**Model1:: (commands executed as in bold, plots on end page)**

> **gmdata<-read.csv("/Users/sonalsingh/Desktop/GeneralMotorData.csv",header=TRUE)**

> **View(gmdata)**

**> class(gmdata)**

[1] "data.frame"

**> names(gmdata)**

[1] "Price" "Mileage" "Make" "Cylinder" "Liter" "Cruise" "Sound"

[8] "Leather"

> **# MODEL 1, MLR for price forecast**

> **gmmod1<-lm(Price~.,data=gmdata)**

**> gmmod1**

Call:

lm(formula = Price ~ ., data = gmdata)

Coefficients:

(Intercept) Mileage MakeChevrolet MakePontiac Cylinder Liter

2.612e+04 -2.058e-01 -1.706e+04 -1.851e+04 -2.220e+03 7.691e+03

Cruise Sound Leather

1.024e+02 2.279e+02 2.472e+02

**> summary(gmmod1)**

**Call**:

lm(formula = Price ~ ., data = gmdata)

**Residuals**:

Min 1Q Median 3Q Max

-8420.7 -1743.5 -150.6 1315.7 26563.5

**Coefficients**:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 2.612e+04 1.815e+03 14.392 < 2e-16 \*\*\*

Mileage -2.058e-01 1.857e-02 -11.084 < 2e-16 \*\*\*

MakeChevrolet -1.706e+04 7.247e+02 -23.538 < 2e-16 \*\*\*

MakePontiac -1.851e+04 7.005e+02 -26.423 < 2e-16 \*\*\*

Cylinder -2.220e+03 5.013e+02 -4.430 1.17e-05 \*\*\*

Liter 7.691e+03 5.693e+02 13.509 < 2e-16 \*\*\*

Cruise 1.024e+02 4.007e+02 0.256 0.798

Sound 2.279e+02 3.877e+02 0.588 0.557

Leather 2.472e+02 4.198e+02 0.589 0.556

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3430 on 491 degrees of freedom

Multiple R-squared: 0.8823, Adjusted R-squared: 0.8803

F-statistic: 459.9 on 8 and 491 DF, p-value: < 2.2e-16

**> gmmod1$residuals**

1 2 3 4 5 6 7

-5962.38532 -132.59697 -1764.70345 -1210.80139 -1052.83628 -743.99226 -438.57605

8 9 10 11 12 13 14

-718.81368 -1533.58727 -1299.82081 -1211.98478 -1381.74811 -714.20034 -1475.79326

15 16 17 18 19 20 21

-1956.79449 -1797.69547 -3485.61013 -3420.66555 -3566.79314 -2942.78064 -4166.68610

22 23 24 25 26 27 28

-132.07246 -1033.90877 -823.13771 309.21028 -2129.91804 -2297.81458 -2574.61020

29 30 31 32 33 34 35

-2664.43737 -3705.76429 -3166.16870 -7041.52953 -6488.02915 -6718.12493 -6378.34937

36 37 38 39 40 41 42

-7979.64091 -7023.56419 -7271.25832 -8420.72936 -7505.78390 -7584.10256 2493.54289

