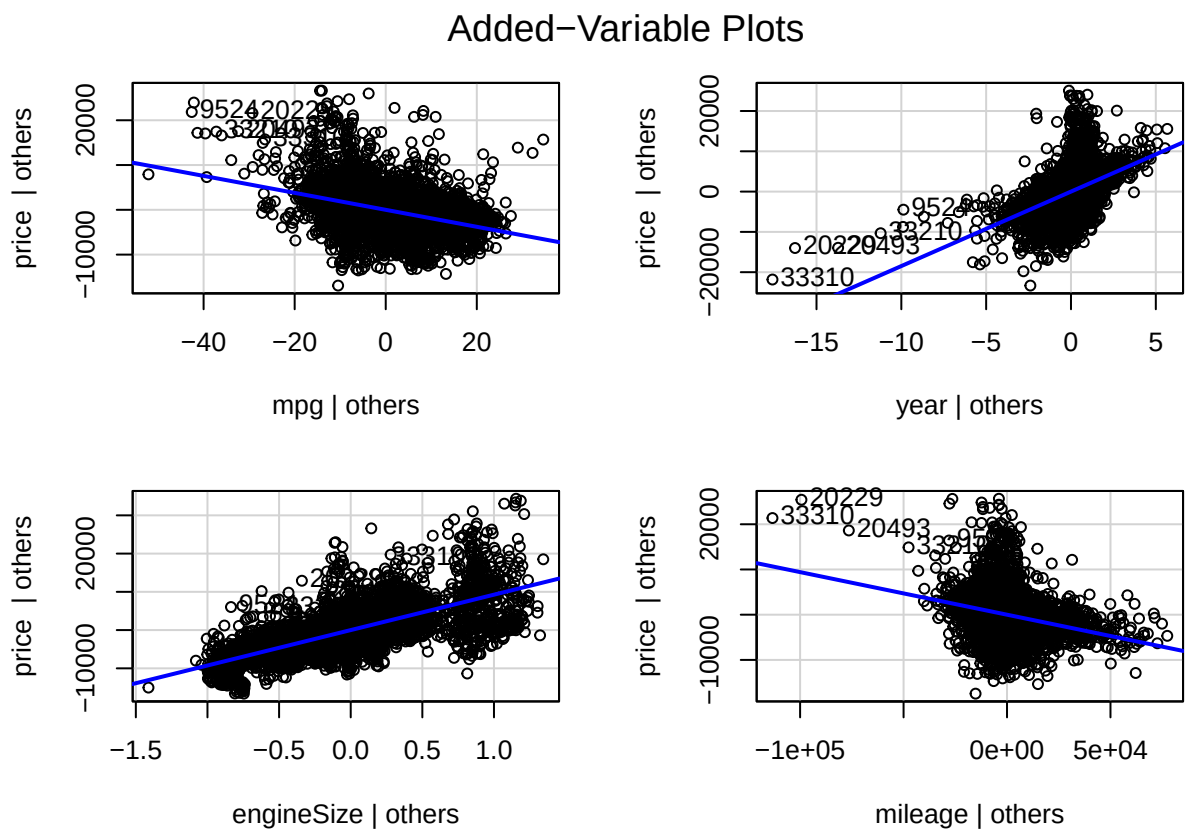
```r
# Assess multicollinearity using the Variance Inflation Factor (VIF).
vif(model_1)
```

```
##        mpg       year engineSize    mileage
##   1.326963   2.430906   1.162692   2.593955
```

```r
# Diagnostic plots to assess model fit and identify potential outliers or influential points.
par(mfrow=c(2,2))
plot(model_1, id.n=0)
```

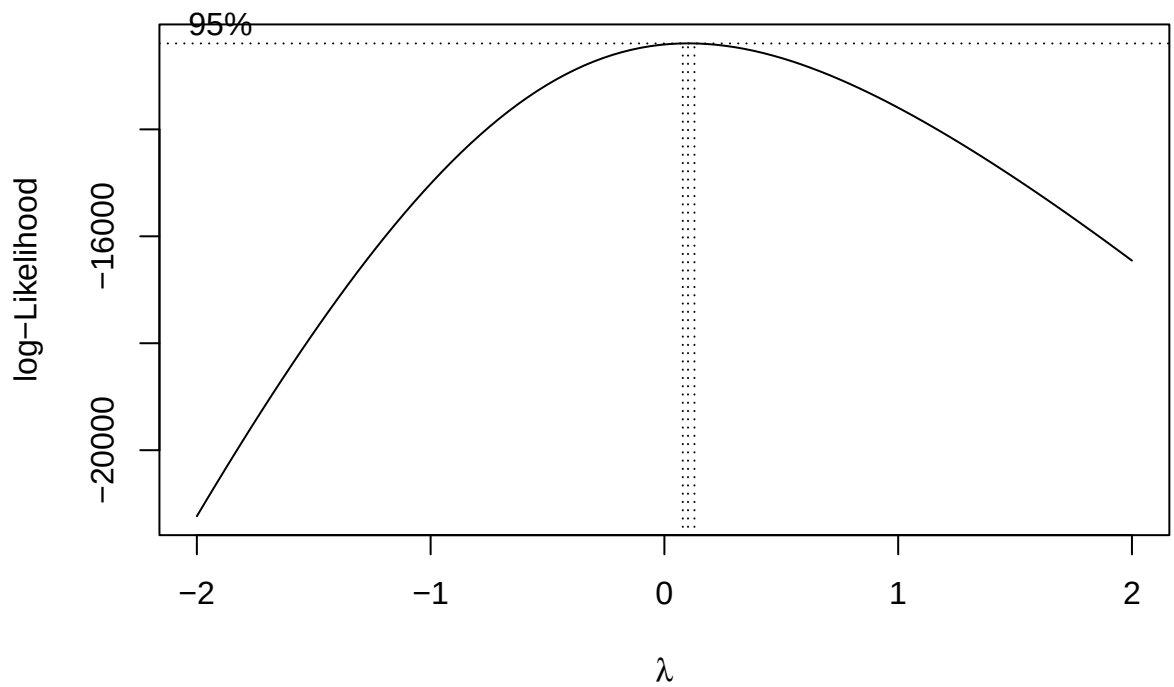



```
avPlots(model_1, id=list(method=cooks.distance(model_1), n=5))
```



Subsequent models incorporate transformations and additional variables to refine the analysis. The Box-Cox transformation assesses the need for a data transformation to meet linear model assumptions.

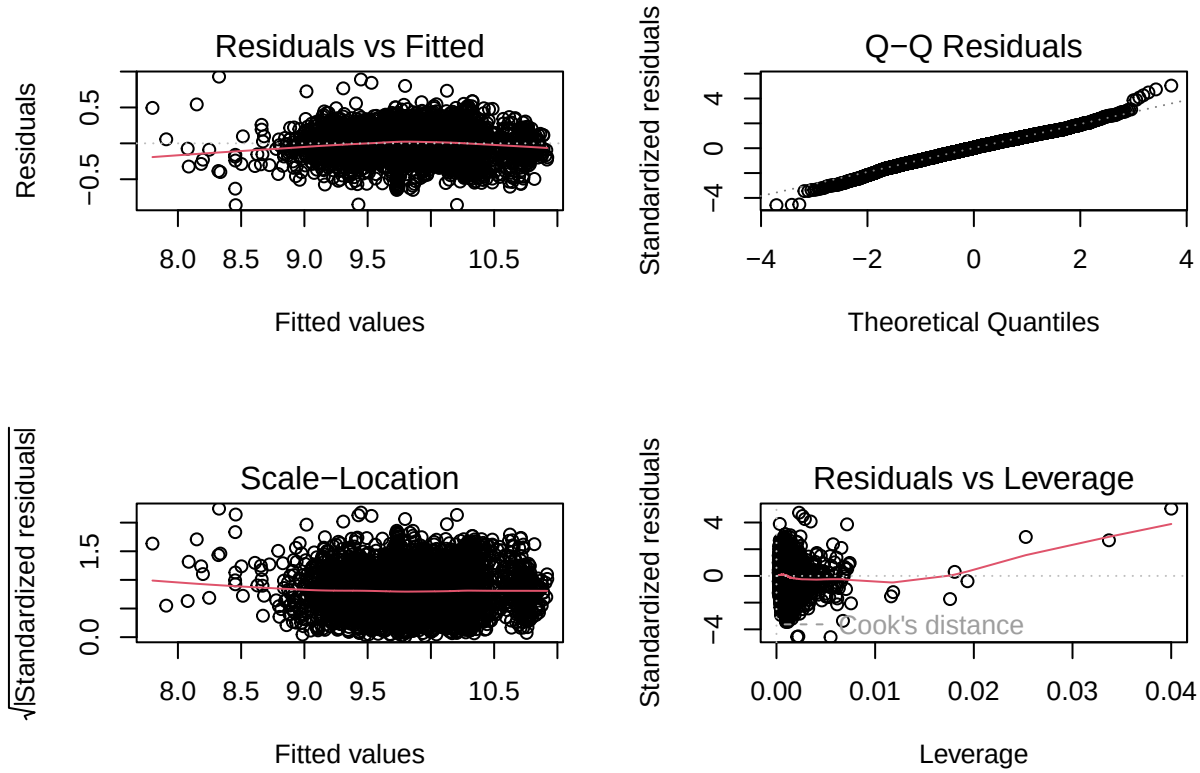
```
# Load the MASS package for Box-Cox transformation.
library(MASS)

# Single plot layout for clarity.
par(mfrow=c(1,1))

# Perform a Box-Cox transformation to determine the optimal transformation for linear model fitting.
boxcox(price ~ mpg + year + engineSize + mileage, data = df)
```



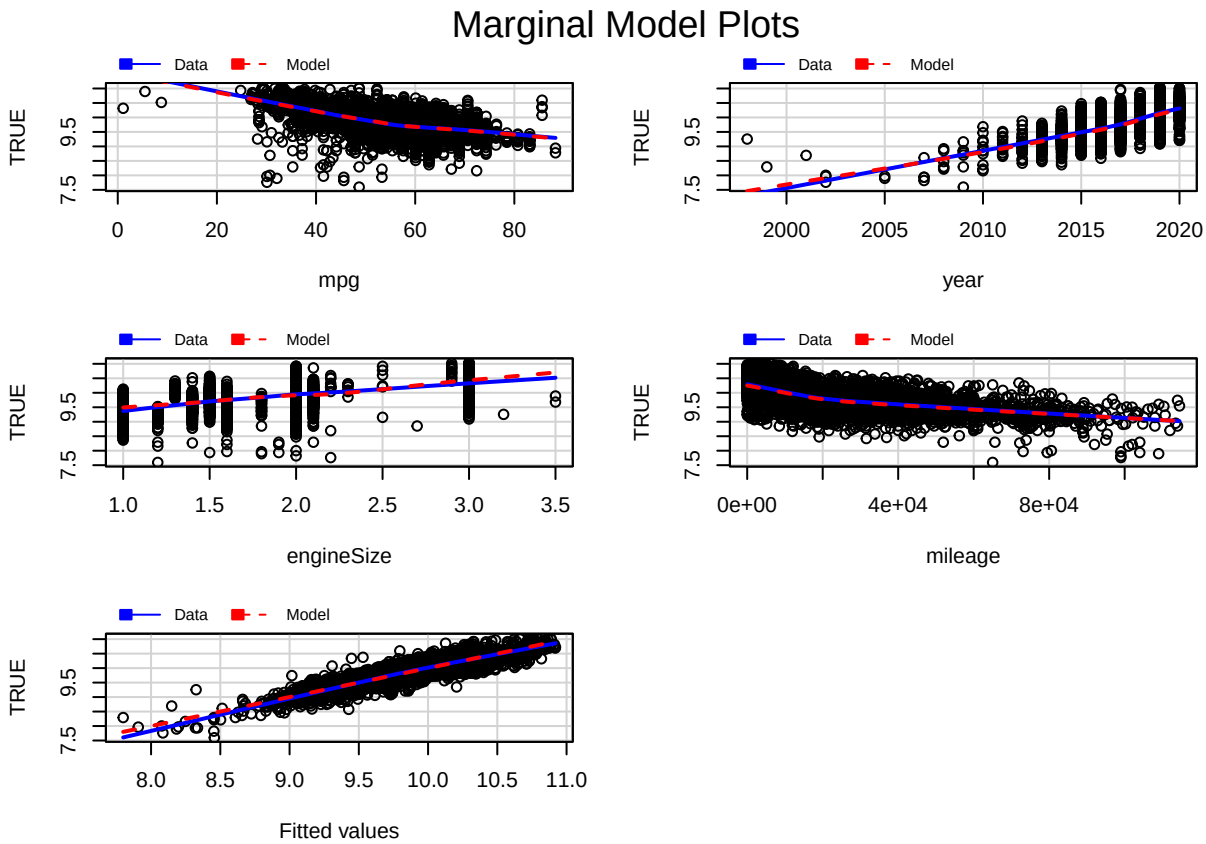

```r
# Fit a transformed linear model using the log of the pricing variable.
model_2 <- lm(log(price) ~ mpg + year + engineSize + mileage, data = df)
summary(model_2)
```

```
##
## Call:
## lm(formula = log(price) ~ mpg + year + engineSize + mileage,
##     data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.86084 -0.11966  0.00611  0.12547  0.92905
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -2.159e+02  4.173e+00  -51.74   <2e-16 ***
## mpg         -6.566e-03  2.793e-04  -23.51   <2e-16 ***
## year         1.117e-01  2.066e-03   54.06   <2e-16 ***
## engineSize   4.446e-01  5.727e-03   77.63   <2e-16 ***
## mileage     -4.590e-06  2.052e-07  -22.37   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1883 on 4823 degrees of freedom
## Multiple R-squared:  0.8278, Adjusted R-squared:  0.8277
## F-statistic:  5797 on 4 and 4823 DF,  p-value: < 2.2e-16
```

```r
# Diagnostic plots for the transformed model to check for assumptions and potential issues.
par(mfrow=c(2,2))
plot(model_2, id.n=0)
```




```r
marginalModelPlots(model_2)
```




```r
# Incorporating categorical variables into the regression model to assess their impact on pricing.
model_3 <- lm(log(price) ~ model + transmission + fuelType + y + manufacturer, data = df)
summary(model_3)
```

```
##
## Call:
## lm(formula = log(price) ~ model + transmission + fuelType + y +
##     manufacturer, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.79733 -0.13186  0.00831  0.14992  0.75763
##
## Coefficients: (3 not defined because of singularities)
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)            9.5102089  0.0189867 500.889  < 2e-16 ***
## model 2 Series         0.0371851  0.0258073   1.441 0.149686
## model 3 Series         0.0812299  0.0231870   3.503 0.000464 ***
## model 4 Series         0.1019421  0.0297479   3.427 0.000616 ***
## model 5 Series         0.0970684  0.0290642   3.340 0.000845 ***
## model 6 Series         0.3036520  0.0881033   3.447 0.000573 ***
## model 7 Series         0.4683154  0.0880764   5.317 1.10e-07 ***
## model 8 Series         0.8716175  0.1623815   5.368 8.35e-08 ***
## model A Class          0.0729788  0.0222042   3.287 0.001021 **
## model A1              -0.0667730  0.0256725  -2.601 0.009325 **
## model A3               0.0257886  0.0237783   1.085 0.278180
```

```
## model A4               0.1369172  0.0255264   5.364 8.54e-08 ***
## model A5               0.1293266  0.0304652   4.245 2.23e-05 ***
## model A6               0.1321763  0.0312476   4.230 2.38e-05 ***
## model A7               0.2415283  0.0781945   3.089 0.002021 **
## model A8               0.5585442  0.0685013   8.154 4.47e-16 ***
## model Amarok           0.2841896  0.0713648   3.982 6.93e-05 ***
## model Arteon           0.0869056  0.0518200   1.677 0.093595 .
## model B Class          0.0130326  0.0358217   0.364 0.716011
## model Beetle           0.0055515  0.1035602   0.054 0.957251
## model C Class          0.0935092  0.0216391   4.321 1.58e-05 ***
## model Caddy Maxi Life  0.1561866  0.0780780   2.000 0.045515 *
## model Caravelle        0.6278688  0.0617941  10.161  < 2e-16 ***
## model CC              -0.2665061  0.0880570  -3.027 0.002487 **
## model CL Class         0.1427311  0.0374895   3.807 0.000142 ***
## model CLA Class        0.1836802  0.0880936   2.085 0.037117 *
## model CLS Class        0.2136944  0.0617160   3.463 0.000540 ***
## model E Class          0.1359368  0.0244321   5.564 2.78e-08 ***
## model Eos             -0.5971253  0.2288876  -2.609 0.009114 **
## model GL Class         0.1700580  0.0636751   2.671 0.007595 **
## model GLA Class        0.1143742  0.0292270   3.913 9.23e-05 ***
## model GLB Class        0.5185559  0.1624619   3.192 0.001423 **
## model GLC Class        0.2795642  0.0281808   9.920  < 2e-16 ***
## model GLE Class        0.5668476  0.0433164  13.086  < 2e-16 ***
## model GLS Class        0.5583150  0.0829005   6.735 1.84e-11 ***
## model Golf             0.0176981  0.0198967   0.889 0.373780
## model Golf SV         -0.0039591  0.0432528  -0.092 0.927071
## model Jetta           -0.2664227  0.2288690  -1.164 0.244449
## model M Class          0.0870493  0.0744082   1.170 0.242104
## model M2               0.6008367  0.1330020   4.517 6.41e-06 ***
## model M3               0.6597548  0.1624030   4.062 4.93e-05 ***
## model M4               0.4771069  0.0658566   7.245 5.04e-13 ***
## model Passat          -0.0229537  0.0288554  -0.795 0.426378
## model Polo            -0.2140293  0.0214600  -9.973  < 2e-16 ***
## model Q2               0.0755748  0.0308136   2.453 0.014217 *
## model Q3               0.1939336  0.0259396   7.476 9.05e-14 ***
## model Q5               0.3039757  0.0317141   9.585  < 2e-16 ***
## model Q7               0.5593272  0.0477749  11.708  < 2e-16 ***
## model Q8               0.8494945  0.1156749   7.344 2.43e-13 ***
## model RS3              0.2425156  0.1330376   1.823 0.068380 .
## model RS4              0.9238195  0.2289889   4.034 5.56e-05 ***
## model RS5              0.6354497  0.1624903   3.911 9.33e-05 ***
## model S Class          0.5088569  0.0637864   7.978 1.86e-15 ***
## model S3               0.0282917  0.1329199   0.213 0.831455
## model S4               0.2141403  0.2289889   0.935 0.349756
## model S5               0.2267959  0.2289733   0.990 0.321985
## model Scirocco         0.0007251  0.0487443   0.015 0.988133
## model Sharan           0.1671018  0.0567580   2.944 0.003255 **
## model Shuttle         -0.0486118  0.1330763  -0.365 0.714909
## model SL CLASS         0.1481349  0.0507769   2.917 0.003547 **
## model SLK             -0.2952080  0.0950145  -3.107 0.001901 **
## model T-Cross          0.0652758  0.0452658   1.442 0.149353
## model T-Roc            0.1284768  0.0300923   4.269 2.00e-05 ***
## model Tiguan           0.1453479  0.0242920   5.983 2.35e-09 ***
## model Tiguan Allspace  0.2022295  0.1036937   1.950 0.051204 .
```

