```r
library(car)
```

```
## Loading required package: carData
```

```r
library(reshape2)
library(ggplot2)
library(MASS)
library(interactions)

source("clean_data.R")


df <- remove_cols(df, c("Color", "Model"))

# Remove columns with only one observation and affected rows
res <- convert_categorical(df, categorical)
design <- as.data.frame(res$dummy)

singles <- c()
bad_idx <- c()
for (col in colnames(design)) {
  if (sum(design[, col] != 0) <= 1) {
    singles <- c(singles, col)
    bad_idx <- c(bad_idx, which(design[, col] != 0))
  }
}
singles
```

```
##  [1] "MakeFiat"              "MakeLexus"             "Fuel.TypePetrol + CNG"
##  [4] "LocationDak. Kannada"  "LocationFaizabad"      "LocationGorakhpur"
##  [7] "LocationPurnea"        "LocationRohtak"        "LocationRudrapur"
## [10] "LocationSamastipur"    "LocationValsad"
```

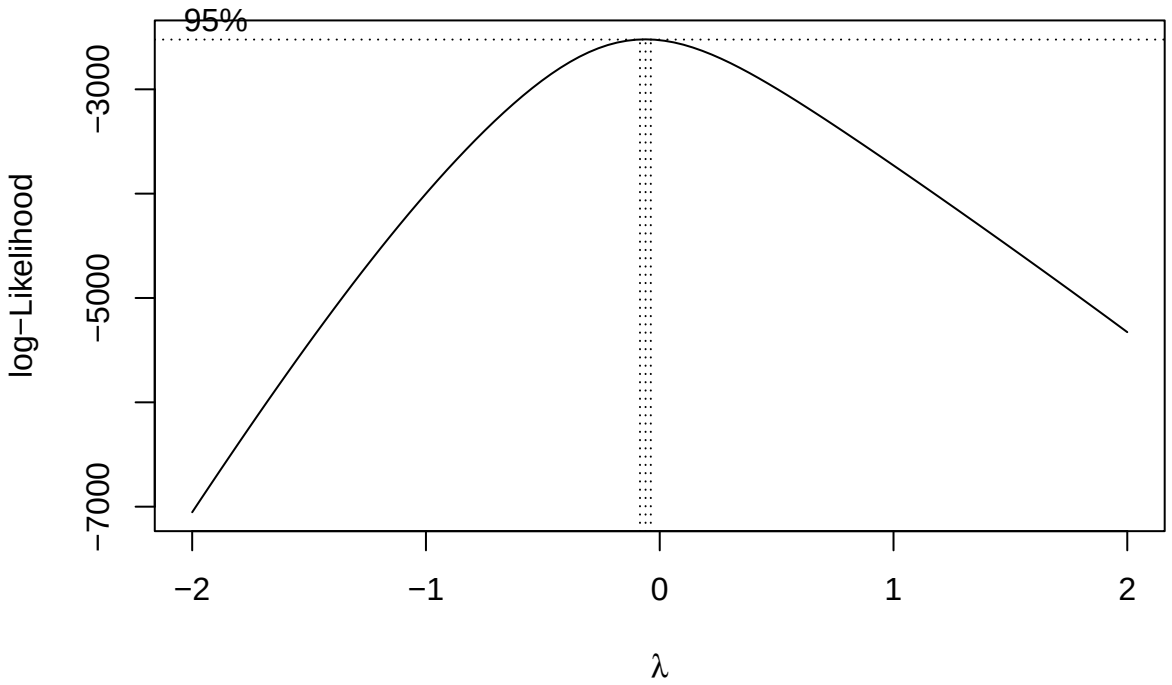
```r
bad_idx
```

```
##  [1]  662 1009 1169 1077  779  569  728  245  510  264  162
```

```r
df <- df[-bad_idx, ]
```

Box Cox

```r
bc <- boxcox(Price ~., data = df)
```




```
bc$x[which.max(bc$y)]
```

```
## [1] -0.06060606
```

For the sake of interpretability, we will use a log transformation, since $\lambda \approx 0$.

Iteratively Remove Multicollinear Regressors

```
x <- df
model <- lm(log(Price) ~., data = x)
removed <- c()

finished <- F
while(!finished) {
  temp <- car::vif(model)[, "GVIF^(1/(2*Df))"]
  worst <- names(which.max(temp))
  if (length(temp) > 0 && temp[worst] > sqrt(5)) {
    x <- remove_cols(x, c(worst))
    model <- lm(log(Price) ~., data = x)

    removed <- c(removed, worst)
  } else {
    finished <- T
  }
}

removed
```

```
## [1] "Max.Torque.Value"   "Max.Power.RPM"      "Max.Power.Value"
## [4] "Engine"             "Fuel.Tank.Capacity" "Height"
```

```
which(abs(rstudent(model)) > 4)
```

```
##   44  366  492 1536 1681
```

```
##   39  268  345 1071 1171
```

After inspecting these data points, we do not find a good reason to remove them (i.e., they are not clerical errors).

Add Interactions

We consider only numerical interactions due to data sparsity; including categorical values produces NA's for most interactions. We do not expect kilometers driven to interact with torque or width, so those interactions are not considered.

```
names(model$coefficients)[names(model$coefficients) %in% numerical]
```

```
## [1] "Year"           "Kilometer"      "Max.Torque.RPM" "Length"
## [5] "Width"
```

```
model <- lm(
  log(Price) ~ . + Year:Kilometer + Year:Max.Torque.RPM
                 + Year:Length + Year:Width
                 + Max.Torque.RPM:Length + Max.Torque.RPM:Width
                 + Length:Width,
  data = x
)

anova(model)
```

```
## Analysis of Variance Table
##
## Response: log(Price)
##                          Df Sum Sq Mean Sq   F value    Pr(>F)
## Make                     25 354.44  14.178  482.1594 < 2.2e-16 ***
## Year                      1 178.52 178.525 6071.3552 < 2.2e-16 ***
## Kilometer                 1   0.98   0.982   33.3800 9.430e-09 ***
## Fuel.Type                 2  19.23   9.615  326.9979 < 2.2e-16 ***
## Transmission              1  20.31  20.313  690.7982 < 2.2e-16 ***
## Location                 63  16.76   0.266    9.0458 < 2.2e-16 ***
## Owner                     3   0.46   0.153    5.2143  0.001397 **
## Seller.Type               2   0.33   0.165    5.6238  0.003697 **
## Max.Torque.RPM            1   1.67   1.669   56.7628 9.050e-14 ***
## Drivetrain                2   5.81   2.905   98.7875 < 2.2e-16 ***
## Length                    1  51.72  51.724 1759.0668 < 2.2e-16 ***
## Width                     1   5.06   5.063  172.1998 < 2.2e-16 ***
## Seating.Capacity          1   0.02   0.019    0.6507  0.419991
## Year:Kilometer            1   1.10   1.100   37.4187 1.251e-09 ***
## Year:Max.Torque.RPM       1   0.99   0.993   33.7868 7.690e-09 ***
## Year:Length               1   2.04   2.038   69.2926 < 2.2e-16 ***
## Year:Width                1   0.08   0.076    2.5959  0.107377
## Max.Torque.RPM:Length     1   0.28   0.276    9.3872  0.002229 **
## Max.Torque.RPM:Width      1   0.01   0.012    0.3960  0.529287
## Length:Width              1   0.01   0.014    0.4748  0.490893
## Residuals              1329  39.08   0.029
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Interactions with width don't seem to be significant; remove them.