43 44 45 46 47 48 49

1443.64590 609.53436 911.82133 290.07430 -141.55258 108.43174 -421.01613

50 51 52 53 54 55 56

-778.23109 -1752.94544 4388.37948 4592.38377 3596.04920 3230.23393 2117.89838

57 58 59 60 61 62 63

1821.90177 2115.16549 2034.19236 338.83940 1489.03821 26563.46749 25575.47327

64 65 66 67 68 69 70

26445.96314 24536.30838 1474.32651 1922.09190 2794.00261 2441.03198 2694.33486

71 72 73 74 75 76 77

2475.09875 2804.33406 3266.75130 4035.29076 3304.31033 683.15571 454.21414

78 79 80 81 82 83 84

653.93451 1813.26165 1498.65544 2251.89255 2834.84119 2261.43787 4147.51394

85 86 87 88 89 90 91

4679.81456 2219.30369 2434.99873 2839.73114 2595.21158 2719.92012 2978.33993

92 93 94 95 96 97 98

3602.00201 3353.11839 3250.09334 4238.25629 931.34337 1778.51729 1600.39407

99 100 101 102 103 104 105

2568.16518 2067.27576 3063.01765 3215.79294 3711.02683 4051.02571 4331.40964

106 107 108 109 110 111 112

-1966.49346 -676.78706 -684.27112 441.08455 629.71957 625.64580 1193.91163

113 114 115 116 117 118 119

1336.36678 1559.64033 2558.75987 -156.90587 554.25660 1117.05907 715.04843

120 121 122 123 124 125 126

732.39172 2007.46710 1343.55296 1699.97385 2829.59599 3548.75510 -3152.08212

127 128 129 130 131 132 133

-1732.59330 -1590.64931 -1048.49860 -1423.94696 -1094.13757 -630.49646 -842.46141

134 135 136 137 138 139 140

-418.59814 561.72944 -2854.08046 -1894.29297 -477.45493 -1265.50349 -1366.05233

141 142 143 144 145 146 147

-401.25711 -463.07872 -301.34278 288.10146 792.90736 -2172.77273 -1149.04306

148 149 150 151 152 153 154

-634.86651 -1396.22619 -314.48012 51.64743 -134.52779 978.59484 1090.60978

155 156 157 158 159 160 161

1872.79314 -1665.92287 -2109.00790 -1651.60396 -1283.64513 -299.87334 -1112.32669

162 163 164 165 166 167 168

-441.10165 173.28731 -542.05345 501.75614 -1618.23315 -1534.93458 170.93381

169 170 171 172 173 174 175

-201.63432 412.05386 -127.12105 -141.07089 690.09582 -167.23946 840.79190

176 177 178 179 180 181 182

-2500.76321 -1556.73876 -1899.99171 -996.93193 -1570.72743 -1062.93843 -286.18927

183 184 185 186 187 188 189

-710.65261 -159.90110 868.34733 -437.97929 -97.82620 -465.53720 93.38214

190 191 192 193 194 195 196

-515.61161 86.32267 -163.56761 1290.47210 1122.78212 1532.52072 -715.74766

197 198 199 200 201 202 203

-861.17592 -55.62619 41.23420 -225.75508 -378.42634 -4.65109 -77.81341

204 205 206 207 208 209 210

693.61525 775.99830 -1698.47697 -582.34529 186.95323 803.23845 1340.81006

211 212 213 214 215 216 217

1013.16384 1460.79351 1092.41906 1159.44860 1635.27673 -749.42442 -56.46304

218 219 220 221 222 223 224

297.60471 411.13273 886.07547 1078.13511 459.34049 1057.45370 1615.61553

225 226 227 228 229 230 231

2331.44090 -1382.39721 887.48709 458.40991 1017.11385 967.49167 825.66809

232 233 234 235 236 237 238

921.95447 873.78083 1257.41730 1051.96997 -1989.17967 -1600.48619 -1630.18913

239 240 241 242 243 244 245

-1412.33178 -367.69271 -25.69617 -123.67270 162.57049 314.03232 1007.10678

246 247 248 249 250 251 252

9456.07608 10120.84965 9448.30259 7744.09769 7692.76955 6428.53002 6849.06598

253 254 255 256 257 258 259

6372.85872 5225.79609 5860.15747 3532.88963 3536.54967 2904.66081 3275.23088

260 261 262 263 264 265 266

3734.56054 1632.80472 2460.71374 1495.22023 2243.36807 428.71419 -2929.02680

267 268 269 270 271 272 273

-2862.25086 -2493.72517 -2264.64466 -2677.90983 -1955.02818 -2236.48599 -1953.31988

274 275 276 277 278 279 280

-1957.02265 -1404.32008 -4678.46425 -4789.59130 -3922.61163 -4249.58510 -3721.46954

281 282 283 284 285 286 287

-4291.88013 -4225.35283 -3382.50400 -3288.45305 -3123.17794 1012.42128 3525.78420