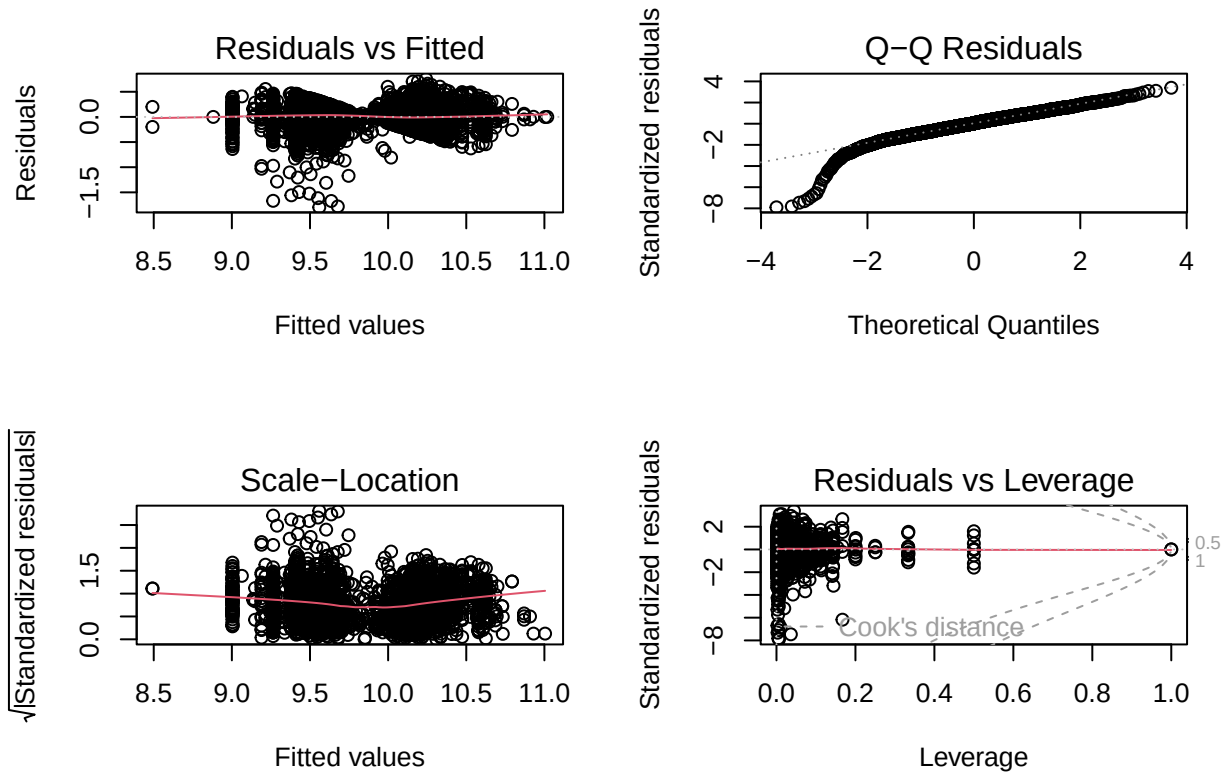
```
## model Touareg          0.3485240  0.0415905   8.380  < 2e-16 ***
## model Touran           0.0268633  0.0444561   0.604 0.545696
## model TT               0.1579221  0.0464764   3.398 0.000685 ***
## model Up              -0.4740910  0.0311965 -15.197  < 2e-16 ***
## model V Class          0.4144692  0.0582313   7.118 1.26e-12 ***
## model X-CLASS          0.2276773  0.0746455   3.050 0.002300 **
## model X1               0.0968980  0.0319297   3.035 0.002421 **
## model X2               0.1820353  0.0436310   4.172 3.07e-05 ***
## model X3               0.1983666  0.0360213   5.507 3.84e-08 ***
## model X4               0.3582734  0.0509594   7.031 2.35e-12 ***
## model X5               0.4534928  0.0405778  11.176  < 2e-16 ***
## model X6               0.3292771  0.0782228   4.209 2.61e-05 ***
## model Z3              -0.9862942  0.1623475  -6.075 1.34e-09 ***
## model Z4               0.1005825  0.0681817   1.475 0.140222
## transmissionManual    -0.1062316  0.0102839 -10.330  < 2e-16 ***
## transmissionSemi-Auto  0.0382648  0.0087554   4.370 1.27e-05 ***
## fuelTypeHybrid         0.1314845  0.0548133   2.399 0.016489 *
## fuelTypeOther          0.0280293  0.0819217   0.342 0.732255
## fuelTypePetrol         0.0742896  0.0081366   9.130  < 2e-16 ***
## y1                     0.5101471  0.0085059  59.976  < 2e-16 ***
## manufacturerBMW               NA         NA      NA       NA
## manufacturerMercedes          NA         NA      NA       NA
## manufacturerVW                NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2282 on 4743 degrees of freedom
## Multiple R-squared:  0.7514, Adjusted R-squared:  0.747
## F-statistic: 170.6 on 84 and 4743 DF,  p-value: < 2.2e-16
```

```r
# Diagnostic plots for the expanded model, including categorical predictors.
par(mfrow=c(2,2))
plot(model_3, id.n=0)
```

```
## Warning: not plotting observations with leverage one:
##   485, 4820, 4828
```

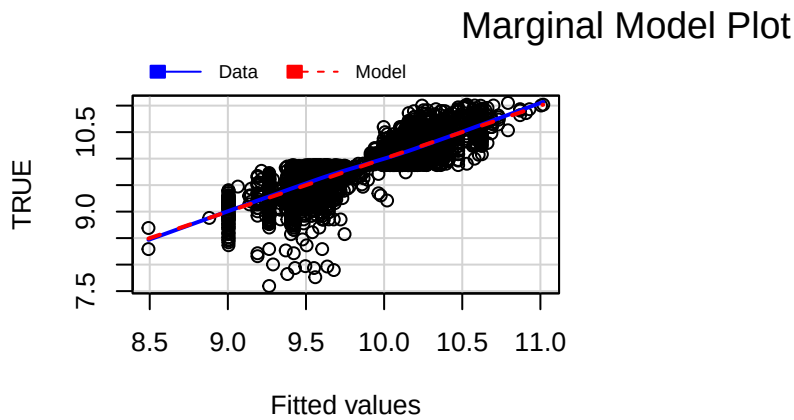
```
## Warning in sqrt(crit * p * (1 - hh)/hh): Se han producido NaNs
```

```
## Warning in sqrt(crit * p * (1 - hh)/hh): Se han producido NaNs
```




```r
marginalModelPlots(model_3)
```

```
## Warning in mmps(...): Interactions and/or factors skipped
```




```r
# A comprehensive model that integrates both numerical and categorical variables to predict vehicle pri
model_4 <- lm(log(price) ~ model + transmission + fuelType + y + manufacturer + mpg + year + engineSize
summary(model_4)
```

```
##
## Call:
## lm(formula = log(price) ~ model + transmission + fuelType + y +
##     manufacturer + mpg + year + engineSize + mileage, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.04402 -0.07325 -0.00405  0.07394  0.78387
##
## Coefficients: (3 not defined because of singularities)
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -1.712e+02  2.985e+00 -57.362  < 2e-16 ***
## model 2 Series         -2.806e-03  1.338e-02  -0.210 0.833875
## model 3 Series          8.129e-02  1.209e-02   6.724 1.98e-11 ***
## model 4 Series          9.669e-02  1.552e-02   6.231 5.04e-10 ***
## model 5 Series          1.542e-01  1.515e-02  10.180  < 2e-16 ***
## model 6 Series          2.134e-01  4.575e-02   4.665 3.17e-06 ***
## model 7 Series          3.570e-01  4.598e-02   7.765 9.95e-15 ***
## model 8 Series          5.486e-01  8.435e-02   6.504 8.65e-11 ***
## model A Class           9.911e-02  1.163e-02   8.521  < 2e-16 ***
## model A1                7.756e-03  1.351e-02   0.574 0.565967
## model A3                1.120e-01  1.240e-02   9.027  < 2e-16 ***
```

```
## model A4               1.312e-01  1.325e-02   9.905  < 2e-16 ***
## model A5               1.867e-01  1.586e-02  11.772  < 2e-16 ***
## model A6               2.215e-01  1.631e-02  13.585  < 2e-16 ***
## model A7               2.314e-01  4.082e-02   5.668 1.53e-08 ***
## model A8               3.328e-01  3.590e-02   9.272  < 2e-16 ***
## model Amarok           1.381e-01  3.760e-02   3.672 0.000243 ***
## model Arteon           8.158e-02  2.686e-02   3.037 0.002401 **
## model B Class          7.357e-03  1.863e-02   0.395 0.692874
## model Beetle           1.212e-03  5.370e-02   0.023 0.981994
## model C Class          1.542e-01  1.123e-02  13.740  < 2e-16 ***
## model Caddy Maxi Life -5.840e-02  4.056e-02  -1.440 0.150000
## model Caravelle        5.573e-01  3.282e-02  16.982  < 2e-16 ***
## model CC              -1.051e-01  4.572e-02  -2.298 0.021611 *
## model CL Class         2.132e-01  1.944e-02  10.969  < 2e-16 ***
## model CLA Class        2.367e-01  4.566e-02   5.184 2.26e-07 ***
## model CLS Class        2.564e-01  3.214e-02   7.978 1.85e-15 ***
## model E Class          2.131e-01  1.273e-02  16.731  < 2e-16 ***
## model Eos             -6.425e-02  1.189e-01  -0.540 0.589005
## model GL Class         3.228e-01  3.313e-02   9.744  < 2e-16 ***
## model GLA Class        1.461e-01  1.515e-02   9.638  < 2e-16 ***
## model GLB Class        3.463e-01  8.426e-02   4.110 4.02e-05 ***
## model GLC Class        3.405e-01  1.478e-02  23.034  < 2e-16 ***
## model GLE Class        4.744e-01  2.300e-02  20.630  < 2e-16 ***
## model GLS Class        4.691e-01  4.341e-02  10.805  < 2e-16 ***
## model Golf             8.000e-03  1.040e-02   0.769 0.441730
## model Golf SV         -7.121e-02  2.252e-02  -3.161 0.001581 **
## model Jetta           -2.828e-01  1.186e-01  -2.384 0.017154 *
## model M Class          2.626e-01  3.928e-02   6.686 2.56e-11 ***
## model M2               2.860e-01  6.922e-02   4.132 3.65e-05 ***
## model M3               5.294e-01  8.437e-02   6.275 3.80e-10 ***
## model M4               3.088e-01  3.470e-02   8.901  < 2e-16 ***
## model Passat          -3.378e-02  1.504e-02  -2.246 0.024761 *
## model Polo            -1.911e-01  1.162e-02 -16.442  < 2e-16 ***
## model Q2               1.324e-01  1.619e-02   8.177 3.70e-16 ***
## model Q3               2.166e-01  1.374e-02  15.770  < 2e-16 ***
## model Q5               3.305e-01  1.693e-02  19.525  < 2e-16 ***
## model Q7               4.644e-01  2.543e-02  18.262  < 2e-16 ***
## model Q8               5.591e-01  6.032e-02   9.268  < 2e-16 ***
## model RS3              4.669e-01  6.910e-02   6.756 1.59e-11 ***
## model RS4              6.545e-01  1.188e-01   5.510 3.78e-08 ***
## model RS5              4.211e-01  8.438e-02   4.991 6.22e-07 ***
## model S Class          4.602e-01  3.345e-02  13.755  < 2e-16 ***
## model S3               2.842e-01  6.894e-02   4.123 3.81e-05 ***
## model S4               1.436e-01  1.188e-01   1.209 0.226905
## model S5               1.622e-01  1.188e-01   1.365 0.172300
## model Scirocco         2.231e-02  2.538e-02   0.879 0.379521
## model Sharan           8.541e-02  2.974e-02   2.872 0.004099 **
## model Shuttle          2.474e-02  6.907e-02   0.358 0.720196
## model SL CLASS         2.336e-01  2.649e-02   8.818  < 2e-16 ***
## model SLK              2.613e-02  4.948e-02   0.528 0.597480
## model T-Cross         -1.252e-04  2.392e-02  -0.005 0.995826
## model T-Roc            6.900e-02  1.583e-02   4.359 1.33e-05 ***
## model Tiguan           1.405e-01  1.307e-02  10.753  < 2e-16 ***
## model Tiguan Allspace  1.726e-01  5.393e-02   3.200 0.001385 **
```