```
model <- lm(
  log(Price) ~ . + Year:Kilometer + Year:Max.Torque.RPM
                 + Year:Length + Max.Torque.RPM:Length,
  data = x
)

anova(model)
```

```
## Analysis of Variance Table
##
## Response: log(Price)
##                          Df Sum Sq Mean Sq   F value    Pr(>F)
## Make                     25 354.44  14.178  481.9160 < 2.2e-16 ***
## Year                      1 178.52 178.525 6068.2914 < 2.2e-16 ***
## Kilometer                 1   0.98   0.982   33.3632 9.505e-09 ***
## Fuel.Type                 2  19.23   9.615  326.8329 < 2.2e-16 ***
## Transmission              1  20.31  20.313  690.4496 < 2.2e-16 ***
## Location                 63  16.76   0.266    9.0412 < 2.2e-16 ***
## Owner                     3   0.46   0.153    5.2117  0.001402 **
## Seller.Type               2   0.33   0.165    5.6210  0.003708 **
## Max.Torque.RPM            1   1.67   1.669   56.7341 9.165e-14 ***
## Drivetrain                2   5.81   2.905   98.7377 < 2.2e-16 ***
## Length                    1  51.72  51.724 1758.1791 < 2.2e-16 ***
## Width                     1   5.06   5.063  172.1129 < 2.2e-16 ***
## Seating.Capacity          1   0.02   0.019    0.6504  0.420108
## Year:Kilometer            1   1.10   1.100   37.3998 1.262e-09 ***
## Year:Max.Torque.RPM       1   0.99   0.993   33.7697 7.752e-09 ***
## Year:Length               1   2.04   2.038   69.2576 < 2.2e-16 ***
## Max.Torque.RPM:Length     1   0.27   0.270    9.1768  0.002498 **
## Residuals              1332  39.19   0.029
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Seems reasonable now. We will double check our assumptions

```
vif(model, type = "predictor")
```

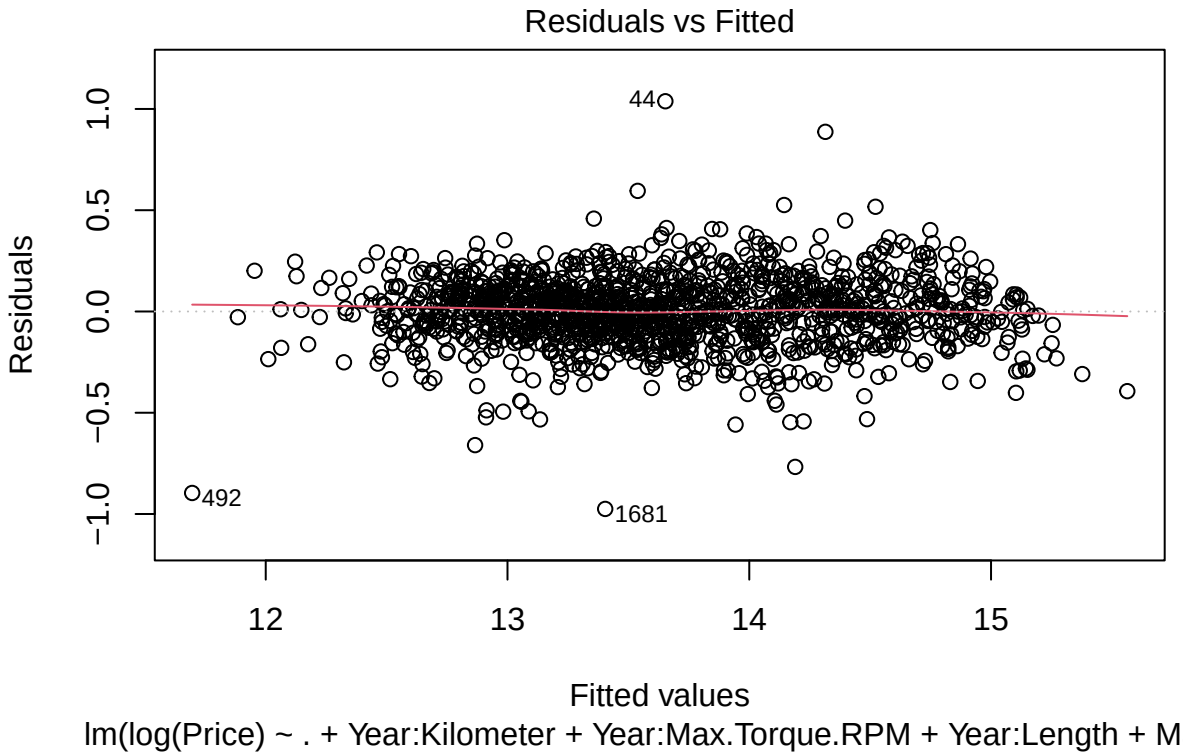
```
## GVIFs computed for predictors
```