288 289 290 291 292 293 294

2531.11598 3057.33741 2528.93393 2758.84734 2157.55630 3834.31166 2390.60279

295 296 297 298 299 300 301

2202.29525 -2953.14267 -2393.95546 -1738.25343 -1444.12563 -2448.50622 -1896.13946

302 303 304 305 306 307 308

-1479.31045 -1529.40188 -1630.71348 -1240.45829 -3765.89353 -2693.31816 -2660.15954

309 310 311 312 313 314 315

-1566.03947 -2301.36927 -1277.58635 -1646.05292 -1854.78713 -1313.44155 -1203.65872

316 317 318 319 320 321 322

-2403.15993 -1996.66480 -1497.85768 -1231.48689 -1781.62620 -1264.65178 -1560.72646

323 324 325 326 327 328 329

-983.36823 -1121.21286 -1106.96788 -3493.99930 -2354.13562 -1886.65687 -2282.19916

330 331 332 333 334 335 336

-1513.84011 -2070.94922 -1714.16026 -1564.66985 -1102.67035 -1025.74655 -2998.67548

337 338 339 340 341 342 343

-3387.92250 -1978.08011 -1926.86645 -1547.34625 -2105.87014 -2518.45184 -2450.66340

344 345 346 347 348 349 350

-1674.20365 -2394.72964 -4245.68238 -3427.31053 -3015.97530 -2697.29342 -3034.11487

351 352 353 354 355 356 357

-2662.42429 -2338.12272 -3233.28668 -2263.37078 -2109.94697 -5068.11311 -4686.39887

358 359 360 361 362 363 364

-3974.62450 -4877.49018 -4110.34044 -3723.64641 -4102.72885 -3612.61258 -4003.09633

365 366 367 368 369 370 371

-2701.34824 -2096.24894 -800.76040 -114.94026 -1041.89257 -740.54998 -929.66595

372 373 374 375 376 377 378

-144.35904 -371.71726 -816.81431 308.77015 844.09783 1308.81299 1344.40477

379 380 381 382 383 384 385

1831.61571 504.79576 -171.15443 1132.07949 34.16794 736.65404 76.13302

386 387 388 389 390 391 392

2325.95295 1430.22354 1944.96693 740.97807 394.07686 942.85056 1894.26965

393 394 395 396 397 398 399

1499.65041 1421.11668 1819.38078 -1801.90014 -1769.07593 95.11124 -171.89695

400 401 402 403 404 405 406

110.29819 -1650.90994 -371.66358 -430.53474 123.28463 -479.82639 -419.90836

407 408 409 410 411 412 413

650.84497 436.15023 24.02186 1108.53664 985.07303 731.32412 657.12166

414 415 416 417 418 419 420

1419.87626 1232.11678 1302.01867 2125.60938 2185.04835 2838.13332 2854.77987

421 422 423 424 425 426 427

3119.97993 2662.16381 3099.51729 2686.30216 3162.06774 1100.51308 1273.10092

428 429 430 431 432 433 434

1448.39354 2008.83315 1536.95105 1201.42350 2317.80047 1974.05668 2013.54489

435 436 437 438 439 440 441

2565.07589 -3368.59168 -2178.89247 -2479.72942 -1777.42935 -1736.16512 -1545.50927

442 443 444 445 446 447 448

-1454.42274 -702.99080 -1294.34896 -1405.11412 566.69864 1017.34168 93.74688

449 450 451 452 453 454 455

825.05030 570.92291 1275.99783 1684.54465 1873.28580 1846.43490 2091.70420

456 457 458 459 460 461 462

-2427.84517 -2666.88484 -2165.00332 -3066.80664 -2848.50478 -1740.41109 -1548.16551

463 464 465 466 467 468 469

-2121.74688 -2226.56061 -2402.51065 -300.48836 792.22552 86.11061 776.72249

470 471 472 473 474 475 476

-93.87397 677.43258 230.11316 821.12093 1471.00411 1291.54482 -3692.69626

477 478 479 480 481 482 483

-4071.90122 -3065.43001 -3302.04771 -3113.21490 -2699.54468 -2953.27997 -2379.14608