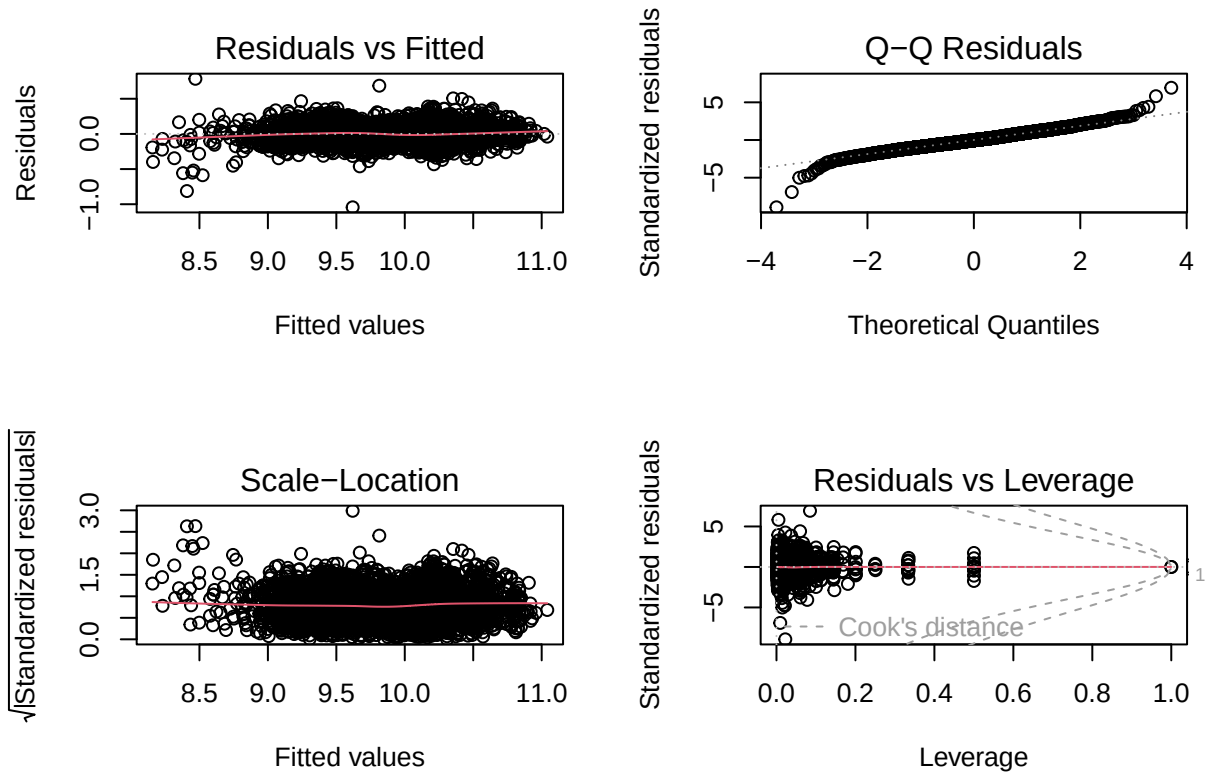
```
## model Touareg          2.310e-01  2.244e-02  10.291  < 2e-16 ***
## model Touran           9.271e-02  2.323e-02   3.990 6.70e-05 ***
## model TT               1.574e-01  2.415e-02   6.519 7.84e-11 ***
## model Up              -4.791e-01  1.672e-02 -28.657  < 2e-16 ***
## model V Class          3.436e-01  3.052e-02  11.260  < 2e-16 ***
## model X-CLASS          9.438e-02  3.914e-02   2.411 0.015941 *
## model X1               1.160e-01  1.657e-02   6.999 2.95e-12 ***
## model X2               1.328e-01  2.265e-02   5.863 4.85e-09 ***
## model X3               2.616e-01  1.878e-02  13.932  < 2e-16 ***
## model X4               2.836e-01  2.670e-02  10.620  < 2e-16 ***
## model X5               4.681e-01  2.163e-02  21.643  < 2e-16 ***
## model X6               3.414e-01  4.097e-02   8.333  < 2e-16 ***
## model Z3               4.333e-01  8.712e-02   4.973 6.81e-07 ***
## model Z4               1.404e-01  3.546e-02   3.961 7.59e-05 ***
## transmissionManual    -7.848e-02  5.448e-03 -14.405  < 2e-16 ***
## transmissionSemi-Auto  6.805e-03  4.551e-03   1.495 0.134894
## fuelTypeHybrid         1.613e-01  2.852e-02   5.655 1.65e-08 ***
## fuelTypeOther          2.631e-02  4.261e-02   0.618 0.536866
## fuelTypePetrol         2.029e-02  6.324e-03   3.208 0.001345 **
## y1                     1.091e-01  5.703e-03  19.125  < 2e-16 ***
## manufacturerBMW               NA         NA      NA       NA
## manufacturerMercedes          NA         NA      NA       NA
## manufacturerVW                NA         NA      NA       NA
## mpg                   -3.442e-03  2.968e-04 -11.598  < 2e-16 ***
## year                   8.966e-02  1.478e-03  60.675  < 2e-16 ***
## engineSize             2.003e-01  6.432e-03  31.135  < 2e-16 ***
## mileage               -4.613e-06  1.376e-07 -33.520  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1182 on 4739 degrees of freedom
## Multiple R-squared:  0.9333, Adjusted R-squared:  0.9321
## F-statistic: 753.8 on 88 and 4739 DF,  p-value: < 2.2e-16
```

```r
# Diagnostic plots for the comprehensive model, checking for overall model fit and individual variable
par(mfrow=c(2,2))
plot(model_4, id.n=0)
```

```
## Warning: not plotting observations with leverage one:
##   485, 4820, 4828
```

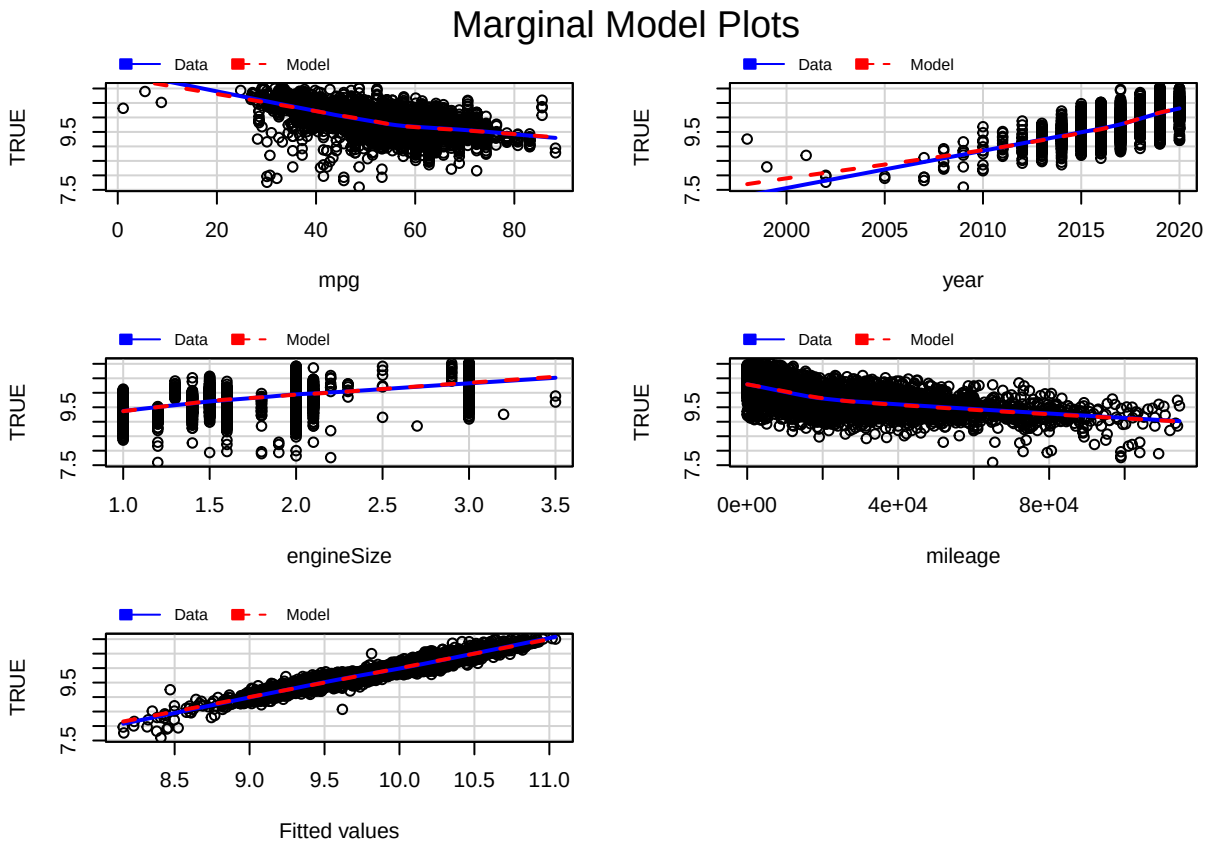
```
## Warning in sqrt(crit * p * (1 - hh)/hh): Se han producido NaNs
```

```
## Warning in sqrt(crit * p * (1 - hh)/hh): Se han producido NaNs
```

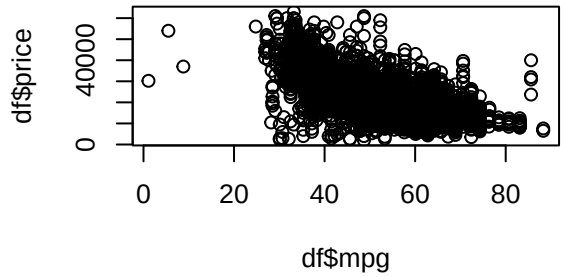



```r
marginalModelPlots(model_4)
```

```
## Warning in mmps(...): Interactions and/or factors skipped
```




```r
# Exploratory plots for individual variables against pricing to visualize relationships and trends.
plot(df$price ~ df$mpg)
```

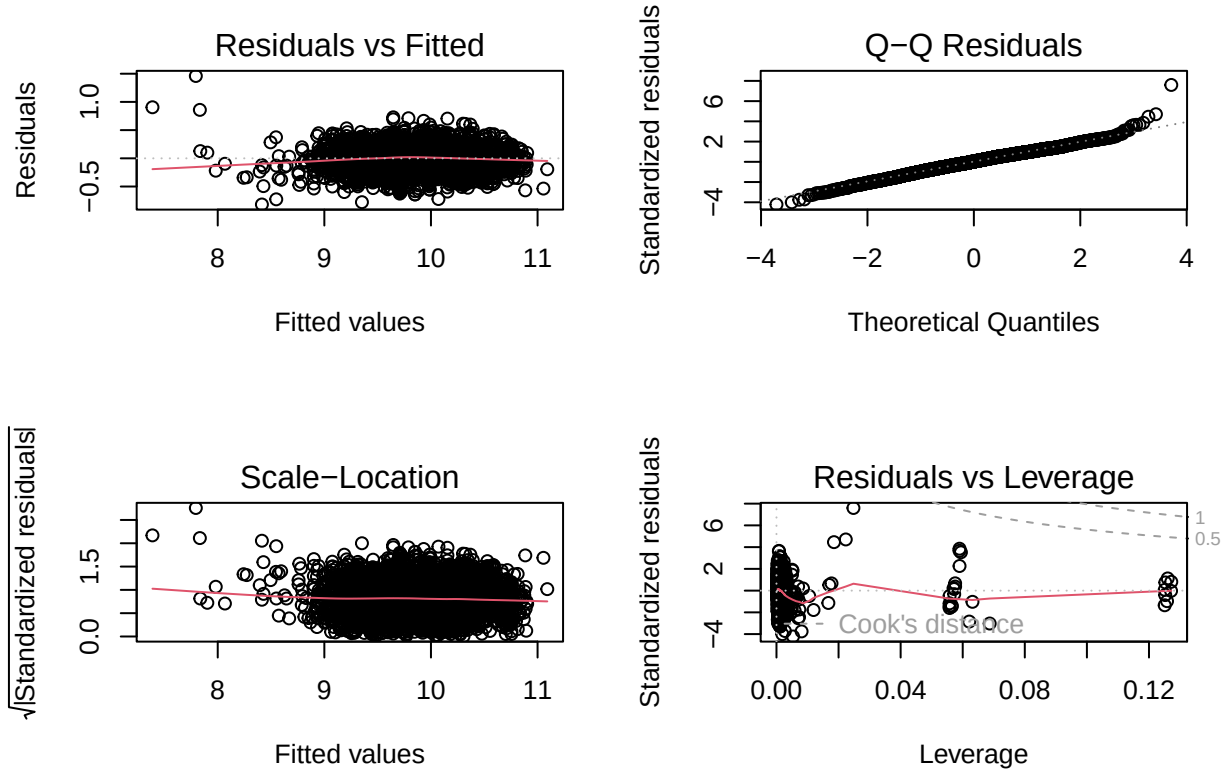



```r
# Fit additional linear models, analyzing the log transformation of price against different subsets of p
model_5 <- lm(log(price) ~ fuelType + mpg + year + engineSize, data = df)
summary(model_5)
```

```
##
## Call:
## lm(formula = log(price) ~ fuelType + mpg + year + engineSize,
##     data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.81846 -0.12390  0.00646  0.13284  1.45970
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.781e+02  2.986e+00 -93.130  < 2e-16 ***
## fuelTypeHybrid  2.496e-01  4.605e-02   5.421 6.21e-08 ***
## fuelTypeOther  -1.761e-01  6.913e-02  -2.547   0.0109 *
## fuelTypePetrol -9.555e-02  8.441e-03 -11.320  < 2e-16 ***
## mpg            -1.091e-02  3.722e-04 -29.307  < 2e-16 ***
## year            1.427e-01  1.475e-03  96.761  < 2e-16 ***
## engineSize      3.632e-01  7.862e-03  46.189  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1945 on 4821 degrees of freedom
```