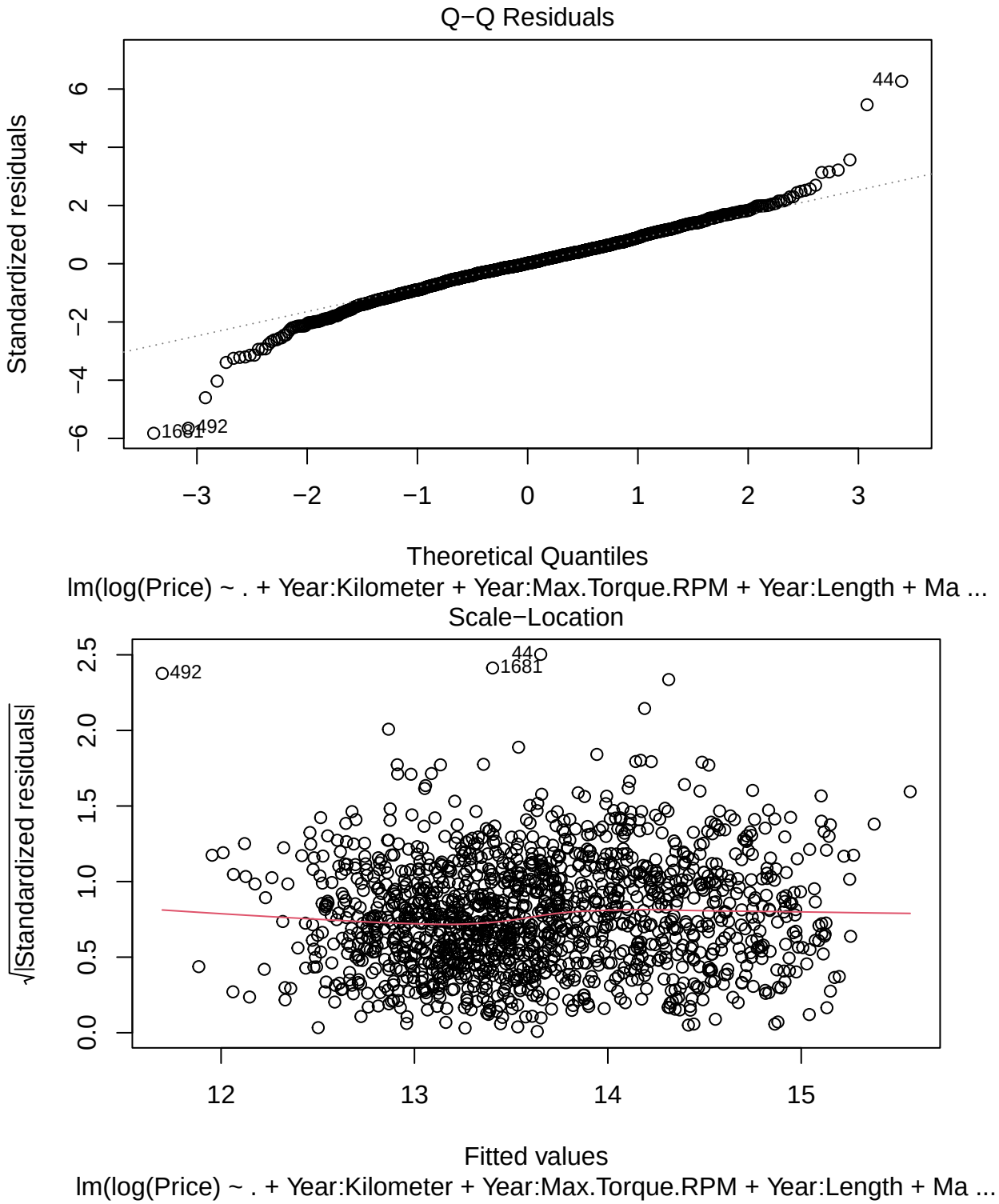
```
##                         GVIF Df GVIF^(1/(2*Df))
## Make              119.109068 25        1.100320
## Year               75.935730  8        1.310774
## Kilometer         330.635985  3        2.629612
## Fuel.Type           5.334325  2        1.519742
## Transmission        1.851632  1        1.360747
## Location           16.448508 63        1.022473
## Owner               1.673586  3        1.089619
## Seller.Type         1.341372  2        1.076186
## Max.Torque.RPM    207.518246  6        1.559869
## Drivetrain          4.003689  2        1.414539
## Length            207.518246  6        1.559869
## Width               4.624641  1        2.150498
## Seating.Capacity    2.882982  1        1.697934
##                                    Interacts With
## Make                                           --
```

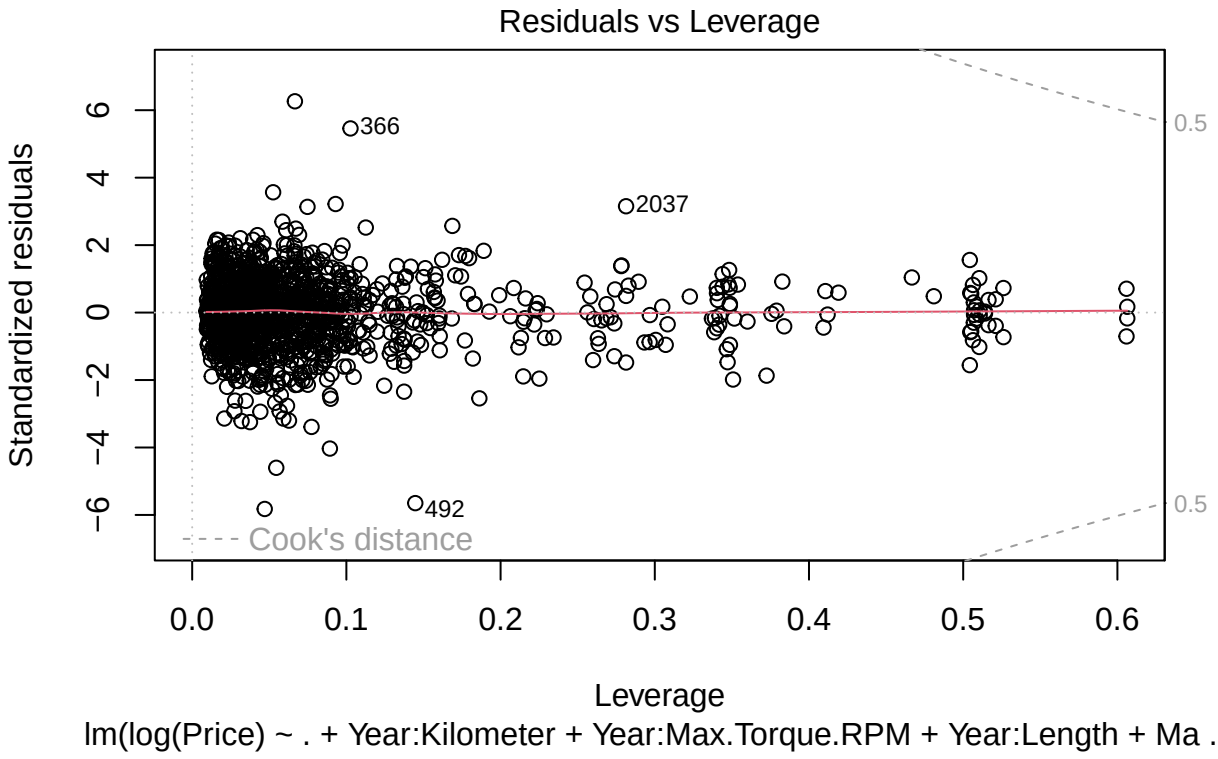
```
## Year              Kilometer, Max.Torque.RPM, Length
## Kilometer                                     Year
## Fuel.Type                                     --
## Transmission                                  --
## Location                                      --
## Owner                                         --
## Seller.Type                                   --
## Max.Torque.RPM                      Year, Length
## Drivetrain                                    --
## Length                        Year, Max.Torque.RPM
## Width                                         --
## Seating.Capacity                              --
##
## Make              Year, Kilometer, Fuel.Type, Transmission, Location, Owner, Seller.Type, Max.Torque.
## Year                                                Make, Fuel.Type, Transmission, Location, Owner,
## Kilometer                    Make, Fuel.Type, Transmission, Location, Owner, Seller.Type, Max.Torque.
## Fuel.Type              Make, Year, Kilometer, Transmission, Location, Owner, Seller.Type, Max.Torque.
## Transmission             Make, Year, Kilometer, Fuel.Type, Location, Owner, Seller.Type, Max.Torque.
## Location              Make, Year, Kilometer, Fuel.Type, Transmission, Owner, Seller.Type, Max.Torque.
## Owner              Make, Year, Kilometer, Fuel.Type, Transmission, Location, Seller.Type, Max.Torque.
## Seller.Type              Make, Year, Kilometer, Fuel.Type, Transmission, Location, Owner, Max.Torque.
## Max.Torque.RPM                          Make, Kilometer, Fuel.Type, Transmission, Location, Owner,
## Drivetrain             Make, Year, Kilometer, Fuel.Type, Transmission, Location, Owner, Seller.Type,
## Length                                  Make, Kilometer, Fuel.Type, Transmission, Location, Owner,
## Width               Make, Year, Kilometer, Fuel.Type, Transmission, Location, Owner, Seller.Type, Max.
## Seating.Capacity             Make, Year, Kilometer, Fuel.Type, Transmission, Location, Owner, Seller
```