484 485 486 487 488 489 490

-2079.38179 -2051.06823 50.75880 203.62981 -422.44743 -1106.06593 38.17495

491 492 493 494 495 496 497

-1692.75644 -1754.46648 -1336.82604 -162.32050 -1227.53496 -256.58584 275.18282

498 499 500

530.57740 610.22921 851.33150

> **par(mfrow=c(2,2))**

> **plot(gmmod1)**

> **par(mfrow=c(2,2))**

> **gm1res<-data.frame(gmdata,fittedval=fitted(gmmod1),resi=resid(gmmod1))**

**> gm1res**

Price Mileage Make Cylinder Liter Cruise Sound Leather fittedval resi

1 40619.072 30082 Cadillac 8 5.7 1 1 1 46581.458 -5962.38532

2 33417.965 6598 Cadillac 6 2.8 1 1 1 33550.562 -132.59697

3 30957.081 10625 Cadillac 6 2.8 1 1 1 32721.784 -1764.70345

4 31431.130 11013 Cadillac 6 2.8 1 1 1 32641.932 -1210.80139

5 30781.516 14937 Cadillac 6 2.8 1 1 1 31834.352 -1052.83628

6 30646.438 17094 Cadillac 6 2.8 1 1 1 31390.430 -743.99226

7 30792.149 17870 Cadillac 6 2.8 1 1 1 31230.725 -438.57605

8 30392.750 18449 Cadillac 6 2.8 1 1 1 31111.564 -718.81368

9 28817.082 21039 Cadillac 6 2.8 1 0 1 30350.669 -1533.58727

10 29275.209 21056 Cadillac 6 2.8 1 1 1 30575.030 -1299.82081

11 28040.129 27484 Cadillac 6 2.8 1 1 1 29252.113 -1211.98478

12 39801.551 14095 Cadillac 8 4.6 1 0 1 41183.299 -1381.74811

13 40335.737 14743 Cadillac 8 4.6 1 0 1 41049.938 -714.20034

14 39307.009 16041 Cadillac 8 4.6 1 0 1 40782.802 -1475.79326

15 38600.240 17138 Cadillac 8 4.6 1 0 1 40557.034 -1956.79449

16 38445.897 18661 Cadillac 8 4.6 1 0 1 40243.593 -1797.69547

17 36077.796 21966 Cadillac 8 4.6 1 0 1 39563.406 -3485.61013

18 35866.583 24415 Cadillac 8 4.6 1 1 1 39287.248 -3420.66555

19 35338.654 25163 Cadillac 8 4.6 1 0 1 38905.447 -3566.79314

20 36154.304 25339 Cadillac 8 4.6 1 1 1 39097.084 -2942.78064

21 34685.663 25421 Cadillac 8 4.6 1 0 1 38852.349 -4166.68610

22 42820.329 5499 Cadillac 8 4.6 1 0 1 42952.401 -132.07246

23 41378.048 8125 Cadillac 8 4.6 1 0 1 42411.957 -1033.90877

24 40856.391 12791 Cadillac 8 4.6 1 1 1 41679.529 -823.13771

25 41419.037 14452 Cadillac 8 4.6 1 0 1 41109.827 309.21028

26 37510.254 21593 Cadillac 8 4.6 1 0 1 39640.172 -2129.91804

27 37215.169 22211 Cadillac 8 4.6 1 0 1 39512.984 -2297.81458

28 36332.895 25153 Cadillac 8 4.6 1 0 1 38907.505 -2574.61020

29 36245.158 26250 Cadillac 8 4.6 1 1 1 38909.596 -2664.43737

30 32954.141 36074 Cadillac 8 4.6 1 0 1 36659.906 -3705.76429

31 32537.187 41829 Cadillac 8 4.6 1 1 1 35703.355 -3166.16870

32 35715.769 6447 Cadillac 8 4.6 1 0 1 42757.298 -7041.52953

