Prediction Model for Predicting Price

library(readr)  
#loading data  
data<-read.csv("E:\\assignments data\\ToyotaCorolla.csv")  
#dataset details  
corralla<-data[,c("Price", "Age\_08\_04", "KM", "HP", "cc", "Doors","Gears", "Quarterly\_Tax", "Weight")]  
dim(corralla)

## [1] 1436 9

colnames(corralla)

## [1] "Price" "Age\_08\_04" "KM" "HP"   
## [5] "cc" "Doors" "Gears" "Quarterly\_Tax"  
## [9] "Weight"

class(corralla)

## [1] "data.frame"

sum(is.null(corralla))

## [1] 0

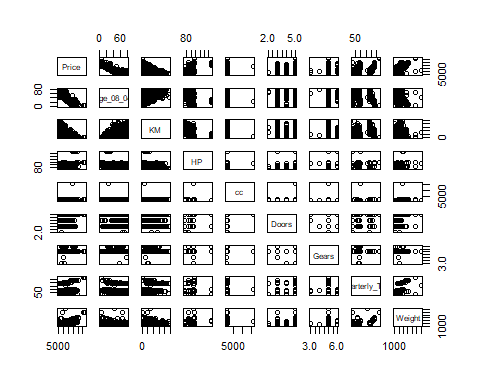
sum(duplicated(corralla))#checking duplicates

## [1] 1

attach(corralla)  
##EDA  
library(psych)  
describe(corralla)

## vars n mean sd median trimmed mad min max  
## Price 1 1436 10730.82 3626.96 9900.0 10160.59 2446.29 4350 32500  
## Age\_08\_04 2 1436 55.95 18.60 61.0 57.93 17.79 1 80  
## KM 3 1436 68533.26 37506.45 63389.5 65249.58 32517.12 1 243000  
## HP 4 1436 101.50 14.98 110.0 102.96 0.00 69 192  
## cc 5 1436 1576.86 424.39 1600.0 1548.26 0.00 1300 16000  
## Doors 6 1436 4.03 0.95 4.0 4.04 1.48 2 5  
## Gears 7 1436 5.03 0.19 5.0 5.00 0.00 3 6  
## Quarterly\_Tax 8 1436 87.12 41.13 85.0 78.84 23.72 19 283  
## Weight 9 1436 1072.46 52.64 1070.0 1066.13 37.06 1000 1615  
## range skew kurtosis se  
## Price 28150 1.70 3.71 95.71  
## Age\_08\_04 79 -0.82 -0.08 0.49  
## KM 242999 1.01 1.67 989.76  
## HP 123 0.95 8.79 0.40  
## cc 14700 27.37 926.17 11.20  
## Doors 3 -0.08 -1.87 0.03  
## Gears 3 2.28 37.51 0.00  
## Quarterly\_Tax 264 1.99 4.27 1.09  
## Weight 615 3.10 19.26 1.39

pairs(corralla)#checking collinearity



cor(corralla)

## Price Age\_08\_04 KM HP cc  
## Price 1.00000000 -0.876590497 -0.56996016 0.31498983 0.12638920  
## Age\_08\_04 -0.87659050 1.000000000 0.50567218 -0.15662202 -0.09808374  
## KM -0.56996016 0.505672180 1.00000000 -0.33353795 0.10268289  
## HP 0.31498983 -0.156622020 -0.33353795 1.00000000 0.03585580  
## cc 0.12638920 -0.098083739 0.10268289 0.03585580 1.00000000  
## Doors 0.18532555 -0.148359215 -0.03619661 0.09242450 0.07990330  
## Gears 0.06310386 -0.005363947 0.01502333 0.20947715 0.01462935  
## Quarterly\_Tax 0.21919691 -0.198430508 0.27816470 -0.29843172 0.30699580  
## Weight 0.58119759 -0.470253184 -0.02859846 0.08961406 0.33563740  
## Doors Gears Quarterly\_Tax Weight  
## Price 0.18532555 0.063103857 0.219196911 0.58119759  
## Age\_08\_04 -0.14835921 -0.005363947 -0.198430508 -0.47025318  
## KM -0.03619661 0.015023328 0.278164697 -0.02859846  
## HP 0.09242450 0.209477146 -0.298431717 0.08961406  
## cc 0.07990330 0.014629352 0.306995798 0.33563740  
## Doors 1.00000000 -0.160141430 0.109363225 0.30261764  
## Gears -0.16014143 1.000000000 -0.005451955 0.02061328  
## Quarterly\_Tax 0.10936323 -0.005451955 1.000000000 0.62613373  
## Weight 0.30261764 0.020613284 0.626133733 1.00000000

library(corpcor)  
cor2pcor(cor(corralla))