We get that GVIF^(1/(2*Df)) $> 2.236068 \approx \sqrt{5}$, for "Kilometer," but this is known to be important is does not exceed the threshold by a lot, so we keep it.

```
plot(model)
```




Q−Q Residuals
Standardized residuals
Theoretical Quantiles
lm(log(Price) ~ . + Year:Kilometer + Year:Max.Torque.RPM + Year:Length + Ma ...
Scale−Location
√|Standardized residuals|
Fitted values
lm(log(Price) ~ . + Year:Kilometer + Year:Max.Torque.RPM + Year:Length + Ma ...



Backwards Stepwise Search

We do a backwards search since our model already conforms to the linear assumptions and is performing well. We simply wish to reduce the model size now.

```
reduced_model <- step(model, direction = "backward", data = x, trace = 0)
old <- names(model$coefficients)
new <- names(reduced_model$coefficients)

old[!(old %in% new)]
```

```
## [1] "Seller.TypeCorporate"  "Seller.TypeIndividual" "Seating.Capacity"
```

Inspect Model Coefficients

```
summary(reduced_model)
```

```
##
## Call:
## lm(formula = log(Price) ~ Make + Year + Kilometer + Fuel.Type +
##     Transmission + Location + Owner + Max.Torque.RPM + Drivetrain +
##     Length + Width + Year:Kilometer + Year:Max.Torque.RPM + Year:Length +
##     Max.Torque.RPM:Length, data = x)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.96723 -0.09029  0.00315  0.09727  1.06985
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)            1.158e+02  4.324e+01   2.678 0.007494 **
## MakeBMW                1.267e-02  4.002e-02   0.317 0.751541
## MakeChevrolet         -7.982e-01  9.078e-02  -8.793  < 2e-16 ***
## MakeDatsun            -8.571e-01  6.913e-02 -12.399  < 2e-16 ***
## MakeFord              -5.727e-01  3.836e-02 -14.932  < 2e-16 ***
## MakeHonda             -4.859e-01  3.120e-02 -15.573  < 2e-16 ***
## MakeHyundai           -4.650e-01  2.736e-02 -16.996  < 2e-16 ***
## MakeIsuzu             -4.377e-01  1.275e-01  -3.433 0.000616 ***
## MakeJaguar             6.590e-02  7.679e-02   0.858 0.390958
## MakeJeep              -3.336e-01  5.056e-02  -6.598 6.01e-11 ***
## MakeKia               -4.155e-01  4.444e-02  -9.350  < 2e-16 ***
## MakeLand Rover         1.808e-01  1.027e-01   1.761 0.078472 .
## MakeMahindra          -5.963e-01  3.300e-02 -18.072  < 2e-16 ***
## MakeMaruti Suzuki     -5.232e-01  2.813e-02 -18.599  < 2e-16 ***
## MakeMercedes-Benz      1.454e-01  3.286e-02   4.426 1.04e-05 ***
## MakeMG                -5.963e-01  5.491e-02 -10.861  < 2e-16 ***
## MakeMINI               7.041e-01  7.573e-02   9.297  < 2e-16 ***
## MakeMitsubishi        -2.496e-01  1.123e-01  -2.223 0.026365 *
## MakeNissan            -7.334e-01  5.153e-02 -14.232  < 2e-16 ***
## MakeRenault           -7.493e-01  3.845e-02 -19.484  < 2e-16 ***
## MakeSkoda             -5.091e-01  3.729e-02 -13.652  < 2e-16 ***
## MakeSsangyong         -8.725e-01  1.130e-01  -7.719 2.29e-14 ***
## MakeTata              -7.190e-01  3.690e-02 -19.485  < 2e-16 ***
## MakeToyota            -2.488e-01  2.997e-02  -8.304 2.44e-16 ***
## MakeVolkswagen        -5.183e-01  3.755e-02 -13.803  < 2e-16 ***
## MakeVolvo              3.094e-02  5.612e-02   0.551 0.581532
## Year                  -5.295e-02  2.144e-02  -2.470 0.013648 *
## Kilometer             -4.525e-04  1.205e-04  -3.755 0.000181 ***
## Fuel.TypeDiesel       -1.647e-01  3.761e-02  -4.378 1.29e-05 ***
## Fuel.TypePetrol       -1.895e-01  