33 35651.680 10555 Cadillac 8 4.6 1 1 1 42139.709 -6488.02915

34 35129.341 11975 Cadillac 8 4.6 1 1 1 41847.466 -6718.12493

35 35165.759 13449 Cadillac 8 4.6 1 1 1 41544.109 -6378.34937

36 32501.245 17508 Cadillac 8 4.6 1 0 1 40480.886 -7979.64091

37 33220.028 18661 Cadillac 8 4.6 1 0 1 40243.593 -7023.56419

38 32509.478 20910 Cadillac 8 4.6 1 0 1 39780.737 -7271.25832

39 31132.213 23124 Cadillac 8 4.6 1 1 1 39552.943 -8420.72936

40 31181.715 26222 Cadillac 8 4.6 1 0 1 38687.499 -7505.78390

41 31059.181 27544 Cadillac 8 4.6 1 1 1 38643.284 -7584.10256

42 42741.524 2846 Cadillac 6 3.6 1 0 1 40247.981 2493.54289

43 40966.607 7476 Cadillac 6 3.6 1 1 1 39522.962 1443.64590

44 38795.379 13973 Cadillac 6 3.6 1 1 1 38185.845 609.53436

45 38297.463 16754 Cadillac 6 3.6 1 0 1 37385.641 911.82133

46 37192.896 19100 Cadillac 6 3.6 1 0 1 36902.822 290.07430

47 36210.123 21778 Cadillac 6 3.6 1 0 1 36351.676 -141.55258

48 36633.634 22042 Cadillac 6 3.6 1 1 1 36525.202 108.43174

49 35895.499 23056 Cadillac 6 3.6 1 1 1 36316.516 -421.01613

50 34974.378 25796 Cadillac 6 3.6 1 1 1 35752.609 -778.23109

51 32038.340 35326 Cadillac 6 3.6 1 1 1 33791.285 -1752.94544

52 48310.330 788 Cadillac 8 4.6 1 0 1 43921.950 4388.37948

53 48365.981 2616 Cadillac 8 4.6 1 1 1 43773.597 4592.38377

54 45061.952 13829 Cadillac 8 4.6 1 1 1 41465.903 3596.04920

55 44205.876 15104 Cadillac 8 4.6 1 0 1 40975.642 3230.23393

56 42377.955 18581 Cadillac 8 4.6 1 0 1 40260.057 2117.89838

57 41671.583 20575 Cadillac 8 4.6 1 0 1 39849.681 1821.90177

58 41516.430 23861 Cadillac 8 4.6 1 1 1 39401.264 2115.16549

59 41053.482 25717 Cadillac 8 4.6 1 1 1 39019.290 2034.19236

60 38208.501 31303 Cadillac 8 4.6 1 1 1 37869.662 338.83940

61 39072.392 31587 Cadillac 8 4.6 1 0 1 37583.354 1489.03821

62 70755.467 583 Cadillac 8 4.6 1 1 1 44191.999 26563.46749

63 68566.187 6420 Cadillac 8 4.6 1 1 1 42990.714 25575.47327

64 69133.732 7892 Cadillac 8 4.6 1 1 1 42687.769 26445.96314

65 66374.307 12021 Cadillac 8 4.6 1 1 1 41837.999 24536.30838

66 12146.188 10011 Chevrolet 4 1.6 0 0 1 10671.862 1474.32651

67 12163.820 12101 Chevrolet 4 1.6 0 0 1 10241.729 1922.09190

68 11472.023 19699 Chevrolet 4 1.6 0 0 1 8678.020 2794.00261

69 11017.169 20100 Chevrolet 4 1.6 0 1 0 8576.137 2441.03198

70 11096.857 20334 Chevrolet 4 1.6 1 0 0 8402.522 2694.33486

71 10386.040 22225 Chevrolet 4 1.6 0 0 0 7910.941 2475.09875

72 11137.046 22484 Chevrolet 4 1.6 0 1 1 8332.712 2804.33406