## [,1] [,2] [,3] [,4] [,5]  
## [1,] 1.000000000 -0.776238352 -0.402745405 0.28521314 -0.03556185  
## [2,] -0.776238352 1.000000000 0.002383081 0.24531845 -0.02014628  
## [3,] -0.402745405 0.002383081 1.000000000 -0.06039653 0.05108725  
## [4,] 0.285213137 0.245318454 -0.060396533 1.00000000 0.09871851  
## [5,] -0.035561846 -0.020146283 0.051087249 0.09871851 1.00000000  
## [6,] -0.001069746 -0.002800916 0.026724172 0.06817527 -0.01606038  
## [7,] 0.079586710 0.051074865 0.100506331 0.20769268 -0.01198838  
## [8,] 0.079548117 0.015830863 0.261673195 -0.38254954 0.12380803  
## [9,] 0.387523482 0.094746528 0.187502181 0.12427899 0.16043171  
## [,6] [,7] [,8] [,9]  
## [1,] -0.001069746 0.07958671 0.07954812 0.38752348  
## [2,] -0.002800916 0.05107486 0.01583086 0.09474653  
## [3,] 0.026724172 0.10050633 0.26167319 0.18750218  
## [4,] 0.068175272 0.20769268 -0.38254954 0.12427899  
## [5,] -0.016060377 -0.01198838 0.12380803 0.16043171  
## [6,] 1.000000000 -0.18924933 -0.07482541 0.23196001  
## [7,] -0.189249333 1.00000000 0.03732241 -0.02325832  
## [8,] -0.074825415 0.03732241 1.00000000 0.51026027  
## [9,] 0.231960007 -0.02325832 0.51026027 1.00000000

##model generation  
model<-lm(Price~., data=corralla)  
summary(model)

##   
## Call:  
## lm(formula = Price ~ ., data = corralla)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -9366.4 -793.3 -21.3 799.7 6444.0   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -5.573e+03 1.411e+03 -3.949 8.24e-05 \*\*\*  
## Age\_08\_04 -1.217e+02 2.616e+00 -46.512 < 2e-16 \*\*\*  
## KM -2.082e-02 1.252e-03 -16.622 < 2e-16 \*\*\*  
## HP 3.168e+01 2.818e+00 11.241 < 2e-16 \*\*\*  
## cc -1.211e-01 9.009e-02 -1.344 0.17909   
## Doors -1.617e+00 4.001e+01 -0.040 0.96777   
## Gears 5.943e+02 1.971e+02 3.016 0.00261 \*\*   
## Quarterly\_Tax 3.949e+00 1.310e+00 3.015 0.00262 \*\*   
## Weight 1.696e+01 1.068e+00 15.880 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1342 on 1427 degrees of freedom  
## Multiple R-squared: 0.8638, Adjusted R-squared: 0.863   
## F-statistic: 1131 on 8 and 1427 DF, p-value: < 2.2e-16

# p values of cc and Doors are >0.05  
model1<-lm(Price ~cc+Doors)  
summary(model1)

##   
## Call:  
## lm(formula = Price ~ cc + Doors)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -7243.9 -2273.6 -821.3 1054.4 20714.1   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 6509.4211 515.7732 12.621 < 2e-16 \*\*\*  
## cc 0.9597 0.2211 4.340 1.52e-05 \*\*\*  
## Doors 671.3973 98.5009 6.816 1.37e-11 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 3543 on 1433 degrees of freedom  
## Multiple R-squared: 0.04688, Adjusted R-squared: 0.04555   
## F-statistic: 35.24 on 2 and 1433 DF, p-value: 1.15e-15

library(car)