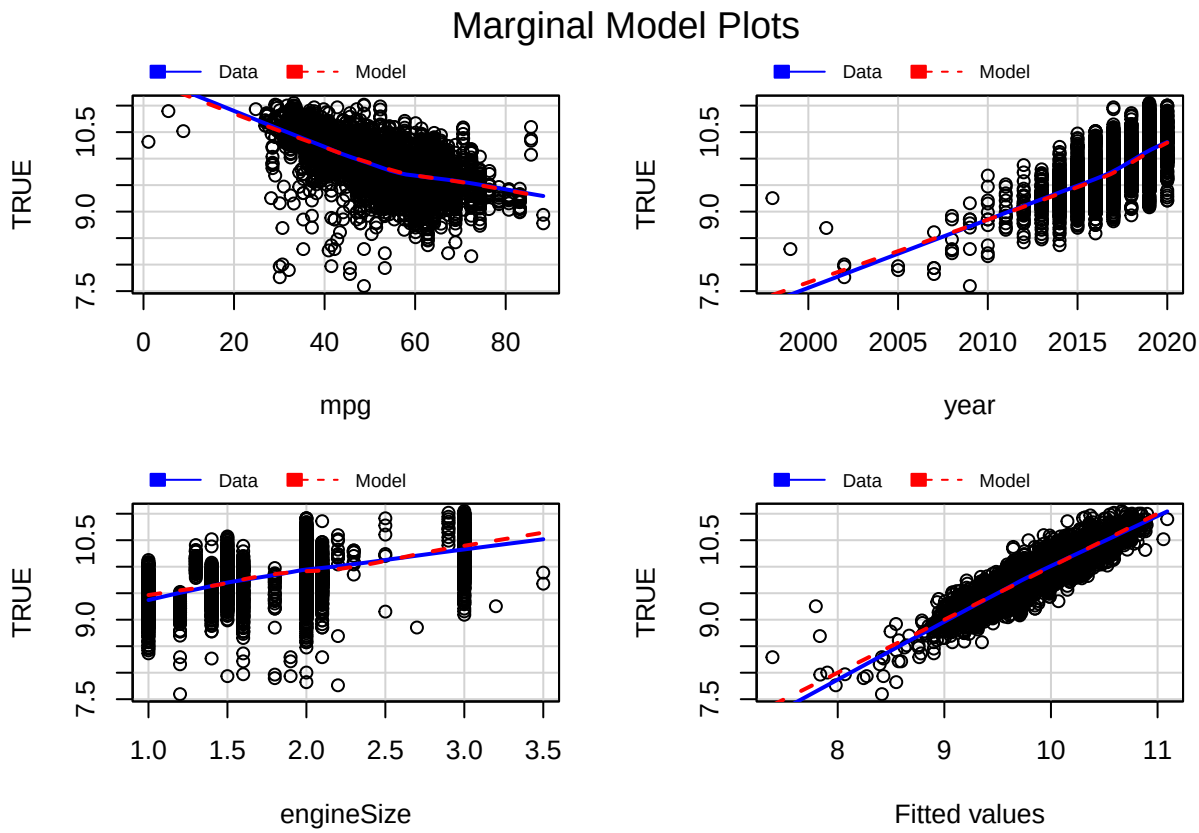
```
## Multiple R-squared:  0.8164, Adjusted R-squared:  0.8162
## F-statistic:  3573 on 6 and 4821 DF,  p-value: < 2.2e-16
```

```r
# Diagnostic plots for the model to identify any deviations from model assumptions.
par(mfrow=c(2,2))
plot(model_5, id.n=0)
```




```r
marginalModelPlots(model_5)
```

```
## Warning in mmps(...): Interactions and/or factors skipped
```




```r
# A complex model including interaction terms to understand the interplay between mileage, model, and t
model_6 <- lm(price ~ mileage * model * transmission, data = df)
summary(model_6)
```

```
##
## Call:
## lm(formula = price ~ mileage * model * transmission, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21277.5  -2334.9   -297.4   1852.9  24318.1
##
## Coefficients: (128 not defined because of singularities)
##                                                    Estimate Std. Error
## (Intercept)                                       2.597e+04  1.242e+03
## mileage                                          -3.161e-01  5.257e-02
## model 2 Series                                   -1.381e+03  1.648e+03
## model 3 Series                                    2.024e+03  1.463e+03
## model 4 Series                                    1.379e+03  1.502e+03
## model 5 Series                                    2.569e+03  1.577e+03
## model 6 Series                                    1.072e+04  4.277e+03
## model 7 Series                                    2.218e+04  4.289e+03
## model 8 Series                                    3.608e+04  7.853e+03
## model A Class                                    -2.125e+03  1.462e+03
## model A1                                         -2.597e+03  2.240e+03
## model A3                                          2.599e+01  1.605e+03
```

```
## model A4                                          3.710e+03  1.515e+03
## model A5                                          4.825e+03  1.601e+03
## model A6                                          3.266e+03  1.636e+03
## model A7                                          1.372e+04  3.033e+03
## model A8                                          1.791e+04  2.563e+03
## model Amarok                                      1.530e+04  2.776e+03
## model Arteon                                      2.841e+03  4.751e+03
## model B Class                                    -3.306e+03  1.824e+03
## model Beetle                                     -5.083e+03  4.414e+03
## model C Class                                     2.900e+03  1.336e+03
## model Caddy Maxi Life                            -2.148e+03  3.348e+03
## model Caravelle                                   2.301e+04  2.138e+03
## model CC                                         -1.626e+04  1.538e+04
## model CL Class                                    5.986e+03  2.490e+03
## model CLA Class                                   2.641e+03  2.926e+03
## model CLS Class                                   1.430e+04  2.790e+03
## model E Class                                     5.320e+03  1.479e+03
## model Eos                                        -4.828e+03  4.109e+03
## model GL Class                                   -2.378e+03  2.957e+03
## model GLA Class                                  -2.225e+02  1.861e+03
## model GLB Class                                   1.141e+04  1.045e+04
## model GLC Class                                   9.248e+03  1.646e+03
## model GLE Class                                   2.664e+04  2.170e+03
## model GLS Class                                   1.683e+04  4.012e+03
## model Golf                                       -8.689e+02  1.467e+03
## model Golf SV                                    -5.892e+03  4.708e+03
## model Jetta                                      -6.363e+03  4.114e+03
## model M Class                                     2.394e+03  1.154e+04
## model M2                                          2.422e+04  2.366e+04
## model M3                                          5.147e+04  7.071e+03
## model M4                                          1.988e+04  4.633e+03
## model Passat                                      1.405e+03  2.130e+03
## model Polo                                       -8.934e+03  2.517e+03
## model Q2                                          2.769e+03  2.195e+03
## model Q3                                          5.358e+03  1.673e+03
## model Q5                                          1.104e+04  1.617e+03
## model Q7                                          2.485e+04  2.033e+03
## model Q8                                          2.936e+04  4.665e+03
## model RS3                                         1.617e+04  4.857e+03
## model RS4                                         3.692e+04  4.207e+03
## model RS5                                         2.379e+04  4.276e+03
## model S Class                                     3.229e+04  2.604e+03
## model S3                                          2.129e+03  1.312e+04
## model S4                                          1.320e+04  4.179e+03
## model S5                                          1.565e+03  4.174e+03
## model Scirocco                                   -5.523e+03  4.013e+03
## model Sharan                                      1.030e+03  4.260e+03
## model Shuttle                                    -3.439e+03  2.150e+05
## model SL CLASS                                    1.216e+04  2.356e+03
## model SLK                                        -2.278e+03  5.269e+03
## model T-Cross                                    -4.257e+03  2.038e+03
## model T-Roc                                       3.593e+03  2.484e+03
## model Tiguan                                      1.721e+03  1.957e+03
## model Tiguan Allspace                             1.370e+03  4.268e+03
```

```
## model Touareg                                    1.689e+04  1.903e+03
## model Touran                                    -1.932e+03  2.650e+03
## model TT                                         1.286e+04  2.879e+03
## model Up                                        -1.259e+04  4.328e+03
## model V Class                                    2.122e+04  3.039e+03
## model X-CLASS                                   -6.759e+02  2.736e+03
## model X1                                        -2.681e+03  1.942e+03
## model X2                                         3.936e+03  1.897e+03
## model X3                                         5.590e+03  1.811e+03
## model X4                                         1.336e+04  2.325e+03
## model X5                                         2.161e+04  1.803e+03
## model X6                                         1.252e+04  3.751e+03
## model Z3                                        -2.749e+04  4.029e+04
## model Z4                                         6.893e+03  3.243e+03
## transmissionManual                              -7.091e+03  1.431e+03
## transmissionSemi-Auto                            9.842e+02  1.500e+03
## mileage:model 2 Series                           3.541e-02  7.649e-02
## mileage:model 3 Series                           7.375e-02  5.550e-02
## mileage:model 4 Series                           1.329e-01  5.703e-02
## mileage:model 5 Series                           1.022e-01  5.600e-02
## mileage:model 6 Series                          -1.243e-01  1.466e-01
## mileage:model 7 Series                          -1.728e-01  9.272e-02
## mileage:model 8 Series                          -1.721e+00  2.907e+00
## mileage:model A Class                            8.496e-02  5.993e-02
## mileage:model A1                                 4.254e-03  8.558e-02
## mileage:model A3                                 8.973e-02  6.539e-02
## mileage:model A4                                 2.334e-02  6.007e-02
## mileage:model A5                                 2.650e-02  6.600e-02
## mileage:model A6                                 1.200e-01  5.683e-02
## mileage:model A7                                -1.423e-02  1.042e-01
## mileage:model A8                                -4.512e-01  1.972e-01
## mileage:model Amarok                            -2.038e-01  1.082e-01
## mileage:model Arteon                             1.318e-01  6.849e-01
## mileage:model B Class                            3.196e-02  8.551e-02
## mileage:model Beetle                             1.337e-01  1.366e-01
## mileage:model C Class                            5.734e-02  5.443e-02
## mileage:model Caddy Maxi Life                   -1.308e-01  2.812e-01
## mileage:model Caravelle                          3.153e-02  6.608e-02
## mileage:model CC                                 3.069e-01  2.089e-01
## mileage:model CL Class                          -4.145e-02  9.153e-02
## mileage:model CLA Class                          1.954e-02  1.458e-01
## mileage:model CLS Class                         -4.488e-01  1.568e-01
## mileage:model E Class                            1.435e-02  5.603e-02
## mileage:model Eos                                       NA         NA
## mileage:model GL Class                           2.617e-01  7.980e-02
## mileage:model GLA Class                          1.237e-01  6.581e-02
## mileage:model GLB Class                          3.876e+01  4.446e+02
## mileage:model GLC Class                          8.871e-02  6.393e-02
## mileage:model GLE Class                         -3.765e-01  1.020e-01
## mileage:model GLS Class                          7.791e-02  1.987e-01
## mileage:model Golf                               2.784e-02  6.140e-02
## mileage:model Golf SV                            3.075e-01  8.781e-01
## mileage:model Jetta                                     NA         NA
## mileage:model M Class                            8.701e-02  2.071e-01
```

```
## mileage:model M2                                  -1.114e+00  4.125e+00
## mileage:model M3                                  -2.290e+00  5.902e-01
## mileage:model M4                                  -3.506e+01  5.114e+01
## mileage:model Passat                               4.507e-02  6.636e-02
## mileage:model Polo                                 1.136e-01  8.610e-02
## mileage:model Q2                                   5.936e-03  1.370e-01
## mileage:model Q3                                   1.236e-02  6.200e-02
## mileage:model Q5                                   7.958e-02  5.920e-02
## mileage:model Q7                                  -1.726e-01  7.704e-02
## mileage:model Q8                                   5.626e-02  5.461e-01
## mileage:model RS3                                  2.624e-02  1.449e-01
## mileage:model RS4                                         NA         NA
## mileage:model RS5                                 -2.753e-01  4.441e-01
## mileage:model S Class                             -3.437e-01  7.787e-02
## mileage:model S3                                   1.054e-01  3.748e-01
## mileage:model S4                                          NA         NA
## mileage:model S5                                          NA         NA
## mileage:model Scirocco                             1.842e-01  7.932e-02
## mileage:model Sharan                              -1.966e-01  1.366e-01
## mileage:model Shuttle                              1.593e-01  1.039e+01
## mileage:model SL CLASS                            -2.626e-01  8.980e-02
## mileage:model SLK                                  6.597e-02  1.144e-01
## mileage:model T-Cross                              1.737e-01  2.849e-01
## mileage:model T-Roc                               -2.321e-01  3.765e-01
## mileage:model Tiguan                               9.439e-02  7.045e-02
## mileage:model Tiguan Allspace                      5.426e-01  3.124e-01
## mileage:model Touareg                             -1.460e-01  6.896e-02
## mileage:model Touran                               1.303e-01  7.882e-02
## mileage:model TT                                  -7.970e-01  3.490e-01
## mileage:model Up                                   1.666e-01  3.367e-01
## mileage:model V Class                             -1.435e-02  1.229e-01
## mileage:model X-CLASS                              5.049e-01  1.638e-01
## mileage:model X1                                   1.592e-01  6.776e-02
## mileage:model X2                                  -4.405e-02  1.724e-01
## mileage:model X3                                   1.033e-01  6.119e-02
## mileage:model X4                                  -2.273e-03  6.766e-02
## mileage:model X5                                  -8.690e-02  6.052e-02
## mileage:model X6                                  -3.282e-02  9.421e-02
## mileage:model Z3                                   4.022e-01  7.180e-01
## mileage:model Z4                                   3.467e-01  4.973e-01
## mileage:transmissionManual                         1.568e-01  5.518e-02
## mileage:transmissionSemi-Auto                      1.718e-02  6.472e-02
## model 2 Series:transmissionManual                  2.608e+03  1.998e+03
## model 3 Series:transmissionManual                  1.654e+03  2.013e+03
## model 4 Series:transmissionManual                  1.107e+03  2.569e+03
## model 5 Series:transmissionManual                 -8.733e+03  8.941e+03
## model 6 Series:transmissionManual                         NA         NA
## model 7 Series:transmissionManual                         NA         NA
## model 8 Series:transmissionManual                         NA         NA
## model A Class:transmissionManual                   2.642e+03  1.808e+03
## model A1:transmissionManual                        5.942e+02  2.481e+03
## model A3:transmissionManual                        1.238e+03  1.888e+03
## model A4:transmissionManual                       -2.242e+03  1.892e+03
## model A5:transmissionManual                        8.423e+02  2.382e+03
```

```
## model A6:transmissionManual                          -1.199e+03  3.129e+03
## model A7:transmissionManual                                  NA         NA
## model A8:transmissionManual                                  NA         NA
## model Amarok:transmissionManual                       7.326e+03  7.093e+03
## model Arteon:transmissionManual                       5.797e+03  6.334e+03
## model B Class:transmissionManual                      5.022e+03  2.567e+03
## model Beetle:transmissionManual                              NA         NA
## model C Class:transmissionManual                     -1.131e+02  2.213e+03
## model Caddy Maxi Life:transmissionManual              2.136e+03  4.284e+03
## model Caravelle:transmissionManual                           NA         NA
## model CC:transmissionManual                           9.386e+03  5.690e+04
## model CL Class:transmissionManual                    -7.575e+03  5.159e+03
## model CLA Class:transmissionManual                   -8.704e+02  5.171e+03
## model CLS Class:transmissionManual                           NA         NA
## model E Class:transmissionManual                     -5.760e+03  5.365e+03
## model Eos:transmissionManual                                 NA         NA
## model GL Class:transmissionManual                    -4.980e+03  4.509e+03
## model GLA Class:transmissionManual                    1.731e+03  3.635e+03
## model GLB Class:transmissionManual                           NA         NA
## model GLC Class:transmissionManual                           NA         NA
## model GLE Class:transmissionManual                           NA         NA
## model GLS Class:transmissionManual                           NA         NA
## model Golf:transmissionManual                         5.161e+02  1.674e+03
## model Golf SV:transmissionManual                      4.027e+03  5.100e+03
## model Jetta:transmissionManual                               NA         NA
## model M Class:transmissionManual                             NA         NA
## model M2:transmissionManual                                  NA         NA
## model M3:transmissionManual                                  NA         NA
## model M4:transmissionManual                           1.313e+06  1.916e+06
## model Passat:transmissionManual                      -2.285e+03  2.489e+03
## model Polo:transmissionManual                         3.576e+03  2.652e+03
## model Q2:transmissionManual                           1.080e+03  2.449e+03
## model Q3:transmissionManual                           2.470e+03  1.943e+03
## model Q5:transmissionManual                          -1.213e+04  6.280e+03
## model Q7:transmissionManual                                  NA         NA
## model Q8:transmissionManual                                  NA         NA
## model RS3:transmissionManual                                 NA         NA
## model RS4:transmissionManual                                 NA         NA
## model RS5:transmissionManual                                 NA         NA
## model S Class:transmissionManual                             NA         NA
## model S3:transmissionManual                          -4.202e+02  7.523e+03
## model S4:transmissionManual                                  NA         NA
## model S5:transmissionManual                                  NA         NA
## model Scirocco:transmissionManual                     5.263e+03  4.955e+03
## model Sharan:transmissionManual                       1.012e+04  8.195e+03
## model Shuttle:transmissionManual                      4.562e+03  1.811e+04
## model SL CLASS:transmissionManual                            NA         NA
## model SLK:transmissionManual                                 NA         NA
## model T-Cross:transmissionManual                      5.203e+03  2.747e+03
## model T-Roc:transmissionManual                       -1.894e+02  2.700e+03
## model Tiguan:transmissionManual                       4.248e+03  2.185e+03
## model Tiguan Allspace:transmissionManual                     NA         NA
## model Touareg:transmissionManual                             NA         NA
## model Touran:transmissionManual                       3.913e+03  3.083e+03
```

```
## model TT:transmissionManual                          -1.142e+04  3.467e+03
## model Up:transmissionManual                           3.560e+03  4.438e+03
## model V Class:transmissionManual                     -2.055e+04  7.503e+03
## model X-CLASS:transmissionManual                     -4.130e+03  4.411e+03
## model X1:transmissionManual                           6.748e+03  2.511e+03
## model X2:transmissionManual                                  NA         NA
## model X3:transmissionManual                                  NA         NA
## model X4:transmissionManual                                  NA         NA
## model X5:transmissionManual                                  NA         NA
## model X6:transmissionManual                                  NA         NA
## model Z3:transmissionManual                                  NA         NA
## model Z4:transmissionManual                          -1.142e+04  9.146e+03
## model 2 Series:transmissionSemi-Auto                 -3.351e+02  1.969e+03
## model 3 Series:transmissionSemi-Auto                  2.170e+02  1.781e+03
## model 4 Series:transmissionSemi-Auto                 -2.286e+02  2.002e+03
## model 5 Series:transmissionSemi-Auto                  1.433e+03  1.958e+03
## model 6 Series:transmissionSemi-Auto                  1.805e+02  5.140e+03
## model 7 Series:transmissionSemi-Auto                 -2.094e+03  5.140e+03
## model 8 Series:transmissionSemi-Auto                         NA         NA
## model A Class:transmissionSemi-Auto                  -9.336e+01  1.771e+03
## model A1:transmissionSemi-Auto                       -1.843e+03  2.621e+03
## model A3:transmissionSemi-Auto                       -7.738e+02  2.012e+03
## model A4:transmissionSemi-Auto                        1.507e+03  2.011e+03
## model A5:transmissionSemi-Auto                       -1.160e+03  2.080e+03
## model A6:transmissionSemi-Auto                        3.722e+03  2.190e+03
## model A7:transmissionSemi-Auto                       -6.512e+03  4.047e+03
## model A8:transmissionSemi-Auto                        6.580e+03  3.853e+03
## model Amarok:transmissionSemi-Auto                           NA         NA
## model Arteon:transmissionSemi-Auto                   -3.125e+03  5.200e+03
## model B Class:transmissionSemi-Auto                   1.090e+03  2.298e+03
## model Beetle:transmissionSemi-Auto                           NA         NA
## model C Class:transmissionSemi-Auto                  -1.710e+02  1.642e+03
## model Caddy Maxi Life:transmissionSemi-Auto                  NA         NA
## model Caravelle:transmissionSemi-Auto                -7.178e+03  3.087e+03
## model CC:transmissionSemi-Auto                        3.186e+04  6.175e+04
## model CL Class:transmissionSemi-Auto                 -2.271e+03  2.937e+03
## model CLA Class:transmissionSemi-Auto                        NA         NA
## model CLS Class:transmissionSemi-Auto                 1.222e+03  4.082e+03
## model E Class:transmissionSemi-Auto                   2.046e+03  1.796e+03
## model Eos:transmissionSemi-Auto                              NA         NA
## model GL Class:transmissionSemi-Auto                  8.778e+03  4.515e+03
## model GLA Class:transmissionSemi-Auto                -2.361e+03  2.263e+03
## model GLB Class:transmissionSemi-Auto                        NA         NA
## model GLC Class:transmissionSemi-Auto                 6.886e+02  1.971e+03
## model GLE Class:transmissionSemi-Auto                -2.798e+03  2.684e+03
## model GLS Class:transmissionSemi-Auto                 7.325e+03  6.526e+03
## model Golf:transmissionSemi-Auto                     -1.051e+03  1.774e+03
## model Golf SV:transmissionSemi-Auto                   6.860e+02  4.980e+03
## model Jetta:transmissionSemi-Auto                            NA         NA
## model M Class:transmissionSemi-Auto                  -5.156e+03  1.324e+04
## model M2:transmissionSemi-Auto                       -3.046e+03  2.063e+04
## model M3:transmissionSemi-Auto                               NA         NA
## model M4:transmissionSemi-Auto                       -1.321e+03  4.969e+03
## model Passat:transmissionSemi-Auto                   -4.467e+03  2.476e+03
```

```
## model Polo:transmissionSemi-Auto                    -8.014e+02  2.759e+03
## model Q2:transmissionSemi-Auto                      -2.811e+03  2.774e+03
## model Q3:transmissionSemi-Auto                      -1.768e+02  2.112e+03
## model Q5:transmissionSemi-Auto                       3.002e+02  2.030e+03
## model Q7:transmissionSemi-Auto                      -1.225e+03  2.729e+03
## model Q8:transmissionSemi-Auto                      -2.117e+03  4.972e+03
## model RS3:transmissionSemi-Auto                      3.566e+02  7.303e+03
## model RS4:transmissionSemi-Auto                             NA         NA
## model RS5:transmissionSemi-Auto                             NA         NA
## model S Class:transmissionSemi-Auto                  3.529e+03  5.262e+03
## model S3:transmissionSemi-Auto                              NA         NA
## model S4:transmissionSemi-Auto                              NA         NA
## model S5:transmissionSemi-Auto                              NA         NA
## model Scirocco:transmissionSemi-Auto                -3.383e+03  5.697e+03
## model Sharan:transmissionSemi-Auto                   2.615e+03  4.650e+03
## model Shuttle:transmissionSemi-Auto                         NA         NA
## model SL CLASS:transmissionSemi-Auto                -4.588e+03  3.070e+03
## model SLK:transmissionSemi-Auto                             NA         NA
## model T-Cross:transmissionSemi-Auto                         NA         NA
## model T-Roc:transmissionSemi-Auto                   -1.724e+03  3.041e+03
## model Tiguan:transmissionSemi-Auto                   1.175e+03  2.254e+03
## model Tiguan Allspace:transmissionSemi-Auto         -8.807e+02  5.267e+03
## model Touareg:transmissionSemi-Auto                  1.174e+02  2.435e+03
## model Touran:transmissionSemi-Auto                  -7.162e+02  5.516e+03
## model TT:transmissionSemi-Auto                      -6.967e+03  3.405e+03
## model Up:transmissionSemi-Auto                      -1.981e+03  5.466e+03
## model V Class:transmissionSemi-Auto                 -1.689e+03  3.683e+03
## model X-CLASS:transmissionSemi-Auto                         NA         NA
## model X1:transmissionSemi-Auto                       3.714e+03  2.461e+03
## model X2:transmissionSemi-Auto                       3.742e+02  2.413e+03
## model X3:transmissionSemi-Auto                       3.162e+03  2.218e+03
## model X4:transmissionSemi-Auto                       4.047e+02  2.880e+03
## model X5:transmissionSemi-Auto                       6.769e+03  3.374e+03
## model X6:transmissionSemi-Auto                       9.751e+02  5.759e+03
## model Z3:transmissionSemi-Auto                              NA         NA
## model Z4:transmissionSemi-Auto                       2.103e+02  4.286e+03
## mileage:model 2 Series:transmissionManual           -3.333e-02  8.288e-02
## mileage:model 3 Series:transmissionManual           -9.236e-02  6.177e-02
## mileage:model 4 Series:transmissionManual           -1.052e-01  7.262e-02
## mileage:model 5 Series:transmissionManual            2.484e-02  1.358e-01
## mileage:model 6 Series:transmissionManual                   NA         NA
## mileage:model 7 Series:transmissionManual                   NA         NA
## mileage:model 8 Series:transmissionManual                   NA         NA
## mileage:model A Class:transmissionManual            -6.638e-02  6.585e-02
## mileage:model A1:transmissionManual                  1.062e-02  9.097e-02
## mileage:model A3:transmissionManual                 -9.527e-02  6.976e-02
## mileage:model A4:transmissionManual                  6.770e-03  6.572e-02
## mileage:model A5:transmissionManual                 -5.890e-02  7.573e-02
## mileage:model A6:transmissionManual                 -8.566e-02  7.436e-02
## mileage:model A7:transmissionManual                         NA         NA
## mileage:model A8:transmissionManual                         NA         NA
## mileage:model Amarok:transmissionManual                     NA         NA
## mileage:model Arteon:transmissionManual             -3.514e-01  1.614e+00
## mileage:model B Class:transmissionManual            -9.922e-02  1.097e-01
```