73 11045.109 24568 Chevrolet 4 1.6 1 0 1 7778.358 3266.75130

74 10777.053 27906 Chevrolet 4 1.6 0 0 0 6741.762 4035.29076

75 9928.188 29680 Chevrolet 4 1.6 0 0 1 6623.878 3304.31033

76 12649.111 3629 Chevrolet 4 1.6 0 1 0 11965.955 683.15571

77 12314.591 4142 Chevrolet 4 1.6 0 1 0 11860.377 454.21414

78 11318.008 11156 Chevrolet 4 1.6 0 1 1 10664.074 653.93451

79 12409.949 11981 Chevrolet 4 1.6 1 1 1 10596.687 1813.26165

80 11555.267 13404 Chevrolet 4 1.6 1 1 0 10056.612 1498.65544

81 11700.111 15253 Chevrolet 4 1.6 1 0 0 9448.219 2251.89255

82 11215.019 19945 Chevrolet 4 1.6 0 0 0 8380.177 2834.84119

83 10144.952 23963 Chevrolet 4 1.6 1 1 0 7883.514 2261.43787

84 10491.075 30948 Chevrolet 4 1.6 0 1 0 6343.561 4147.51394

85 9954.054 37345 Chevrolet 4 1.6 0 1 1 5274.240 4679.81456

86 11031.130 20156 Chevrolet 4 1.6 0 1 1 8811.826 2219.30369

87 11343.054 20186 Chevrolet 4 1.6 1 1 1 8908.055 2434.99873

88 11391.214 21421 Chevrolet 4 1.6 0 1 1 8551.483 2839.73114

89 11247.863 21427 Chevrolet 4 1.6 1 1 1 8652.651 2595.21158

90 10921.945 23119 Chevrolet 4 1.6 0 1 1 8202.025 2719.92012

91 11179.954 23121 Chevrolet 4 1.6 0 1 1 8201.614 2978.33993

92 11394.886 25107 Chevrolet 4 1.6 0 1 1 7792.884 3602.00201

93 11070.061 25476 Chevrolet 4 1.6 0 1 1 7716.942 3353.11839

94 11013.871 25746 Chevrolet 4 1.6 1 1 1 7763.778 3250.09334

95 11115.014 30056 Chevrolet 4 1.6 1 1 1 6876.757 4238.25629

96 11918.456 7278 Chevrolet 4 1.6 0 0 0 10987.113 931.34337

97 12408.806 10213 Chevrolet 4 1.6 0 0 1 10630.289 1778.51729

98 11302.903 14627 Chevrolet 4 1.6 0 1 0 9702.509 1600.39407

99 11615.021 19014 Chevrolet 4 1.6 0 1 1 9046.856 2568.16518

100 10805.130 21013 Chevrolet 4 1.6 1 1 1 8737.854 2067.27576

[ reached getOption("max.print") -- omitted 400 rows ]

**> head(gm1res)**

Price Mileage Make Cylinder Liter Cruise Sound Leather fittedval resi

1 40619.07 30082 Cadillac 8 5.7 1 1 1 46581.46 -5962.3853

2 33417.97 6598 Cadillac 6 2.8 1 1 1 33550.56 -132.5970

3 30957.08 10625 Cadillac 6 2.8 1 1 1 32721.78 -1764.7034

4 31431.13 11013 Cadillac 6 2.8 1 1 1 32641.93 -1210.8014

5 30781.52 14937 Cadillac 6 2.8 1 1 1 31834.35 -1052.8363

6 30646.44 17094 Cadillac 6 2.8 1 1 1 31390.43 -743.9923

**> library(MASS)**

**> boxcox(lm(Price~.,data=gmdata),lambda=seq(-2,2,by=.1))**

**> plot(gm1res$Mileage,gm1res$resi)**

**> plot(gm1res$Cylinder,gm1res$resi)**

**> plot(gm1res$Liter,gm1res$resi)**

**plots on next page.**