## Loading required package: carData

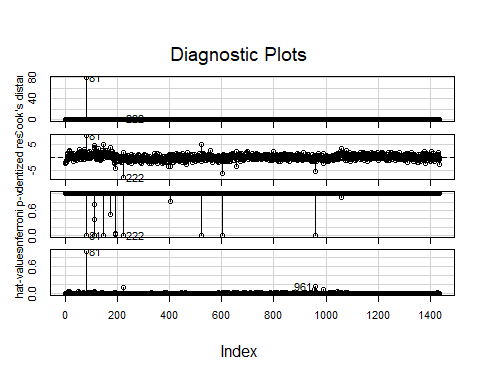
##   
## Attaching package: 'car'

## The following object is masked from 'package:psych':  
##   
## logit

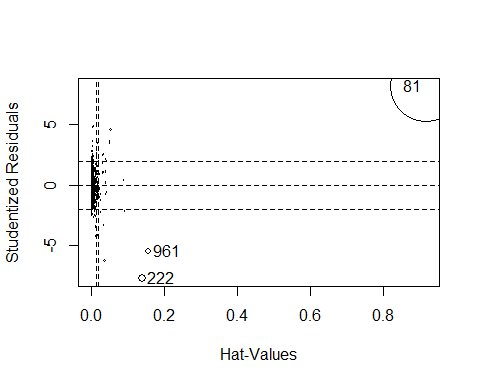
vif(model)

## Age\_08\_04 KM HP cc Doors   
## 1.884620 1.756905 1.419422 1.163894 1.156575   
## Gears Quarterly\_Tax Weight   
## 1.098723 2.311431 2.516420

#vif <10 so there is no multicolliearity  
influenceIndexPlot(model)



influencePlot(model)



## StudRes Hat CookD  
## 81 8.164500 0.9182368 79.5201062  
## 222 -7.673262 0.1397116 1.0210312  
## 961 -5.456195 0.1572484 0.6049996

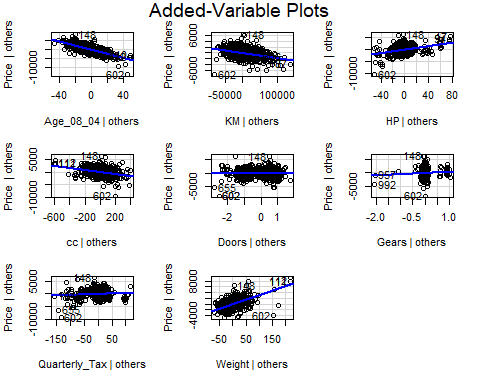
#for better R-squared values removing the influence factors  
#fitted multiple linear regression model  
model2<-lm(Price ~ ., corralla[-c(81,222,961),])  
summary(model2)

##   
## Call:  
## lm(formula = Price ~ ., data = corralla[-c(81, 222, 961), ])  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -8756.8 -761.3 -31.7 720.6 6306.6   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -1.474e+04 1.433e+03 -10.289 < 2e-16 \*\*\*  
## Age\_08\_04 -1.120e+02 2.479e+00 -45.185 < 2e-16 \*\*\*  
## KM -1.699e-02 1.200e-03 -14.160 < 2e-16 \*\*\*  
## HP 3.661e+01 2.745e+00 13.334 < 2e-16 \*\*\*  
## cc -3.795e+00 3.021e-01 -12.562 < 2e-16 \*\*\*  
## Doors -1.225e+02 3.748e+01 -3.270 0.00110 \*\*   
## Gears 4.650e+02 1.810e+02 2.569 0.01029 \*   
## Quarterly\_Tax 5.213e+00 1.371e+00 3.802 0.00015 \*\*\*  
## Weight 3.064e+01 1.290e+00 23.748 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1231 on 1424 degrees of freedom  
## Multiple R-squared: 0.8852, Adjusted R-squared: 0.8845   
## F-statistic: 1372 on 8 and 1424 DF, p-value: < 2.2e-16

# here P values are <0.05 and  
#multiple R-squared value is 0.8852  
#Adjusted R-squared value is 0.8845  
predicted\_values<-predict(model2)  
predicted\_values