3.407e-02  -5.561 3.24e-08 ***
## TransmissionManual    -1.439e-01  1.264e-02 -11.384  < 2e-16 ***
## LocationAhmedabad      6.225e-02  4.846e-02   1.284 0.199240
## LocationAllahabad     -9.060e-02  1.081e-01  -0.838 0.401922
## LocationAmbala Cantt  -9.213e-02  6.973e-02  -1.321 0.186672
## LocationAmritsar       1.218e-01  9.740e-02   1.251 0.211326
## LocationAurangabad     2.931e-01  1.082e-01   2.710 0.006818 **
## LocationBangalore      2.465e-01  4.583e-02   5.379 8.84e-08 ***
## LocationBhopal         2.905e-02  1.085e-01   0.268 0.788928
## LocationBhubaneswar    8.012e-02  1.126e-01   0.711 0.476905
## LocationBulandshahar  -3.137e-01  1.311e-01  -2.392 0.016889 *
## LocationChandigarh     3.183e-02  6.192e-02   0.514 0.607355
## LocationChennai        2.161e-01  5.086e-02   4.248 2.30e-05 ***
## LocationCoimbatore     2.694e-01  5.931e-02   4.542 6.07e-06 ***
## LocationDehradun       5.931e-02  5.817e-02   1.019 0.308151
## LocationDelhi          7.161e-02  4.396e-02   1.629 0.103563
## LocationDharwad        2.073e-01  1.289e-01   1.609 0.107889
## LocationErnakulam      2.090e-01  1.296e-01   1.613 0.106954
## LocationFaridabad     -6.976e-02  5.634e-02  -1.238 0.215806
## LocationGhaziabad     -2.308e-02  1.298e-01  -0.178 0.858964
## LocationGoa            2.481e-01  9.789e-02   2.534 0.011380 *
## LocationGurgaon       -1.028e-02  5.621e-02  -0.183 0.854956
## LocationGuwahati       1.672e-01  8.915e-02   1.875 0.060970 .
## LocationHaldwani      -1.095e-02  1.292e-01  -0.085 0.932493
## LocationHyderabad      1.855e-01  4.650e-02   3.990 6.97e-05 ***
```

```
## LocationIndore         2.097e-01  9.657e-02   2.172 0.030046 *
## LocationJaipur         1.230e-01  5.472e-02   2.247 0.024785 *
## LocationJalandhar      1.812e-01  5.766e-02   3.143 0.001708 **
## LocationJamshedpur    -1.725e-02  8.972e-02  -0.192 0.847533
## LocationKanpur        -8.606e-02  5.155e-02  -1.669 0.095280 .
## LocationKarnal         9.667e-02  7.439e-02   1.299 0.194010
## LocationKharar         5.630e-02  1.293e-01   0.435 0.663336
## LocationKheda         -8.822e-02  1.289e-01  -0.684 0.493901
## LocationKolkata       -7.600e-02  4.854e-02  -1.566 0.117611
## LocationKollam         2.268e-01  1.292e-01   1.755 0.079410 .
## LocationKota           1.171e-01  1.409e-01   0.831 0.405932
## LocationLucknow        2.163e-02  4.870e-02   0.444 0.656920
## LocationLudhiana       4.327e-02  5.132e-02   0.843 0.399288
## LocationMangalore      5.662e-02  9.648e-02   0.587 0.557384
## LocationMeerut         3.854e-02  7.468e-02   0.516 0.605902
## LocationMirzapur       9.829e-02  1.402e-01   0.701 0.483506
## LocationMohali         1.159e-01  5.559e-02   2.086 0.037195 *
## LocationMumbai         1.007e-01  4.387e-02   2.295 0.021871 *
## LocationMuzaffurpur   -6.818e-02  1.290e-01  -0.528 0.597330
## LocationMysore         3.209e-01  7.812e-02   4.107 4.25e-05 ***
## LocationNagpur         1.676e-01  1.081e-01   1.550 0.121461
## LocationNashik         5.820e-02  7.787e-02   0.747 0.454960
## LocationNavi Mumbai    9.202e-02  6.287e-02   1.464 0.143490
## LocationNoida          9.597e-02  6.413e-02   1.497 0.134746
## LocationPanchkula     -2.740e-02  1.079e-01  -0.254 0.799604
## LocationPatna          6.216e-02  5.200e-02   1.195 0.232170
## LocationPune           1.310e-01  4.601e-02   2.848 0.004468 **