```
## mileage:model Beetle:transmissionManual                    NA         NA
## mileage:model C Class:transmissionManual           -2.646e-02  6.577e-02
## mileage:model Caddy Maxi Life:transmissionManual    1.805e-01  3.441e-01
## mileage:model Caravelle:transmissionManual                  NA         NA
## mileage:model CC:transmissionManual                -1.787e-01  1.583e+00
## mileage:model CL Class:transmissionManual           1.615e-01  1.385e-01
## mileage:model CLA Class:transmissionManual                  NA         NA
## mileage:model CLS Class:transmissionManual                  NA         NA
## mileage:model E Class:transmissionManual                    NA         NA
## mileage:model Eos:transmissionManual                        NA         NA
## mileage:model GL Class:transmissionManual                   NA         NA
## mileage:model GLA Class:transmissionManual         -8.459e-02  1.199e-01
## mileage:model GLB Class:transmissionManual                  NA         NA
## mileage:model GLC Class:transmissionManual                  NA         NA
## mileage:model GLE Class:transmissionManual                  NA         NA
## mileage:model GLS Class:transmissionManual                  NA         NA
## mileage:model Golf:transmissionManual              -1.044e-02  6.452e-02
## mileage:model Golf SV:transmissionManual           -3.119e-01  8.803e-01
## mileage:model Jetta:transmissionManual                      NA         NA
## mileage:model M Class:transmissionManual                    NA         NA
## mileage:model M2:transmissionManual                         NA         NA
## mileage:model M3:transmissionManual                         NA         NA
## mileage:model M4:transmissionManual                         NA         NA
## mileage:model Passat:transmissionManual            -8.218e-03  7.195e-02
## mileage:model Polo:transmissionManual              -8.571e-02  8.932e-02
## mileage:model Q2:transmissionManual                -1.628e-02  1.473e-01
## mileage:model Q3:transmissionManual                -9.949e-02  6.758e-02
## mileage:model Q5:transmissionManual                 1.070e-01  1.646e-01
## mileage:model Q7:transmissionManual                         NA         NA
## mileage:model Q8:transmissionManual                         NA         NA
## mileage:model RS3:transmissionManual                        NA         NA
## mileage:model RS4:transmissionManual                        NA         NA
## mileage:model RS5:transmissionManual                        NA         NA
## mileage:model S Class:transmissionManual                    NA         NA
## mileage:model S3:transmissionManual                         NA         NA
## mileage:model S4:transmissionManual                         NA         NA
## mileage:model S5:transmissionManual                         NA         NA
## mileage:model Scirocco:transmissionManual          -2.008e-01  1.157e-01
## mileage:model Sharan:transmissionManual            -1.847e-01  4.280e-01
## mileage:model Shuttle:transmissionManual                    NA         NA
## mileage:model SL CLASS:transmissionManual                   NA         NA
## mileage:model SLK:transmissionManual                        NA         NA
## mileage:model T-Cross:transmissionManual            3.449e-02  5.291e-01
## mileage:model T-Roc:transmissionManual              1.758e-01  3.836e-01
## mileage:model Tiguan:transmissionManual            -1.521e-01  7.569e-02
## mileage:model Tiguan Allspace:transmissionManual            NA         NA
## mileage:model Touareg:transmissionManual                    NA         NA
## mileage:model Touran:transmissionManual            -1.443e-01  8.944e-02
## mileage:model TT:transmissionManual                 8.117e-01  3.519e-01
## mileage:model Up:transmissionManual                -1.072e-01  3.386e-01
## mileage:model V Class:transmissionManual            1.614e-01  3.262e-01
## mileage:model X-CLASS:transmissionManual                    NA         NA
## mileage:model X1:transmissionManual                -1.918e-01  7.760e-02
## mileage:model X2:transmissionManual                         NA         NA
```

```
## mileage:model X3:transmissionManual                        NA         NA
## mileage:model X4:transmissionManual                        NA         NA
## mileage:model X5:transmissionManual                        NA         NA
## mileage:model X6:transmissionManual                        NA         NA
## mileage:model Z3:transmissionManual                        NA         NA
## mileage:model Z4:transmissionManual                 -2.547e-01  5.159e-01
## mileage:model 2 Series:transmissionSemi-Auto        -2.383e-02  9.508e-02
## mileage:model 3 Series:transmissionSemi-Auto        -6.330e-02  7.030e-02
## mileage:model 4 Series:transmissionSemi-Auto        -1.226e-01  9.218e-02
## mileage:model 5 Series:transmissionSemi-Auto        -5.139e-02  7.223e-02
## mileage:model 6 Series:transmissionSemi-Auto        -9.962e-02  2.989e-01
## mileage:model 7 Series:transmissionSemi-Auto         4.225e-02  2.208e-01
## mileage:model 8 Series:transmissionSemi-Auto                NA         NA
## mileage:model A Class:transmissionSemi-Auto         -2.949e-02  7.570e-02
## mileage:model A1:transmissionSemi-Auto               2.334e-02  1.107e-01
## mileage:model A3:transmissionSemi-Auto              -3.083e-02  8.226e-02
## mileage:model A4:transmissionSemi-Auto              -1.114e-01  8.496e-02
## mileage:model A5:transmissionSemi-Auto               1.441e-02  8.352e-02
## mileage:model A6:transmissionSemi-Auto              -1.653e-01  7.655e-02
## mileage:model A7:transmissionSemi-Auto               1.429e-02  1.338e-01
## mileage:model A8:transmissionSemi-Auto              -5.848e-01  4.404e-01
## mileage:model Amarok:transmissionSemi-Auto                  NA         NA
## mileage:model Arteon:transmissionSemi-Auto          -6.411e-02  7.052e-01
## mileage:model B Class:transmissionSemi-Auto         -2.447e-02  1.147e-01
## mileage:model Beetle:transmissionSemi-Auto                  NA         NA
## mileage:model C Class:transmissionSemi-Auto         -8.651e-02  6.907e-02
## mileage:model Caddy Maxi Life:transmissionSemi-Auto         NA         NA
## mileage:model Caravelle:transmissionSemi-Auto        1.664e-01  2.731e-01
## mileage:model CC:transmissionSemi-Auto              -9.065e-01  1.742e+00
## mileage:model CL Class:transmissionSemi-Auto         4.002e-02  1.081e-01
## mileage:model CLA Class:transmissionSemi-Auto               NA         NA
## mileage:model CLS Class:transmissionSemi-Auto        2.392e-01  1.786e-01
## mileage:model E Class:transmissionSemi-Auto         -1.299e-01  7.236e-02
## mileage:model Eos:transmissionSemi-Auto                     NA         NA
## mileage:model GL Class:transmissionSemi-Auto                NA         NA
## mileage:model GLA Class:transmissionSemi-Auto        1.568e-02  8.332e-02
## mileage:model GLB Class:transmissionSemi-Auto               NA         NA
## mileage:model GLC Class:transmissionSemi-Auto       -8.935e-02  8.032e-02
## mileage:model GLE Class:transmissionSemi-Auto        1.367e-01  1.263e-01
## mileage:model GLS Class:transmissionSemi-Auto       -2.942e-01  3.622e-01
## mileage:model Golf:transmissionSemi-Auto             3.422e-02  7.503e-02
## mileage:model Golf SV:transmissionSemi-Auto         -3.451e-01  8.859e-01
## mileage:model Jetta:transmissionSemi-Auto                   NA         NA
## mileage:model M Class:transmissionSemi-Auto          1.005e-01  2.441e-01
## mileage:model M2:transmissionSemi-Auto                      NA         NA
## mileage:model M3:transmissionSemi-Auto                      NA         NA
## mileage:model M4:transmissionSemi-Auto               3.493e+01  5.115e+01
## mileage:model Passat:transmissionSemi-Auto           2.301e-02  8.446e-02
## mileage:model Polo:transmissionSemi-Auto             1.141e-02  1.014e-01
## mileage:model Q2:transmissionSemi-Auto              -8.313e-03  1.743e-01
## mileage:model Q3:transmissionSemi-Auto              -7.665e-02  8.548e-02
## mileage:model Q5:transmissionSemi-Auto              -1.294e-01  7.843e-02
## mileage:model Q7:transmissionSemi-Auto               7.309e-02  1.021e-01
## mileage:model Q8:transmissionSemi-Auto                      NA         NA
```

```
## mileage:model RS3:transmissionSemi-Auto                    NA         NA
## mileage:model RS4:transmissionSemi-Auto                    NA         NA
## mileage:model RS5:transmissionSemi-Auto                    NA         NA
## mileage:model S Class:transmissionSemi-Auto         -1.515e+00  4.808e-01
## mileage:model S3:transmissionSemi-Auto                     NA         NA
## mileage:model S4:transmissionSemi-Auto                     NA         NA
## mileage:model S5:transmissionSemi-Auto                     NA         NA
## mileage:model Scirocco:transmissionSemi-Auto         4.058e-02  1.293e-01
## mileage:model Sharan:transmissionSemi-Auto                 NA         NA
## mileage:model Shuttle:transmissionSemi-Auto                NA         NA
## mileage:model SL CLASS:transmissionSemi-Auto        -4.118e-01  2.237e-01
## mileage:model SLK:transmissionSemi-Auto                    NA         NA
## mileage:model T-Cross:transmissionSemi-Auto                NA         NA
## mileage:model T-Roc:transmissionSemi-Auto            1.844e-01  4.222e-01
## mileage:model Tiguan:transmissionSemi-Auto          -9.609e-02  8.460e-02
## mileage:model Tiguan Allspace:transmissionSemi-Auto         NA         NA
## mileage:model Touareg:transmissionSemi-Auto          3.186e-02  8.795e-02
## mileage:model Touran:transmissionSemi-Auto           9.969e-04  1.708e-01
## mileage:model TT:transmissionSemi-Auto               6.739e-01  3.644e-01
## mileage:model Up:transmissionSemi-Auto                     NA         NA
## mileage:model V Class:transmissionSemi-Auto         -1.095e-02  1.510e-01
## mileage:model X-CLASS:transmissionSemi-Auto                NA         NA
## mileage:model X1:transmissionSemi-Auto              -1.661e-01  9.606e-02
## mileage:model X2:transmissionSemi-Auto               8.122e-02  2.284e-01
## mileage:model X3:transmissionSemi-Auto              -1.554e-01  8.069e-02
## mileage:model X4:transmissionSemi-Auto              -1.158e-01  1.133e-01
## mileage:model X5:transmissionSemi-Auto              -2.980e-01  4.267e-01
## mileage:model X6:transmissionSemi-Auto               4.313e-02  1.704e-01
## mileage:model Z3:transmissionSemi-Auto                     NA         NA
## mileage:model Z4:transmissionSemi-Auto              -7.812e-01  5.254e-01
##                                                     t value Pr(>|t|)
## (Intercept)                                          20.907  < 2e-16 ***
## mileage                                              -6.013 1.96e-09 ***
## model 2 Series                                       -0.838 0.402102
## model 3 Series                                        1.384 0.166579
## model 4 Series                                        0.918 0.358892
## model 5 Series                                        1.629 0.103297
## model 6 Series                                        2.506 0.012245 *
## model 7 Series                                        5.172 2.42e-07 ***
## model 8 Series                                        4.594 4.47e-06 ***
## model A Class                                        -1.453 0.146300
## model A1                                             -1.160 0.246286
## model A3                                              0.016 0.987081
## model A4                                              2.449 0.014351 *
## model A5                                              3.014 0.002596 **
## model A6                                              1.996 0.045993 *
## model A7                                              4.525 6.20e-06 ***
## model A8                                              6.987 3.22e-12 ***
## model Amarok                                          5.511 3.76e-08 ***
## model Arteon                                          0.598 0.549834
## model B Class                                        -1.812 0.069991 .
## model Beetle                                         -1.151 0.249609
## model C Class                                         2.170 0.030028 *
## model Caddy Maxi Life                                -0.642 0.521119
```

```
## model Caravelle                                    10.761  < 2e-16 ***
## model CC                                           -1.058 0.290198
## model CL Class                                      2.404 0.016244 *
## model CLA Class                                     0.903 0.366748
## model CLS Class                                     5.127 3.07e-07 ***
## model E Class                                       3.598 0.000324 ***
## model Eos                                          -1.175 0.240088
## model GL Class                                     -0.804 0.421209
## model GLA Class                                    -0.120 0.904847
## model GLB Class                                     1.093 0.274557
## model GLC Class                                     5.617 2.06e-08 ***
## model GLE Class                                    12.279  < 2e-16 ***
## model GLS Class                                     4.194 2.79e-05 ***
## model Golf                                         -0.592 0.553742
## model Golf SV                                      -1.251 0.210890
## model Jetta                                        -1.546 0.122061
## model M Class                                       0.207 0.835644
## model M2                                            1.024 0.306114
## model M3                                            7.279 3.95e-13 ***
## model M4                                            4.291 1.82e-05 ***
## model Passat                                        0.660 0.509368
## model Polo                                         -3.549 0.000390 ***
## model Q2                                            1.262 0.207151
## model Q3                                            3.202 0.001375 **
## model Q5                                            6.827 9.86e-12 ***
## model Q7                                           12.224  < 2e-16 ***
## model Q8                                            6.294 3.38e-10 ***
## model RS3                                           3.330 0.000875 ***
## model RS4                                           8.776  < 2e-16 ***
## model RS5                                           5.565 2.78e-08 ***
## model S Class                                      12.401  < 2e-16 ***
## model S3                                            0.162 0.871098
## model S4                                            3.158 0.001600 **
## model S5                                            0.375 0.707615
## model Scirocco                                     -1.376 0.168765
## model Sharan                                        0.242 0.809033
## model Shuttle                                      -0.016 0.987237
## model SL CLASS                                      5.160 2.58e-07 ***
## model SLK                                          -0.432 0.665520
## model T-Cross                                      -2.088 0.036812 *
## model T-Roc                                         1.446 0.148180
## model Tiguan                                        0.879 0.379258
## model Tiguan Allspace                               0.321 0.748277
## model Touareg                                       8.876  < 2e-16 ***
## model Touran                                       -0.729 0.465893
## model TT                                            4.466 8.18e-06 ***
## model Up                                           -2.908 0.003650 **
## model V Class                                       6.984 3.30e-12 ***
## model X-CLASS                                      -0.247 0.804900
## model X1                                           -1.381 0.167387
## model X2                                            2.075 0.038034 *
## model X3                                            3.087 0.002035 **
## model X4                                            5.747 9.70e-09 ***
## model X5                                           11.989  < 2e-16 ***
```

```
## model X6                                          3.337 0.000854 ***
## model Z3                                         -0.682 0.495023
## model Z4                                          2.125 0.033604 *
## transmissionManual                               -4.955 7.49e-07 ***
## transmissionSemi-Auto                             0.656 0.511740
## mileage:model 2 Series                            0.463 0.643406
## mileage:model 3 Series                            1.329 0.183961
## mileage:model 4 Series                            2.331 0.019822 *
## mileage:model 5 Series                            1.826 0.067992 .
## mileage:model 6 Series                           -0.848 0.396501
## mileage:model 7 Series                           -1.863 0.062458 .
## mileage:model 8 Series                           -0.592 0.553988
## mileage:model A Class                             1.418 0.156400
## mileage:model A1                                  0.050 0.960357
## mileage:model A3                                  1.372 0.170034
## mileage:model A4                                  0.388 0.697667
## mileage:model A5                                  0.402 0.688026
## mileage:model A6                                  2.111 0.034868 *
## mileage:model A7                                 -0.136 0.891443
## mileage:model A8                                 -2.288 0.022155 *
## mileage:model Amarok                             -1.883 0.059814 .
## mileage:model Arteon                              0.192 0.847362
## mileage:model B Class                             0.374 0.708589
## mileage:model Beetle                              0.979 0.327428
## mileage:model C Class                             1.053 0.292250
## mileage:model Caddy Maxi Life                    -0.465 0.641961
## mileage:model Caravelle                           0.477 0.633317
## mileage:model CC                                  1.469 0.141972
## mileage:model CL Class                           -0.453 0.650641
## mileage:model CLA Class                           0.134 0.893386
## mileage:model CLS Class                          -2.863 0.004219 **
## mileage:model E Class                             0.256 0.797820
## mileage:model Eos                                    NA       NA
## mileage:model GL Class                            3.279 0.001049 **
## mileage:model GLA Class                           1.880 0.060146 .
## mileage:model GLB Class                           0.087 0.930527
## mileage:model GLC Class                           1.388 0.165339
## mileage:model GLE Class                          -3.690 0.000227 ***
## mileage:model GLS Class                           0.392 0.695031
## mileage:model Golf                                0.453 0.650235
## mileage:model Golf SV                             0.350 0.726233
## mileage:model Jetta                                  NA       NA
## mileage:model M Class                             0.420 0.674364
## mileage:model M2                                 -0.270 0.787077
## mileage:model M3                                 -3.880 0.000106 ***
## mileage:model M4                                 -0.686 0.493007
## mileage:model Passat                              0.679 0.497111
## mileage:model Polo                                1.319 0.187253
## mileage:model Q2                                  0.043 0.965430
## mileage:model Q3                                  0.199 0.841930
## mileage:model Q5                                  1.344 0.178925
## mileage:model Q7                                 -2.240 0.025109 *
## mileage:model Q8                                  0.103 0.917963
## mileage:model RS3                                 0.181 0.856329
```

```
## mileage:model RS4                                        NA       NA
## mileage:model RS5                                    -0.620 0.535410
## mileage:model S Class                                -4.413 1.04e-05 ***
## mileage:model S3                                      0.281 0.778599
## mileage:model S4                                         NA       NA
## mileage:model S5                                         NA       NA
## mileage:model Scirocco                                2.322 0.020287 *
## mileage:model Sharan                                 -1.439 0.150132
## mileage:model Shuttle                                 0.015 0.987770
## mileage:model SL CLASS                               -2.924 0.003473 **
## mileage:model SLK                                     0.577 0.564042
## mileage:model T-Cross                                 0.610 0.542099
## mileage:model T-Roc                                  -0.616 0.537607
## mileage:model Tiguan                                  1.340 0.180372
## mileage:model Tiguan Allspace                         1.737 0.082479 .
## mileage:model Touareg                                -2.117 0.034332 *
## mileage:model Touran                                  1.654 0.098245 .
## mileage:model TT                                     -2.284 0.022431 *
## mileage:model Up                                      0.495 0.620673
## mileage:model V Class                                -0.117 0.907060
## mileage:model X-CLASS                                 3.083 0.002060 **
## mileage:model X1                                      2.350 0.018835 *
## mileage:model X2                                     -0.255 0.798358
## mileage:model X3                                      1.689 0.091340 .
## mileage:model X4                                     -0.034 0.973209
## mileage:model X5                                     -1.436 0.151055
## mileage:model X6                                     -0.348 0.727613
## mileage:model Z3                                      0.560 0.575445
## mileage:model Z4                                      0.697 0.485698
## mileage:transmissionManual                            2.841 0.004516 **
## mileage:transmissionSemi-Auto                         0.265 0.790679
## model 2 Series:transmissionManual                     1.305 0.191923
## model 3 Series:transmissionManual                     0.821 0.411454
## model 4 Series:transmissionManual                     0.431 0.666677
## model 5 Series:transmissionManual                    -0.977 0.328772
## model 6 Series:transmissionManual                        NA       NA
## model 7 Series:transmissionManual                        NA       NA
## model 8 Series:transmissionManual                        NA       NA
## model A Class:transmissionManual                      1.461 0.144033
## model A1:transmissionManual                           0.239 0.810736
## model A3:transmissionManual                           0.656 0.512042
## model A4:transmissionManual                          -1.185 0.235980
## model A5:transmissionManual                           0.354 0.723608
## model A6:transmissionManual                          -0.383 0.701554
## model A7:transmissionManual                              NA       NA
## model A8:transmissionManual                              NA       NA
## model Amarok:transmissionManual                       1.033 0.301772
## model Arteon:transmissionManual                       0.915 0.360138
## model B Class:transmissionManual                      1.957 0.050448 .
## model Beetle:transmissionManual                          NA       NA
## model C Class:transmissionManual                     -0.051 0.959227
## model Caddy Maxi Life:transmissionManual              0.499 0.618008
## model Caravelle:transmissionManual                       NA       NA
## model CC:transmissionManual                           0.165 0.868983
```