## 1 2 3 4 5 6 7 8   
## 16333.274 15892.327 16310.886 15979.990 15846.537 15240.191 17527.146 17509.225   
## 9 10 11 12 13 14 15 16   
## 20881.292 13564.938 21370.475 21500.099 21358.105 20842.132 20540.981 21250.587   
## 17 18 19 20 21 22 23 24   
## 20302.259 16410.903 14775.858 15014.225 14958.136 17543.576 15833.960 16243.949   
## 25 26 27 28 29 30 31 32   
## 16240.795 16644.061 16316.461 15975.694 16041.376 16378.944 15840.023 16535.819   
## 33 34 35 36 37 38 39 40   
## 16072.394 16130.345 16437.252 15955.196 16373.062 16851.971 15583.346 16106.547   
## 41 42 43 44 45 46 47 48   
## 16300.317 15825.032 16335.965 17445.249 18177.871 18801.562 17972.479 15920.035   
## 49 50 51 52 53 54 55 56   
## 18654.228 20190.104 18816.990 15329.092 17735.428 20430.036 17504.020 13942.528   
## 57 58 59 60 61 62 63 64   
## 15788.903 16016.507 18348.375 15966.870 16559.731 16333.050 15895.734 16059.287   
## 65 66 67 68 69 70 71 72   
## 16077.649 14500.683 16326.108 16678.672 20716.489 16354.189 16026.852 14046.927   
## 73 74 75 76 77 78 79 80   
## 16370.672 16603.577 16376.963 16477.457 16087.364 16106.033 15897.528 15925.257   
## 82 83 84 85 86 87 88 89   
## 15941.281 16570.253 17850.954 16597.253 16707.669 15873.732 18781.020 16588.370   
## 90 91 92 93 94 95 96 97   
## 20651.317 16540.478 19866.411 20384.911 16791.630 17146.380 20342.915 16969.813   
## 98 99 100 101 102 103 104 105   
## 17029.062 18279.429 17175.845 17293.781 17143.721 17650.395 17962.171 19597.645   
## 106 107 108 109 110 111 112 113   
## 17236.359 15782.866 17524.079 17105.845 29998.807 29930.858 29973.336 24167.739   
## 114 115 116 117 118 119 120 121   
## 24167.739 22803.041 22113.569 21724.915 18684.180 19034.841 20812.490 17104.254   
## 122 123 124 125 126 127 128 129   
## 19349.075 17281.551 17084.247 17473.025 17585.247 15107.900 16824.547 17948.005   
## 130 131 132 133 134 135 136 137   
## 15934.896 16864.868 16912.954 17031.021 17046.400 16926.496 17058.547 17832.188   
## 138 139 140 141 142 143 144 145   
## 16995.238 22745.801 17358.065 17035.446 21076.349 18168.902 16743.376 17964.542   
## 146 147 148 149 150 151 152 153   
## 17525.708 18559.634 18193.370 17549.467 18852.237 17125.297 17571.386 18305.848   
## 154 155 156 157 158 159 160 161   
## 17953.755 18309.082 17112.332 17332.601 18085.041 17881.043 19607.415 17366.584   
## 162 163 164 165 166 167 168 169   
## 17156.605 18391.486 17513.883 18322.830 18319.029 18328.221 19066.636 18560.056   
## 170 171 172 173 174 175 176 177   
## 17087.706 16951.776 18906.179 18592.243 18593.551 18926.773 18947.401 18514.549   
## 178 179 180 181 182 183 184 185   
## 18639.310 19008.128 19266.148 17141.846 18867.838 19431.751 19764.939 19056.243   
## 186 187 188 189 190 191 192 193   
## 17847.920 8557.580 12106.310 13151.740 11552.949 10133.739 9388.033 9847.602   
## 194 195 196 197 198 199 200 201   
## 11486.728 11487.483 12150.689 10000.750 14470.377 10716.158 14188.242 11729.978   
## 202 203 204 205 206 207 208 209   
## 11096.193 12032.599 12028.687 11831.932 11092.621 12372.433 11866.279 12431.913   
## 210 211 212 213 214 215 216 217   
## 14746.782 12206.547 14841.292 14077.781 12490.762 14837.483 13293.646 12367.259   
## 218 219 220 221 223 224 225 226   
## 11337.956 11016.361 12784.565 12225.053 12589.818 12616.708 13173.615 12895.248   
## 227 228 229 230 231 232 233 234   
## 12351.455 13208.698 