## LocationRaipur         9.927e-02  6.040e-02   1.644 0.100513
## LocationRanchi        -4.610e-02  5.965e-02  -0.773 0.439798
## LocationRanga Reddy    6.674e-02  1.300e-01   0.514 0.607655
## LocationRoorkee        4.763e-02  1.098e-01   0.434 0.664466
## LocationSalem          4.209e-01  1.290e-01   3.264 0.001128 **
## LocationSurat          4.111e-02  8.797e-02   0.467 0.640325
## LocationThane          1.021e-01  6.216e-02   1.642 0.100858
## LocationUdupi          1.480e-01  7.408e-02   1.998 0.045881 *
## LocationVadodara      -9.552e-03  1.081e-01  -0.088 0.929598
## LocationVaranasi      -4.888e-02  6.047e-02  -0.808 0.419060
## LocationWarangal      -6.318e-02  1.290e-01  -0.490 0.624449
## LocationYamunanagar    2.302e-02  1.088e-01   0.212 0.832520
## LocationZirakpur      -2.603e-02  6.193e-02  -0.420 0.674326
## OwnerSecond           -2.011e-02  1.340e-02  -1.501 0.133607
## OwnerThird            -1.212e-01  4.872e-02  -2.488 0.012972 *
## OwnerUnRegistered Car  8.222e-02  9.193e-02   0.894 0.371321
## Max.Torque.RPM         1.067e-02  2.914e-03   3.661 0.000261 ***
## DrivetrainFWD         -2.637e-01  2.231e-02 -11.820  < 2e-16 ***
## DrivetrainRWD         -2.210e-01  2.694e-02  -8.204 5.44e-16 ***
## Length                -7.860e-02  9.661e-03  -8.136 9.26e-16 ***
## Width                  1.503e-03  1.077e-04  13.951  < 2e-16 ***
## Year:Kilometer         2.237e-07  5.974e-08   3.745 0.000188 ***
## Year:Max.Torque.RPM   -5.232e-06  1.441e-06  -3.631 0.000293 ***
## Year:Length            3.933e-05  4.789e-06   8.212 5.07e-16 ***
## Max.Torque.RPM:Length -3.811e-08  1.344e-08  -2.834 0.004661 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

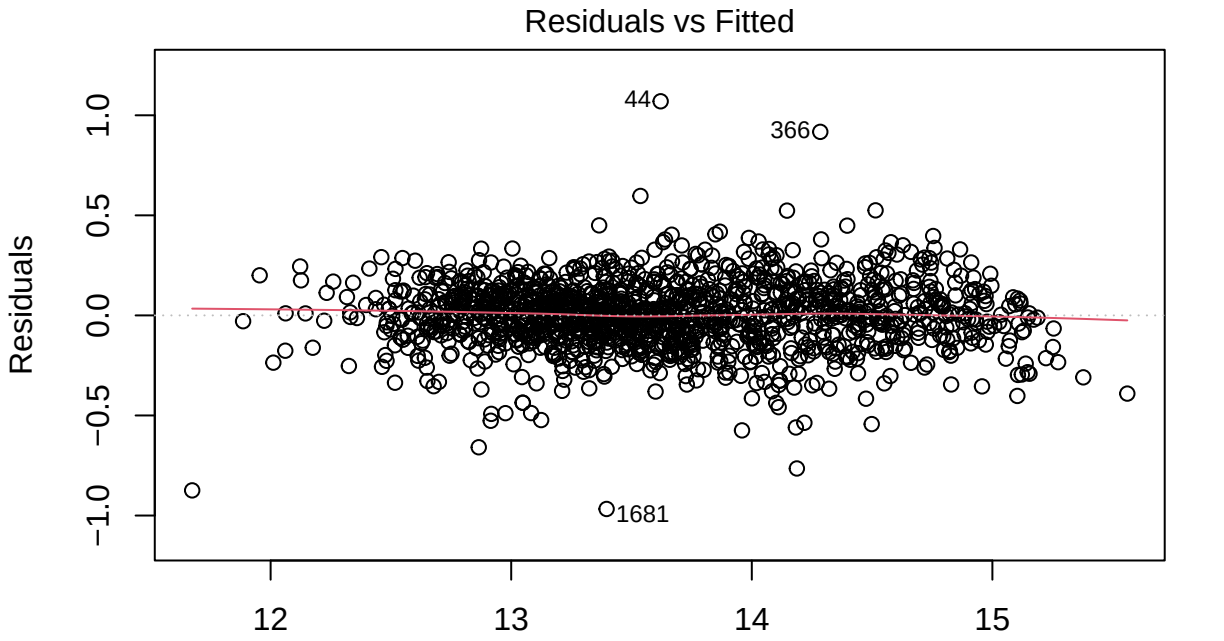
```
##
## Residual standard error: 0.1715 on 1335 degrees of freedom
## Multiple R-squared:  0.9439, Adjusted R-squared:  0.9394
## F-statistic: 213.7 on 105 and 1335 DF,  p-value: < 2.2e-16
```

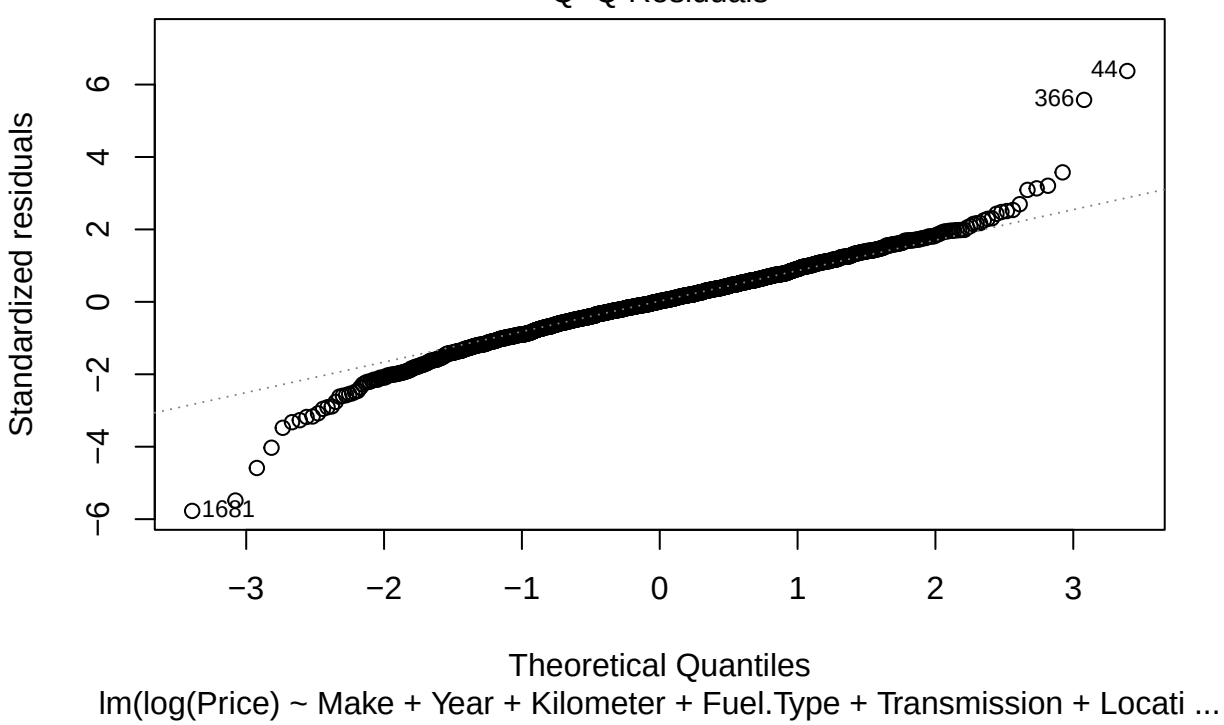
```
anova(reduced_model)
```

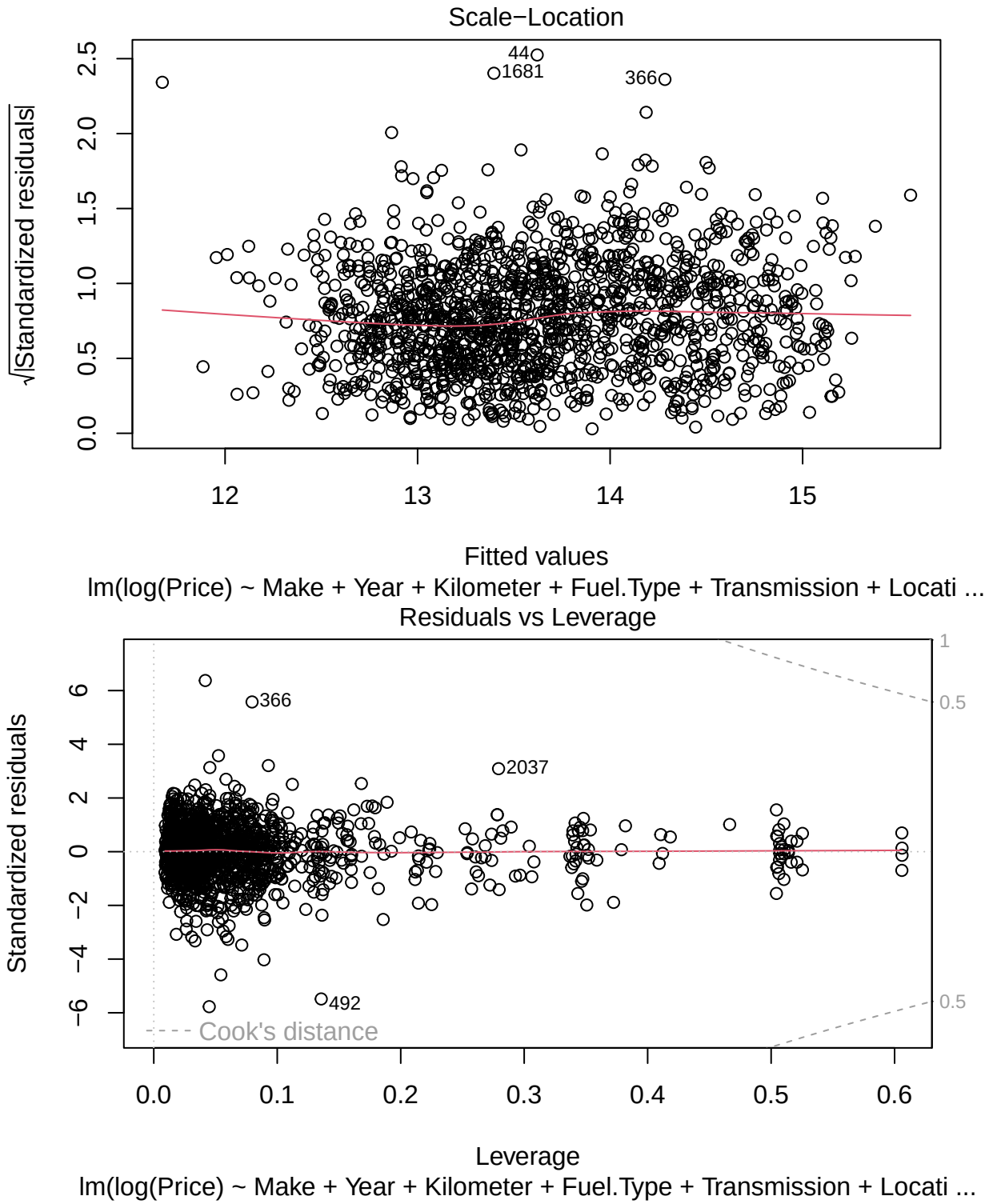
```
## Analysis of Variance Table
##
## Response: log(Price)
##                          Df Sum Sq Mean Sq   F value    Pr(>F)
## Make                     25 354.44  14.178  482.3002 < 2.2e-16 ***
## Year                      1 178.52 178.525 6073.1284 < 2.2e-16 ***
## Kilometer                 1   0.98   0.982   33.3898 9.375e-09 ***
## Fuel.Type                 2  19.23   9.615  327.0934 < 2.2e-16 ***
## Transmission              1  20.31  20.313  691.0000 < 2.2e-16 ***
## Location                 63  16.76   0.266    9.0484 < 2.2e-16 ***
## Owner                     3   0.46   0.153    5.2159  0.001394 **
## Max.Torque.RPM            1   1.73   1.728   58.7925 3.357e-14 ***
## Drivetrain                2   5.72   2.859   97.2752 < 2.2e-16 ***
## Length                    1  52.04  52.042 1770.3899 < 2.2e-16 ***
## Width                     1   5.07   5.072  172.5249 < 2.2e-16 ***
## Year:Kilometer            1   1.12   1.119   38.0572 9.091e-10 ***
## Year:Max.Torque.RPM       1   0.95   0.953   32.4200 1.525e-08 ***
## Year:Length               1   2.09   2.092   71.1609 < 2.2e-16 ***
## Max.Torque.RPM:Length     1   0.24   0.236    8.0336  0.004661 **
## Residuals              1335  39.24   0.029
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Final Model Verification

```
plot(reduced_model)
```