```
## model CL Class:transmissionManual                    -1.468 0.142056
## model CLA Class:transmissionManual                   -0.168 0.866341
## model CLS Class:transmissionManual                       NA       NA
## model E Class:transmissionManual                     -1.074 0.283031
## model Eos:transmissionManual                             NA       NA
## model GL Class:transmissionManual                    -1.105 0.269434
## model GLA Class:transmissionManual                    0.476 0.633936
## model GLB Class:transmissionManual                       NA       NA
## model GLC Class:transmissionManual                       NA       NA
## model GLE Class:transmissionManual                       NA       NA
## model GLS Class:transmissionManual                       NA       NA
## model Golf:transmissionManual                         0.308 0.757785
## model Golf SV:transmissionManual                      0.790 0.429735
## model Jetta:transmissionManual                           NA       NA
## model M Class:transmissionManual                         NA       NA
## model M2:transmissionManual                              NA       NA
## model M3:transmissionManual                              NA       NA
## model M4:transmissionManual                           0.685 0.493417
## model Passat:transmissionManual                      -0.918 0.358655
## model Polo:transmissionManual                         1.348 0.177573
## model Q2:transmissionManual                           0.441 0.659283
## model Q3:transmissionManual                           1.271 0.203634
## model Q5:transmissionManual                          -1.931 0.053529 .
## model Q7:transmissionManual                              NA       NA
## model Q8:transmissionManual                              NA       NA
## model RS3:transmissionManual                             NA       NA
## model RS4:transmissionManual                             NA       NA
## model RS5:transmissionManual                             NA       NA
## model S Class:transmissionManual                         NA       NA
## model S3:transmissionManual                          -0.056 0.955458
## model S4:transmissionManual                              NA       NA
## model S5:transmissionManual                              NA       NA
## model Scirocco:transmissionManual                     1.062 0.288270
## model Sharan:transmissionManual                       1.235 0.216937
## model Shuttle:transmissionManual                      0.252 0.801156
## model SL CLASS:transmissionManual                        NA       NA
## model SLK:transmissionManual                             NA       NA
## model T-Cross:transmissionManual                      1.894 0.058235 .
## model T-Roc:transmissionManual                       -0.070 0.944057
## model Tiguan:transmissionManual                       1.944 0.051954 .
## model Tiguan Allspace:transmissionManual                 NA       NA
## model Touareg:transmissionManual                         NA       NA
## model Touran:transmissionManual                       1.269 0.204407
## model TT:transmissionManual                          -3.293 0.000999 ***
## model Up:transmissionManual                           0.802 0.422461
## model V Class:transmissionManual                     -2.739 0.006188 **
## model X-CLASS:transmissionManual                     -0.936 0.349135
## model X1:transmissionManual                           2.688 0.007218 **
## model X2:transmissionManual                              NA       NA
## model X3:transmissionManual                              NA       NA
## model X4:transmissionManual                              NA       NA
## model X5:transmissionManual                              NA       NA
## model X6:transmissionManual                              NA       NA
## model Z3:transmissionManual                              NA       NA
```

```
## model Z4:transmissionManual                          -1.248 0.212022
## model 2 Series:transmissionSemi-Auto                 -0.170 0.864863
## model 3 Series:transmissionSemi-Auto                  0.122 0.902995
## model 4 Series:transmissionSemi-Auto                 -0.114 0.909088
## model 5 Series:transmissionSemi-Auto                  0.732 0.464402
## model 6 Series:transmissionSemi-Auto                  0.035 0.971979
## model 7 Series:transmissionSemi-Auto                 -0.407 0.683736
## model 8 Series:transmissionSemi-Auto                     NA       NA
## model A Class:transmissionSemi-Auto                  -0.053 0.957958
## model A1:transmissionSemi-Auto                       -0.703 0.482031
## model A3:transmissionSemi-Auto                       -0.385 0.700491
## model A4:transmissionSemi-Auto                        0.750 0.453578
## model A5:transmissionSemi-Auto                       -0.558 0.576917
## model A6:transmissionSemi-Auto                        1.700 0.089283 .
## model A7:transmissionSemi-Auto                       -1.609 0.107667
## model A8:transmissionSemi-Auto                        1.708 0.087779 .
## model Amarok:transmissionSemi-Auto                       NA       NA
## model Arteon:transmissionSemi-Auto                   -0.601 0.547960
## model B Class:transmissionSemi-Auto                   0.474 0.635305
## model Beetle:transmissionSemi-Auto                       NA       NA
## model C Class:transmissionSemi-Auto                  -0.104 0.917050
## model Caddy Maxi Life:transmissionSemi-Auto              NA       NA
## model Caravelle:transmissionSemi-Auto                -2.325 0.020107 *
## model CC:transmissionSemi-Auto                        0.516 0.605937
## model CL Class:transmissionSemi-Auto                 -0.773 0.439416
## model CLA Class:transmissionSemi-Auto                    NA       NA
## model CLS Class:transmissionSemi-Auto                 0.299 0.764660
## model E Class:transmissionSemi-Auto                   1.139 0.254818
## model Eos:transmissionSemi-Auto                          NA       NA
## model GL Class:transmissionSemi-Auto                  1.944 0.051934 .
## model GLA Class:transmissionSemi-Auto                -1.043 0.296942
## model GLB Class:transmissionSemi-Auto                    NA       NA
## model GLC Class:transmissionSemi-Auto                 0.349 0.726794
## model GLE Class:transmissionSemi-Auto                -1.042 0.297274
## model GLS Class:transmissionSemi-Auto                 1.122 0.261721
## model Golf:transmissionSemi-Auto                     -0.592 0.553666
## model Golf SV:transmissionSemi-Auto                   0.138 0.890455
## model Jetta:transmissionSemi-Auto                        NA       NA
## model M Class:transmissionSemi-Auto                  -0.389 0.696962
## model M2:transmissionSemi-Auto                       -0.148 0.882638
## model M3:transmissionSemi-Auto                           NA       NA
## model M4:transmissionSemi-Auto                       -0.266 0.790373
## model Passat:transmissionSemi-Auto                   -1.804 0.071254 .
## model Polo:transmissionSemi-Auto                     -0.290 0.771511
## model Q2:transmissionSemi-Auto                       -1.014 0.310870
## model Q3:transmissionSemi-Auto                       -0.084 0.933291
## model Q5:transmissionSemi-Auto                        0.148 0.882421
## model Q7:transmissionSemi-Auto                       -0.449 0.653418
## model Q8:transmissionSemi-Auto                       -0.426 0.670196
## model RS3:transmissionSemi-Auto                       0.049 0.961060
## model RS4:transmissionSemi-Auto                          NA       NA
## model RS5:transmissionSemi-Auto                          NA       NA
## model S Class:transmissionSemi-Auto                   0.671 0.502510
## model S3:transmissionSemi-Auto                           NA       NA
```

```
## model S4:transmissionSemi-Auto                          NA       NA
## model S5:transmissionSemi-Auto                          NA       NA
## model Scirocco:transmissionSemi-Auto                -0.594 0.552709
## model Sharan:transmissionSemi-Auto                   0.562 0.573969
## model Shuttle:transmissionSemi-Auto                     NA       NA
## model SL CLASS:transmissionSemi-Auto                -1.494 0.135131
## model SLK:transmissionSemi-Auto                         NA       NA
## model T-Cross:transmissionSemi-Auto                     NA       NA
## model T-Roc:transmissionSemi-Auto                   -0.567 0.570711
## model Tiguan:transmissionSemi-Auto                   0.521 0.602212
## model Tiguan Allspace:transmissionSemi-Auto         -0.167 0.867206
## model Touareg:transmissionSemi-Auto                  0.048 0.961557
## model Touran:transmissionSemi-Auto                  -0.130 0.896684
## model TT:transmissionSemi-Auto                      -2.046 0.040810 *
## model Up:transmissionSemi-Auto                      -0.363 0.716963
## model V Class:transmissionSemi-Auto                 -0.459 0.646602
## model X-CLASS:transmissionSemi-Auto                     NA       NA
## model X1:transmissionSemi-Auto                       1.509 0.131350
## model X2:transmissionSemi-Auto                       0.155 0.876793
## model X3:transmissionSemi-Auto                       1.426 0.154065
## model X4:transmissionSemi-Auto                       0.141 0.888266
## model X5:transmissionSemi-Auto                       2.006 0.044924 *
## model X6:transmissionSemi-Auto                       0.169 0.865560
## model Z3:transmissionSemi-Auto                          NA       NA
## model Z4:transmissionSemi-Auto                       0.049 0.960873
## mileage:model 2 Series:transmissionManual           -0.402 0.687593
## mileage:model 3 Series:transmissionManual           -1.495 0.134941
## mileage:model 4 Series:transmissionManual           -1.449 0.147433
## mileage:model 5 Series:transmissionManual            0.183 0.854892
## mileage:model 6 Series:transmissionManual               NA       NA
## mileage:model 7 Series:transmissionManual               NA       NA
## mileage:model 8 Series:transmissionManual               NA       NA
## mileage:model A Class:transmissionManual            -1.008 0.313473
## mileage:model A1:transmissionManual                  0.117 0.907060
## mileage:model A3:transmissionManual                 -1.366 0.172091
## mileage:model A4:transmissionManual                  0.103 0.917958
## mileage:model A5:transmissionManual                 -0.778 0.436747
## mileage:model A6:transmissionManual                 -1.152 0.249387
## mileage:model A7:transmissionManual                     NA       NA
## mileage:model A8:transmissionManual                     NA       NA
## mileage:model Amarok:transmissionManual                 NA       NA
## mileage:model Arteon:transmissionManual             -0.218 0.827702
## mileage:model B Class:transmissionManual            -0.905 0.365751
## mileage:model Beetle:transmissionManual                 NA       NA
## mileage:model C Class:transmissionManual            -0.402 0.687500
## mileage:model Caddy Maxi Life:transmissionManual     0.525 0.599889
## mileage:model Caravelle:transmissionManual              NA       NA
## mileage:model CC:transmissionManual                 -0.113 0.910111
## mileage:model CL Class:transmissionManual            1.166 0.243704
## mileage:model CLA Class:transmissionManual              NA       NA
## mileage:model CLS Class:transmissionManual              NA       NA
## mileage:model E Class:transmissionManual                NA       NA
## mileage:model Eos:transmissionManual                    NA       NA
## mileage:model GL Class:transmissionManual               NA       NA
```

```
## mileage:model GLA Class:transmissionManual          -0.705 0.480627
## mileage:model GLB Class:transmissionManual              NA       NA
## mileage:model GLC Class:transmissionManual              NA       NA
## mileage:model GLE Class:transmissionManual              NA       NA
## mileage:model GLS Class:transmissionManual              NA       NA
## mileage:model Golf:transmissionManual               -0.162 0.871497
## mileage:model Golf SV:transmissionManual            -0.354 0.723160
## mileage:model Jetta:transmissionManual                  NA       NA
## mileage:model M Class:transmissionManual                NA       NA
## mileage:model M2:transmissionManual                     NA       NA
## mileage:model M3:transmissionManual                     NA       NA
## mileage:model M4:transmissionManual                     NA       NA
## mileage:model Passat:transmissionManual             -0.114 0.909065
## mileage:model Polo:transmissionManual               -0.960 0.337357
## mileage:model Q2:transmissionManual                 -0.110 0.912032
## mileage:model Q3:transmissionManual                 -1.472 0.141065
## mileage:model Q5:transmissionManual                  0.650 0.515560
## mileage:model Q7:transmissionManual                     NA       NA
## mileage:model Q8:transmissionManual                     NA       NA
## mileage:model RS3:transmissionManual                    NA       NA
## mileage:model RS4:transmissionManual                    NA       NA
## mileage:model RS5:transmissionManual                    NA       NA
## mileage:model S Class:transmissionManual                NA       NA
## mileage:model S3:transmissionManual                     NA       NA
## mileage:model S4:transmissionManual                     NA       NA
## mileage:model S5:transmissionManual                     NA       NA
## mileage:model Scirocco:transmissionManual           -1.736 0.082700 .
## mileage:model Sharan:transmissionManual             -0.432 0.666053
## mileage:model Shuttle:transmissionManual                NA       NA
## mileage:model SL CLASS:transmissionManual               NA       NA
## mileage:model SLK:transmissionManual                    NA       NA
## mileage:model T-Cross:transmissionManual             0.065 0.948026
## mileage:model T-Roc:transmissionManual               0.458 0.646840
## mileage:model Tiguan:transmissionManual             -2.009 0.044571 *
## mileage:model Tiguan Allspace:transmissionManual        NA       NA
## mileage:model Touareg:transmissionManual                NA       NA
## mileage:model Touran:transmissionManual             -1.613 0.106843
## mileage:model TT:transmissionManual                  2.307 0.021114 *
## mileage:model Up:transmissionManual                 -0.317 0.751463
## mileage:model V Class:transmissionManual             0.495 0.620841
## mileage:model X-CLASS:transmissionManual                NA       NA
## mileage:model X1:transmissionManual                 -2.471 0.013515 *
## mileage:model X2:transmissionManual                     NA       NA
## mileage:model X3:transmissionManual                     NA       NA
## mileage:model X4:transmissionManual                     NA       NA
## mileage:model X5:transmissionManual                     NA       NA
## mileage:model X6:transmissionManual                     NA       NA
## mileage:model Z3:transmissionManual                     NA       NA
## mileage:model Z4:transmissionManual                 -0.494 0.621480
## mileage:model 2 Series:transmissionSemi-Auto        -0.251 0.802142
## mileage:model 3 Series:transmissionSemi-Auto        -0.900 0.367908
## mileage:model 4 Series:transmissionSemi-Auto        -1.330 0.183547
## mileage:model 5 Series:transmissionSemi-Auto        -0.711 0.476860
## mileage:model 6 Series:transmissionSemi-Auto        -0.333 0.738885
```

```
## mileage:model 7 Series:transmissionSemi-Auto          0.191 0.848241
## mileage:model 8 Series:transmissionSemi-Auto             NA       NA
## mileage:model A Class:transmissionSemi-Auto          -0.390 0.696905
## mileage:model A1:transmissionSemi-Auto                0.211 0.833115
## mileage:model A3:transmissionSemi-Auto               -0.375 0.707875
## mileage:model A4:transmissionSemi-Auto               -1.311 0.189838
## mileage:model A5:transmissionSemi-Auto                0.172 0.863055
## mileage:model A6:transmissionSemi-Auto               -2.160 0.030828 *
## mileage:model A7:transmissionSemi-Auto                0.107 0.914948
## mileage:model A8:transmissionSemi-Auto               -1.328 0.184297
## mileage:model Amarok:transmissionSemi-Auto               NA       NA
## mileage:model Arteon:transmissionSemi-Auto           -0.091 0.927559
## mileage:model B Class:transmissionSemi-Auto          -0.213 0.831062
## mileage:model Beetle:transmissionSemi-Auto               NA       NA
## mileage:model C Class:transmissionSemi-Auto          -1.253 0.210438
## mileage:model Caddy Maxi Life:transmissionSemi-Auto      NA       NA
## mileage:model Caravelle:transmissionSemi-Auto         0.609 0.542394
## mileage:model CC:transmissionSemi-Auto               -0.520 0.602766
## mileage:model CL Class:transmissionSemi-Auto          0.370 0.711165
## mileage:model CLA Class:transmissionSemi-Auto            NA       NA
## mileage:model CLS Class:transmissionSemi-Auto         1.339 0.180543
## mileage:model E Class:transmissionSemi-Auto          -1.795 0.072703 .
## mileage:model Eos:transmissionSemi-Auto                  NA       NA
## mileage:model GL Class:transmissionSemi-Auto             NA       NA
## mileage:model GLA Class:transmissionSemi-Auto         0.188 0.850727
## mileage:model GLB Class:transmissionSemi-Auto            NA       NA
## mileage:model GLC Class:transmissionSemi-Auto        -1.112 0.265999
## mileage:model GLE Class:transmissionSemi-Auto         1.083 0.278871
## mileage:model GLS Class:transmissionSemi-Auto        -0.812 0.416702
## mileage:model Golf:transmissionSemi-Auto              0.456 0.648414
## mileage:model Golf SV:transmissionSemi-Auto          -0.390 0.696889
## mileage:model Jetta:transmissionSemi-Auto                NA       NA
## mileage:model M Class:transmissionSemi-Auto           0.412 0.680609
## mileage:model M2:transmissionSemi-Auto                   NA       NA
## mileage:model M3:transmissionSemi-Auto                   NA       NA
## mileage:model M4:transmissionSemi-Auto                0.683 0.494693
## mileage:model Passat:transmissionSemi-Auto            0.272 0.785261
## mileage:model Polo:transmissionSemi-Auto              0.113 0.910416
## mileage:model Q2:transmissionSemi-Auto               -0.048 0.961966
## mileage:model Q3:transmissionSemi-Auto               -0.897 0.369948
## mileage:model Q5:transmissionSemi-Auto               -1.650 0.099010 .
## mileage:model Q7:transmissionSemi-Auto                0.716 0.474222
## mileage:model Q8:transmissionSemi-Auto                   NA       NA
## mileage:model RS3:transmissionSemi-Auto                  NA       NA
## mileage:model RS4:transmissionSemi-Auto                  NA       NA
## mileage:model RS5:transmissionSemi-Auto                  NA       NA
## mileage:model S Class:transmissionSemi-Auto          -3.152 0.001633 **
## mileage:model S3:transmissionSemi-Auto                   NA       NA
## mileage:model S4:transmissionSemi-Auto                   NA       NA
## mileage:model S5:transmissionSemi-Auto                   NA       NA
## mileage:model Scirocco:transmissionSemi-Auto          0.314 0.753592
## mileage:model Sharan:transmissionSemi-Auto               NA       NA
## mileage:model Shuttle:transmissionSemi-Auto              NA       NA
## mileage:model SL CLASS:transmissionSemi-Auto         -1.841 0.065718 .
```

```
## mileage:model SLK:transmissionSemi-Auto                 NA       NA
## mileage:model T-Cross:transmissionSemi-Auto              NA       NA
## mileage:model T-Roc:transmissionSemi-Auto             0.437 0.662337
## mileage:model Tiguan:transmissionSemi-Auto           -1.136 0.256081
## mileage:model Tiguan Allspace:transmissionSemi-Auto      NA       NA
## mileage:model Touareg:transmissionSemi-Auto           0.362 0.717207
## mileage:model Touran:transmissionSemi-Auto            0.006 0.995343
## mileage:model TT:transmissionSemi-Auto                1.849 0.064460 .
## mileage:model Up:transmissionSemi-Auto                   NA       NA
## mileage:model V Class:transmissionSemi-Auto          -0.073 0.942184
## mileage:model X-CLASS:transmissionSemi-Auto              NA       NA
## mileage:model X1:transmissionSemi-Auto               -1.730 0.083772 .
## mileage:model X2:transmissionSemi-Auto                0.356 0.722183
## mileage:model X3:transmissionSemi-Auto               -1.926 0.054182 .
## mileage:model X4:transmissionSemi-Auto               -1.023 0.306490
## mileage:model X5:transmissionSemi-Auto               -0.698 0.484957
## mileage:model X6:transmissionSemi-Auto                0.253 0.800146
## mileage:model Z3:transmissionSemi-Auto                   NA       NA
## mileage:model Z4:transmissionSemi-Auto               -1.487 0.137147
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4087 on 4482 degrees of freedom
## Multiple R-squared:  0.825,  Adjusted R-squared:  0.8115
## F-statistic: 61.23 on 345 and 4482 DF,  p-value: < 2.2e-16
```

```r
# Calculate the number of parameters (p) in the model and the total number of observations (n) in the d
p <- as.numeric(length(coef(model_5)))
n <- as.numeric(nrow(df))

# Calculate the cutoff value (h_param) for identifying influential data points.
h_param <- as.numeric(2 * (p / n))

# Identify influential data points based on their leverage and Cook's distance.
ll_priori_influential <- which(abs(hatvalues(model_5)) > h_param * (p / n))
length(ll_priori_influential)
```

```
## [1] 4828
```

```r
ll_posteriori_influential <- which(abs(cooks.distance(model_5)) > (4 / (n - p)))
length(ll_posteriori_influential)
```

```
## [1] 180
```

```r
ll_unique_influential <- unique(c(ll_priori_influential, ll_posteriori_influential))
length(ll_unique_influential)
```

```
## [1] 4828
```

```r
# Update the model by excluding influential data points and summarize the refined model.
model_7 <- update(model_5, data = df[-ll_posteriori_influential, ])
summary(model_7)
```

```
##
## Call:
## lm(formula = log(price) ~ fuelType + mpg + year + engineSize,
##     data = df[-ll_posteriori_influential, ])
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.59036 -0.11808  0.00451  0.12570  0.54105
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.799e+02  3.030e+00 -92.390   <2e-16 ***
## fuelTypeHybrid  2.920e-01  1.244e-01   2.347    0.019 *
## fuelTypeOther  -1.738e-01  1.245e-01  -1.396    0.163
## fuelTypePetrol -7.498e-02  8.171e-03  -9.176   <2e-16 ***
## mpg            -1.058e-02  3.655e-04 -28.956   <2e-16 ***
## year            1.436e-01  1.496e-03  95.987   <2e-16 ***
## engineSize      3.791e-01  7.761e-03  48.851   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1758 on 4641 degrees of freedom
## Multiple R-squared:  0.8368, Adjusted R-squared:  0.8366
## F-statistic:  3965 on 6 and 4641 DF,  p-value: < 2.2e-16
```