12655.444 13016.708 11209.980 13209.886 11623.764 11913.902   
## 235 236 237 238 239 240 241 242   
## 12674.821 13013.780 12347.263 11940.842 13445.142 12974.802 13048.290 12687.973   
## 243 244 245 246 247 248 249 250   
## 11739.532 15030.860 13634.360 12983.798 12043.982 11649.624 12849.973 12657.955   
## 251 252 253 254 255 256 257 258   
## 13666.967 11219.869 12573.583 13605.712 12679.760 12692.788 13146.807 11403.122   
## 259 260 261 262 263 264 265 266   
## 11404.550 13724.823 11745.158 13070.930 11507.521 12962.871 12909.343 13206.277   
## 267 268 269 270 271 272 273 274   
## 12690.223 12747.181 15376.066 12192.970 12822.139 13228.417 12612.988 12339.988   
## 275 276 277 278 279 280 281 282   
## 12671.675 12906.755 12963.359 12231.218 11364.679 12892.483 13420.216 13196.848   
## 283 284 285 286 287 288 289 290   
## 13404.093 13967.702 12941.809 13169.345 13061.592 12311.745 12447.498 12745.894   
## 291 292 293 294 295 296 297 298   
## 12622.783 13200.388 13048.454 13879.820 13029.325 12427.174 14111.938 13274.108   
## 299 300 301 302 303 304 305 306   
## 13686.759 12887.971 13483.844 12279.916 12445.846 12184.217 12527.392 12864.754   
## 307 308 309 310 311 312 313 314   
## 11625.440 12027.052 12412.760 12942.309 13319.747 12874.938 11865.142 13116.945   
## 315 316 317 318 319 320 321 322   
## 11914.852 13073.561 12893.153 12326.093 11883.459 12525.020 13661.607 13655.128   
## 323 324 325 326 327 328 329 330   
## 13202.337 11851.713 13347.450 13133.592 11940.839 14036.686 13818.308 12924.627   
## 331 332 333 334 335 336 337 338   
## 13271.480 13976.893 13490.359 12359.834 13767.957 12928.963 13736.624 12427.232   
## 339 340 341 342 343 344 345 346   
## 12054.194 13086.312 13426.034 12962.218 12727.949 13041.177 14119.536 13685.436   
## 347 348 349 350 351 352 353 354   
## 12430.688 13569.046 12112.662 14144.599 13297.259 12961.698 13601.126 13429.157   
## 355 356 357 358 359 360 361 362   
## 12301.085 13662.697 13178.205 13820.899 13223.274 11833.231 12609.279 12888.288   
## 363 364 365 366 367 368 369 370   
## 12216.366 13422.050 13658.847 12275.257 12924.089 12256.279 12331.853 13171.168   
## 371 372 373 374 375 376 377 378   
## 12281.335 14077.564 13357.179 14572.371 13699.134 13599.073 13731.441 13140.932   
## 379 380 381 382 383 384 385 386   
## 7896.171 7841.076 8422.633 7796.776 8801.274 9771.636 9168.184 10251.055   
## 387 388 389 390 391 392 393 394   
## 9801.941 12444.229 8859.809 8520.656 9265.655 10054.224 10583.085 8539.374   
## 395 396 397 398 399 400 401 402   
## 10192.633 11045.778 8686.904 12447.891 8965.607 9105.101 9324.002 10173.621   
## 403 404 405 406 407 408 409 410   
## 8913.666 10806.050 9611.168 10497.229 10714.049 11453.278 10793.076 10686.144   
## 411 412 413 414 415 416 417 418   
## 9819.821 10423.749 11133.667 11078.474 10399.266 10644.097 10040.377 10775.383   
## 419 420 421 422 423 424 425 426   
## 9621.768 9127.087 10895.446 9747.312 10709.560 11237.679 10966.860 10869.594   
## 427 428 429 430 431 432 433 434   
## 10592.613 10473.534 11283.211 11291.044 10385.439 10363.406 11438.486 11542.289   
## 435 436 437 438 439 440 441 442   
## 10520.367 11011.164 13632.574 11591.644 9910.731 10156.140 9755.672 11232.528   
## 443 444 445 446 447 448 449 450   
## 10686.156 11129.979 11749.325 11094.290 11026.729 10592.693 9678.024 11549.393   
## 451 452 453 454 455 456 457 