Residuals vs Fitted
Residuals
Fitted values
lm(log(Price) ~ Make + Year + Kilometer + Fuel.Type + Transmission + Locati ...
44
366
1681
1.0
0.5
0.0
−0.5
−1.0
12
13
14
15


Q−Q Residuals
Standardized residuals
Theoretical Quantiles
lm(log(Price) ~ Make + Year + Kilometer + Fuel.Type + Transmission + Locati ...
44
366
1681
6
4
2
0
−2
−4
−6
−3
−2
−1
0
1
2
3



Normalized Coefficients

```
normalized <- remove_cols(x, old[!(old %in% new)]) # removed from multicollinearity test
normalized <- remove_cols(x, c("Seating.Capacity", "Seller.Type"))
```

```r
for (col in colnames(normalized)) {
  if (col != "Price" && !(col %in% categorical)) {
    normalized[, col] <- (normalized[, col] - mean(normalized[, col])) / sd(normalized[, col])
  }
}

normalized_model <- lm(log(Price) ~ . + Year:Kilometer + Year:Max.Torque.RPM
                  + Year:Length + Max.Torque.RPM:Length, data = normalized)

sort(abs(normalized_model$coefficients), decreasing = T)
```

```
##           (Intercept)         MakeSsangyong             MakeDatsun
##          14.479239336           0.872512749           0.857115032
##         MakeChevrolet           MakeRenault             MakeNissan
##           0.798238688           0.749256440           0.733447399
##              MakeTata              MakeMINI                MakeMG
##           0.718998608           0.704054157           0.596345412
##          MakeMahindra              MakeFord     MakeMaruti Suzuki
##           0.596297888           0.572746578           0.523222676
##        MakeVolkswagen             MakeSkoda             MakeHonda
##           0.518324656           0.509078901           0.485869081
##           MakeHyundai             MakeIsuzu         LocationSalem
##           0.465042221           0.437700433           0.420870279
##               MakeKia              MakeJeep        LocationMysore
##           0.415501427           0.333574675           0.320886296
##                  Year  LocationBulandshahar    LocationAurangabad
##           0.313783661           0.313704055           0.293113281
##    LocationCoimbatore         DrivetrainFWD        MakeMitsubishi
##           0.269393557           0.263692508           0.249563035
##            MakeToyota           LocationGoa     LocationBangalore
##           0.248826742           0.248093841           0.246496783
##        LocationKollam                Length         DrivetrainRWD
##           0.226788237           0.226439416           0.221018253
##       LocationChennai        LocationIndore     LocationErnakulam
##           0.216077914           0.209724881           0.208988890
##       LocationDharwad       Fuel.TypePetrol     LocationHyderabad
##           0.207341744           0.189472148           0.185525949
##     LocationJalandhar        MakeLand Rover        LocationNagpur
##           0.181224043           0.180846132           0.167588274
##      LocationGuwahati       Fuel.TypeDiesel         LocationUdupi
##           0.167182283           0.164673775           0.148042941
##     MakeMercedes-Benz    TransmissionManual                 Width
##           0.145432782           0.143902253           0.135371333
##          LocationPune        LocationJaipur      LocationAmritsar
##           0.131030713           0.122967074           0.121805119
##            OwnerThird          LocationKota        LocationMohali
##           0.121210169           0.117146416           0.115934495
##         LocationThane        LocationMumbai        LocationRaipur
##           0.102055354           0.100701797           0.099272043
##      LocationMirzapur        LocationKarnal         LocationNoida
##           0.098291704           0.096670247           0.095972455
##  LocationAmbala Cantt   LocationNavi Mumbai     LocationAllahabad
##           0.092130013           0.092020794           0.090599537
```

```
##         LocationKheda        LocationKanpur OwnerUnRegistered Car
##           0.088221751           0.086058622           0.082215522
##   LocationBhubaneswar       LocationKolkata         LocationDelhi
##           0.080119830           0.076002757           0.071607021
##     LocationFaridabad   LocationMuzaffurpur   LocationRanga Reddy
##           0.069764717           0.068179314           0.066742019
##            MakeJaguar      LocationWarangal     LocationAhmedabad
##           0.065901543           0.063180846           0.062246218
##         LocationPatna      LocationDehradun        LocationNashik
##           0.062160128           0.059305473           0.058196769
##        Max.Torque.RPM     LocationMangalore        LocationKharar
##           0.056697498           0.056620215           0.056298195
##      LocationVaranasi       LocationRoorkee        LocationRanchi
##           0.048878372           0.047629067           0.046096495
##      LocationLudhiana           Year:Length         LocationSurat
##           0.043273053           0.041510876           0.041112278
##        LocationMeerut             Kilometer    LocationChandigarh
##           0.038541407           0.034232361           0.031825300
##             MakeVolvo       LocationBhopal     LocationPanchkula
##           0.030938615           0.029053023           0.027400801
##      LocationZirakpur     LocationGhaziabad   LocationYamunanagar
##           0.026027821           0.023076512           0.023015393
##       LocationLucknow           OwnerSecond   Year:Max.Torque.RPM
##           0.021634758           0.020113875           0.018733584
## Max.Torque.RPM:Length        Year:Kilometer    LocationJamshedpur
##           0.017715033           0.017494262           0.017254036
##               MakeBMW      LocationHaldwani       LocationGurgaon
##           0.012673995           0.010949026           0.010276737
##      LocationVadodara
##           0.009552204
```