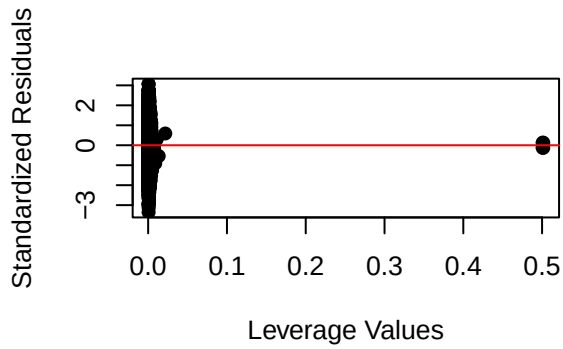
```r
# Calculate residuals and standardized residuals to check for homoscedasticity and other potential issu
residuals <- residuals(model_7)
SSR <- sum(residuals^2)
SSE <- sum((residuals / sqrt(1 - hatvalues(model_7)))^2)
SST <- sum((residuals - mean(residuals))^2)
F_statistic <- ((SST - SSR) / (length(residuals) - length(coef(model_7)))) / (SSE / (length(residuals) -
p_value <- 1 - pf(F_statistic, length(residuals) - length(coef(model_7)), length(residuals) - length(coe
```

```
## Warning in pf(F_statistic, length(residuals) - length(coef(model_7)),
## length(residuals) - : NaNs produced
```

```r
print(p_value)
```

```
## [1] NaN
```

```r
standarized_residuals <- rstandard(model_7)
raised_values <- hatvalues(model_7)
plot(raised_values, standarized_residuals, pch = 19, xlab = "Leverage Values", ylab = "Standardized Resi
abline(h = 0, col = "red")
```