458   
## 11501.329 11791.967 10637.863 10871.016 11567.529 10056.557 9849.890 11197.181   
## 459 460 461 462 463 464 465 466   
## 10552.312 10262.900 9869.682 10986.241 11945.824 11740.138 10310.474 10061.526   
## 467 468 469 470 471 472 473 474   
## 10901.615 11355.988 11501.910 11592.156 11414.269 9832.647 10284.627 10582.498   
## 475 476 477 478 479 480 481 482   
## 10925.721 10080.471 11171.146 10099.369 10577.988 9996.051 11730.069 9886.123   
## 483 484 485 486 487 488 489 490   
## 11338.024 10360.476 10105.636 11468.489 11655.241 10712.402 10390.229 12035.765   
## 491 492 493 494 495 496 497 498   
## 10674.130 11231.517 10501.483 11795.807 10070.440 10725.949 11260.556 10546.815   
## 499 500 501 502 503 504 505 506   
## 11196.311 10295.322 11764.846 12759.833 10479.780 10421.381 10877.042 11305.634   
## 507 508 509 510 511 512 513 514   
## 10237.596 11033.796 11777.698 12062.348 11392.602 11836.839 11839.218 10825.497   
## 515 516 517 518 519 520 521 522   
## 10052.721 11747.535 11103.898 10060.334 11884.750 11999.968 10318.353 10998.965   
## 523 524 525 526 527 528 529 530   
## 11518.038 12793.118 11382.794 11034.859 11329.987 10329.125 10835.312 11586.389   
## 531 532 533 534 535 536 537 538   
## 11023.237 10102.330 11075.710 11668.797 11193.115 12054.018 11075.648 11282.494   
## 539 540 541 542 543 544 545 546   
## 10191.948 10503.404 12250.942 11101.843 10357.341 10834.391 11923.231 12083.714   
## 547 548 549 550 551 552 553 554   
## 11413.905 10299.159 10178.214 11260.561 11195.723 10683.418 12682.807 11825.430   
## 555 556 557 558 559 560 561 562   
## 12366.381 11840.263 12812.998 10827.304 12512.734 12181.675 10676.736 10505.259   
## 563 564 565 566 567 568 569 570   
## 11291.085 11570.890 10307.373 10539.243 10337.996 12292.176 11867.411 12356.664   
## 571 572 573 574 575 576 577 578   
## 12743.425 11870.418 10345.282 11962.353 11135.185 11998.425 12573.502 11606.555   
## 579 580 581 582 583 584 585 586   
## 10974.101 12743.336 11337.506 10855.390 10417.156 12451.352 11036.089 12443.819   
## 587 588 589 590 591 592 593 594   
## 10993.946 11610.148 12930.843 10588.644 11558.740 11738.285 11506.520 12141.897   
## 595 596 597 598 599 600 601 602   
## 11233.692 10615.736 11064.106 11213.955 11585.164 12506.436 13040.876 16256.752   
## 603 604 605 606 607 608 609 610   
## 10872.819 6824.328 6299.032 5382.373 7534.031 7844.622 7111.971 6328.750   
## 611 612 613 614 615 616 617 618   
## 6624.209 7307.244 8300.913 7960.787 8979.895 7745.665 8300.807 8058.963   
## 619 620 621 622 623 624 625 626   
## 9024.009 7723.937 8614.402 8290.280 10287.204 9547.526 10461.950 8097.883   
## 627 628 629 630 631 632 633 634   
## 8990.685 8216.720 8335.772 8765.154 9059.067 8091.354 8094.752 9068.640   
## 635 636 637 638 639 640 641 642   
## 10752.820 7645.610 8831.428 9038.985 9548.707 7372.464 8287.926 8503.132   
## 643 644 645 646 647 648 649 650   
## 7473.453 10303.536 9039.928 8498.729 7607.827 7781.543 8421.291 9687.625   
## 651 652 653 654 655 656 657 658   
## 10454.699 8363.878 11163.628 9183.481 12632.957 9112.559 7613.299 8882.096   
## 659 660 661 662 663 664 665 666   
## 8628.597 9411.477 8398.034 9527.420 9434.184 8208.551 9497.555 8786.602   
## 667 668 669 670 671 672 673 674   
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avPlots(model2)



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