Confidence Intervals

```
confint(reduced_model, level = 0.95)
```

```
##                               2.5 %        97.5 %
## (Intercept)            3.097671e+01  2.006291e+02
## MakeBMW               -6.583948e-02  9.118747e-02
## MakeChevrolet         -9.763334e-01 -6.201439e-01
## MakeDatsun            -9.927263e-01 -7.215037e-01
## MakeFord              -6.479947e-01 -4.974984e-01
## MakeHonda             -5.470757e-01 -4.246625e-01
## MakeHyundai           -5.187203e-01 -4.113642e-01
## MakeIsuzu             -6.878548e-01 -1.875461e-01
## MakeJaguar            -8.474833e-02  2.165514e-01
## MakeJeep              -4.327616e-01 -2.343877e-01
## MakeKia               -5.026782e-01 -3.283247e-01
## MakeLand Rover        -2.061831e-02  3.823106e-01
## MakeMahindra          -6.610257e-01 -5.315700e-01
## MakeMaruti Suzuki     -5.784090e-01 -4.680363e-01
## MakeMercedes-Benz      8.097184e-02  2.098937e-01
## MakeMG                -7.040558e-01 -4.886350e-01
## MakeMINI               5.554995e-01  8.526088e-01
## MakeMitsubishi        -4.697699e-01 -2.935620e-02
```

```
## MakeNissan            -8.345425e-01 -6.323523e-01
## MakeRenault           -8.246941e-01 -6.738188e-01
## MakeSkoda             -5.822294e-01 -4.359284e-01
## MakeSsangyong         -1.094264e+00 -6.507613e-01
## MakeTata              -7.913884e-01 -6.466088e-01
## MakeToyota            -3.076110e-01 -1.900425e-01
## MakeVolkswagen        -5.919894e-01 -4.446599e-01
## MakeVolvo             -7.915660e-02  1.410338e-01
## Year                  -9.500900e-02 -1.088987e-02
## Kilometer             -6.888294e-04 -2.160802e-04
## Fuel.TypeDiesel       -2.384552e-01 -9.089237e-02
## Fuel.TypePetrol       -2.563113e-01 -1.226330e-01
## TransmissionManual    -1.687006e-01 -1.191039e-01
## LocationAhmedabad     -3.282940e-02  1.573218e-01
## LocationAllahabad     -3.025746e-01  1.213755e-01
## LocationAmbala Cantt  -2.289298e-01  4.466978e-02
## LocationAmritsar      -6.927460e-02  3.128848e-01
## LocationAurangabad     8.091882e-02  5.053077e-01
## LocationBangalore      1.565970e-01  3.363965e-01
## LocationBhopal        -1.838064e-01  2.419125e-01
## LocationBhubaneswar   -1.407892e-01  3.010288e-01
## LocationBulandshahar  -5.709691e-01 -5.643906e-02
## LocationChandigarh    -8.964572e-02  1.532963e-01
## LocationChennai        1.162988e-01  3.158570e-01
## LocationCoimbatore     1.530404e-01  3.857467e-01
## LocationDehradun      -5.481136e-02  1.734223e-01
## LocationDelhi         -1.463001e-02  1.578440e-01
## LocationDharwad       -4.548198e-02  4.601655e-01
## LocationErnakulam     -4.516543e-02  4.631432e-01
## LocationFaridabad     -1.802835e-01  4.075409e-02
## LocationGhaziabad     -2.777928e-01  2.316398e-01
## LocationGoa            5.605099e-02  4.401367e-01
## LocationGurgaon       -1.205426e-01  9.998910e-02
## LocationGuwahati      -7.706673e-03  3.420712e-01
## LocationHaldwani      -2.644659e-01  2.425678e-01
## LocationHyderabad      9.430717e-02  2.767447e-01
## LocationIndore         2.028461e-02  3.991652e-01
## LocationJaipur         1.562376e-02  2.303104e-01
## LocationJalandhar      6.811753e-02  2.943306e-01
## LocationJamshedpur    -1.932662e-01  1.587581e-01
## LocationKanpur        -1.871899e-01  1.507262e-02
## LocationKarnal        -4.926889e-02  2.426094e-01
## LocationKharar        -1.973544e-01  3.099507e-01
## LocationKheda         -3.411327e-01  1.646892e-01
## LocationKolkata       -1.712186e-01  1.921307e-02
## LocationKollam        -2.665001e-02  4.802265e-01
## LocationKota          -1.592889e-01  3.935818e-01
## LocationLucknow       -7.389690e-02  1.171664e-01
## LocationLudhiana      -5.740803e-02  1.439541e-01
## LocationMangalore     -1.326422e-01  2.458826e-01
## LocationMeerut        -1.079708e-01  1.850536e-01
## LocationMirzapur      -1.768274e-01  3.734108e-01
## LocationMohali         6.890658e-03  2.249783e-01
## LocationMumbai         1.463348e-02  1.867701e-01
```

```
## LocationMuzaffurpur   -3.213162e-01  1.849576e-01
## LocationMysore         1.676259e-01  4.741467e-01
## LocationNagpur        -4.456527e-02  3.797418e-01
## LocationNashik        -9.455767e-02  2.109512e-01
## LocationNavi Mumbai   -3.130472e-02  2.153463e-01
## LocationNoida         -2.983226e-02  2.217772e-01
## LocationPanchkula     -2.391027e-01  1.843011e-01
## LocationPatna         -3.985521e-02  1.641755e-01
## LocationPune           4.077207e-02  2.212894e-01
## LocationRaipur        -1.922212e-02  2.177662e-01
## LocationRanchi        -1.631170e-01  7.092398e-02
## LocationRanga Reddy   -1.882123e-01  3.216963e-01
## LocationRoorkee       -1.677348e-01  2.629929e-01
## LocationSalem          1.678870e-01  6.738535e-01
## LocationSurat         -1.314596e-01  2.136842e-01
## LocationThane         -1.988465e-02  2.239954e-01
## LocationUdupi          2.711925e-03  2.933740e-01
## LocationVadodara      -2.216110e-01  2.025066e-01
## LocationVaranasi      -1.675057e-01  6.974894e-02
## LocationWarangal      -3.163003e-01  1.899386e-01
## LocationYamunanagar   -1.904491e-01  2.364799e-01
## LocationZirakpur      -1.475090e-01  9.545337e-02
## OwnerSecond           -4.640287e-02  6.175123e-03
## OwnerThird            -2.167867e-01 -2.563362e-02
## OwnerUnRegistered Car -9.813258e-02  2.625636e-01
## Max.Torque.RPM         4.950203e-03  1.638198e-02
## DrivetrainFWD         -3.074587e-01 -2.199264e-01
## DrivetrainRWD         -2.738714e-01 -1.681651e-01
## Length                -9.755450e-02 -5.964957e-02
## Width                  1.291687e-03  1.714377e-03
## Year:Kilometer         1.065315e-07  3.409337e-07
## Year:Max.Torque.RPM   -8.057828e-06 -2.405186e-06
## Year:Length            2.993538e-05  4.872614e-05
## Max.Torque.RPM:Length -6.448120e-08 -1.173199e-08
```