Logistic Regression Analysis

Now, we will conduct a logistic regression to classify vehicles based on a binary outcome derived from their price.

```
# Split the data into training and test sets for the logistic regression.
set.seed(123) # Ensure reproducibility.
llwork <- sample(1:nrow(df), round(0.80 * nrow(df), 0))
df_train <- df[llwork, ]
df_test <- df[-llwork, ]

# Fit the logistic regression model using both categorical and numerical predictors.
mFinal <- glm(formula = y ~ model + transmission + fuelType + manufacturer + engineSize + mileage, famil
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
summary(mFinal)
```

```
##
## Call:
## glm(formula = y ~ model + transmission + fuelType + manufacturer +
##     engineSize + mileage, family = "binomial", data = df_train)
##
## Coefficients: (3 not defined because of singularities)
```

```
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)            -2.779e+00  5.600e-01  -4.962 6.97e-07 ***
## model 2 Series          4.581e-01  4.241e-01   1.080 0.280069
## model 3 Series          1.268e+00  4.160e-01   3.048 0.002304 **
## model 4 Series          1.771e+00  5.458e-01   3.244 0.001177 **
## model 5 Series          2.839e+00  5.589e-01   5.080 3.77e-07 ***
## model 6 Series          2.371e+00  1.408e+00   1.684 0.092164 .
## model 7 Series          4.891e+00  6.421e+00   0.762 0.446185
## model 8 Series          1.293e+01  6.523e+03   0.002 0.998418
## model A Class           8.207e-01  3.757e-01   2.185 0.028921 *
## model A1                5.351e-01  5.019e-01   1.066 0.286331
## model A3                1.909e+00  4.046e-01   4.718 2.38e-06 ***
## model A4                1.249e+00  4.628e-01   2.699 0.006952 **
## model A5                3.226e+00  6.127e-01   5.265 1.40e-07 ***
## model A6                3.943e+00  5.792e-01   6.806 1.00e-11 ***
## model A7                2.247e+01  2.065e+03   0.011 0.991318
## model A8                1.505e+01  2.023e+03   0.007 0.994066
## model Amarok            4.619e+00  1.535e+00   3.009 0.002625 **
## model Arteon            2.727e+00  1.184e+00   2.303 0.021284 *
## model B Class           8.021e-01  5.126e-01   1.565 0.117637
## model Beetle           -1.473e+01  2.908e+03  -0.005 0.995959
## model C Class           2.123e+00  3.760e-01   5.645 1.65e-08 ***
## model Caddy Maxi Life   5.488e-01  1.045e+00   0.525 0.599503
## model Caravelle         9.784e+00  5.189e+01   0.189 0.850463
## model CC               -1.338e+01  2.261e+03  -0.006 0.995279
## model CL Class          2.554e+00  6.490e-01   3.934 8.34e-05 ***
## model CLA Class         1.529e+00  1.264e+00   1.209 0.226639
## model CLS Class         6.332e+00  1.528e+00   4.143 3.42e-05 ***
## model E Class           3.460e+00  4.485e-01   7.716 1.20e-14 ***
## model Eos              -1.082e+01  6.523e+03  -0.002 0.998676
## model GL Class          4.671e+00  1.036e+00   4.509 6.52e-06 ***
## model GLA Class         1.713e+00  4.668e-01   3.670 0.000243 ***
## model GLB Class         1.633e+01  6.523e+03   0.003 0.998003
## model GLC Class         1.052e+01  1.272e+00   8.268  < 2e-16 ***
## model GLE Class         2.066e+01  9.661e+02   0.021 0.982937
## model GLS Class         1.805e+01  2.216e+03   0.008 0.993501
## model Golf              5.444e-01  3.438e-01   1.584 0.113306
## model Golf SV          -1.674e+00  6.421e-01  -2.607 0.009138 **
## model Jetta            -1.497e+01  6.523e+03  -0.002 0.998169
## model M Class           3.714e+00  1.100e+00   3.376 0.000735 ***
## model M2                1.335e+01  3.694e+03   0.004 0.997117
## model M3                1.487e+01  4.459e+03   0.003 0.997339
## model M4                1.884e+01  1.466e+03   0.013 0.989747
## model Passat            8.424e-01  5.553e-01   1.517 0.129269
## model Polo             -3.408e+00  6.243e-01  -5.459 4.79e-08 ***
## model Q2                3.608e+00  5.412e-01   6.668 2.59e-11 ***
## model Q3                2.882e+00  4.712e-01   6.117 9.52e-10 ***
## model Q5                6.532e+00  7.481e-01   8.732  < 2e-16 ***
## model Q7                2.192e+01  9.830e+02   0.022 0.982210
## model Q8                1.597e+01  3.746e+03   0.004 0.996599
## model RS3               2.333e+01  3.483e+03   0.007 0.994655
## model RS4               1.431e+01  6.523e+03   0.002 0.998250
## model RS5               1.487e+01  4.369e+03   0.003 0.997285
## model S Class           7.372e+00  2.389e+00   3.086 0.002027 **
```

```
## model S3               5.642e+00  2.013e+00   2.802 0.005072 **
## model S4               1.816e+01  6.523e+03   0.003 0.997778
## model S5              -1.877e+01  6.523e+03  -0.003 0.997703
## model Scirocco        -1.601e+01  1.190e+03  -0.013 0.989268
## model Sharan           1.973e+00  8.382e-01   2.354 0.018562 *
## model Shuttle          2.206e+01  3.531e+03   0.006 0.995017
## model SL CLASS         1.582e+00  8.649e-01   1.829 0.067373 .
## model SLK             -1.452e+01  2.543e+03  -0.006 0.995444
## model T-Cross          1.375e+00  5.998e-01   2.293 0.021847 *
## model T-Roc            2.696e+00  4.706e-01   5.729 1.01e-08 ***
## model Tiguan           3.061e+00  4.069e-01   7.523 5.34e-14 ***
## model Tiguan Allspace  1.807e+01  2.702e+03   0.007 0.994663
## model Touareg          5.952e+00  1.145e+00   5.198 2.02e-07 ***
## model Touran           3.030e+00  7.037e-01   4.306 1.66e-05 ***
## model TT               1.857e-01  7.239e-01   0.256 0.797596
## model Up              -1.650e+01  7.183e+02  -0.023 0.981675
## model V Class          5.939e+00  1.122e+00   5.293 1.20e-07 ***
## model X-CLASS          2.940e+00  1.198e+00   2.455 0.014085 *
## model X1               1.514e+00  5.320e-01   2.845 0.004445 **
## model X2               1.831e+01  1.052e+03   0.017 0.986112
## model X3               4.673e+00  8.432e-01   5.541 3.00e-08 ***
## model X4               7.953e+00  2.515e+00   3.162 0.001569 **
## model X5               1.070e+01  1.378e+00   7.762 8.36e-15 ***
## model X6               2.966e+00  1.211e+00   2.449 0.014333 *
## model Z3              -1.009e+01  4.581e+03  -0.002 0.998243
## model Z4               4.567e-01  1.411e+00   0.324 0.746181
## transmissionManual    -1.912e+00  1.915e-01  -9.983  < 2e-16 ***
## transmissionSemi-Auto  3.413e-01  1.611e-01   2.118 0.034193 *
## fuelTypeHybrid         1.120e+00  1.193e+00   0.939 0.347801
## fuelTypeOther          7.444e-01  1.309e+00   0.569 0.569518
## fuelTypePetrol         1.317e+00  1.605e-01   8.202 2.35e-16 ***
## manufacturerBMW               NA         NA      NA       NA
## manufacturerMercedes          NA         NA      NA       NA
## manufacturerVW                NA         NA      NA       NA
## engineSize             2.340e+00  2.200e-01  10.636  < 2e-16 ***
## mileage               -1.779e-04  7.290e-06 -24.400  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 5353.9  on 3861  degrees of freedom
## Residual deviance: 1717.5  on 3776  degrees of freedom
## AIC: 1889.5
##
## Number of Fisher Scoring iterations: 17
```

```r
# Make predictions on the test set and create a confusion matrix to evaluate the model's performance.
pred_test <- predict(mFinal, newdata = df_test, type = "response")
y.est <- ifelse(pred_test < 0.5, "no", "yes")
tt <- table(y.est, df_test$y)
tt
```

```
##
```

```
## y.est   0   1
##   no  435  52
##   yes  50 429
```

```r
# Calculate the accuracy of the model from the confusion matrix.
accuracy <- 100 * sum(diag(tt)) / sum(tt)
accuracy
```

```
## [1] 89.44099
```

Conclusion

This comprehensive analysis has enabled us to predict vehicle prices and classify vehicles with considerable accuracy. Through linear regression, we have identified key numerical predictors of vehicle pricing, and logistic regression has allowed us to categorize vehicles effectively. These models have provided significant insights and will serve as a solid foundation for further predictive modeling and analysis within the automotive industry. “‘