Econometrics project

Car data

Econometrics(SE307)

English section

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Introduction

In this project, we deal with a sample of 200 from a dataset comprising 810 observations of used cars manufactured by General Motors in the year 2005. The dataset includes information on various attributes such as mileage, make, body type, engine capacity, and optional features like cruise control, sound system, and leather seats.

Our objective is to estimate several models to address specific research questions and hypotheses. Each model will be designed to test a particular relationship between the explanatory variables and the retail price of the cars. We will interpret the results of these models to gain insights into the factors influencing pricing dynamics within the used car market.

we'll examine price as the dependent variable in our models. We'll explore how this variable responds to changes in the eight independent variables under consideration.

- **Categorical variables**

For each category in the categorical variables we need to create k-1 dummy variables to avoid multicollinearity

• Make: manufacturer of the car such as Saturn, Pontiac, and Chevrolet, will have 5 dummies and the base category will be 'Buick'.

• Type: body type such as sedan, coupe, etc, will have 4 dummies variables and the base category will be 'convertible'

• Cylinder: engine's capacity low, moderate, and high. will have 2 dummy variables and the base category will be 'high'.

• Cruise: indicator variable representing whether the car has cruise control (1=

cruise)

• Sound: indicator variable representing whether the car has upgraded speakers

(1 = upgraded)

• Leather: indicator variable representing whether the car has leather seats (1=

leather)

- **Quantitative variables**

• Doors: number of doors in car.

• Mileage: number of miles the car has been driven (Unit of measurement:

miles)

Model (1)

Desired model: Price=$\beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + u_t$

$D_{1i} = \begin{cases} 1 & ,if\ the\ type\ is\ coupe \\ 0 & ,o.w \end{cases}$ $D_{2i} = \begin{cases} 1 & ,if\ the\ type\ is\ hatchbach \\ 0 & ,o.w \end{cases}$

$D_{3i} = \begin{cases} 1 & ,if\ the\ type\ is\ sedan \\ 0 & ,o.w \end{cases}$ $D_{4i} = \begin{cases} 1 & ,if\ the\ type\ is\ wagon \\ 0 & ,o.w \end{cases}$

The hypothesis:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ (there is no significant effect)

H_1: $at\ least$ one of them $\neq 0$ (there is significant effect)

R output:

```
> summary(model1)

Call:
lm(formula = price ~ Type)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.7251 -0.9138 -0.0329  0.9005  3.5277 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept)     5.0651     0.3762  13.462  < 2e-16 ***
TypeCoupe       2.2424     0.4488   4.996 1.30e-06 ***
TypeHatchback   3.4026     0.4954   6.869 8.45e-11 ***
TypeSedan       2.1661     0.3917   5.530 1.02e-07 ***
TypeWagon       1.9982     0.4829   4.138 5.20e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.248 on 195 degrees of freedom
Multiple R-squared:  0.198,	Adjusted R-squared:  0.1816 
F-statistic: 12.04 on 4 and 195 DF,  p-value: 9.164e-09
```

Interpretations:

The intercept($\hat{\beta}_0$): the mean price of the car of type convertible is 5.651thousend $.

$\hat{\beta}_1 =$ the mean price of the car of type coupe is differ from the price of the car of type convertible by 2.2424 thousand $.

$\hat{\beta}_2 =$ the mean price of the car of type hatchback is differ from the price of the car of type convertible by 3.4026 thousand $.

$\hat{\beta}_3 =$ the mean price of the car of type sedan is differ from the price of the car of type convertible by 2.1661 thousand $.

$\hat{\beta}_4 =$ the mean price of the car of type wagon is differ from the price of the car of type convertible by 1.9982 thousand $.

And from the output we see that the p- values of all the coefficients are significant at α=0.05 this means that the price of cars changes when the type of the car changes.

Model (2)

Desired model: Price=$\beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \beta_5 D_{5i} + \beta_6 D_{6i} + \beta_7 D_{7i} + \beta_8 D_{8i} + \beta_9 D_{9i} + \beta_{10} D_{13i} + \beta_{11} D_{14i} + u_t$

Type: will have 4 dummies variables and the base category will be 'convertible'.

$$D_{1i} = \begin{cases} 1 & ,if\ the\ type\ is\ coupe \\ 0 & ,o.w \end{cases} \qquad D_{2i} = \begin{cases} 1 & ,if\ the\ type\ is\ hatchbach \\ 0 & ,o.w \end{cases}$$

$$D_{3i} = \begin{cases} 1 & ,if\ the\ type\ is\ sedan \\ 0 & ,o.w \end{cases} \qquad D_{4i} = \begin{cases} 1 & ,if\ the\ type\ is\ wagon \\ 0 & ,o.w \end{cases}$$

Make: will have 5 dummies and the base category will be 'Buick'.

$$D_{5i} = \begin{cases} 1 & ,if\ the\ make\ is\ cadillac \\ 0 & ,o.w \end{cases} \qquad D_{6i} = \begin{cases} 1 & ,if\ the\ make\ is\ chevrolet \\ 0 & ,o.w \end{cases}$$

$$D_{7i} = \begin{cases} 1 & ,if\ the\ make\ is\ pontiac \\ 0 & ,o.w \end{cases} \qquad D_{8i} = \begin{cases} 1 & ,if\ the\ make\ is\ SAAB \\ 0 & ,o.w \end{cases}$$

$$D_{9i} = \begin{cases} 1 & ,if\ the\ make\ is\ saturn \\ 0 & ,o.w \end{cases}$$

Cylinder: will have 2 dummy variables and the base category will be 'high'

$$D_{13i} = \begin{cases} 1 & ,if\ the\ type\ is\ low \\ 0 & ,o.w \end{cases} \qquad D_{14i} = \begin{cases} 1 & ,if\ the\ type\ is\ moderate \\ 0 & ,o.w \end{cases}$$

The hypothesis:

$H_0: \beta_1 = \beta_2 \ldots \ldots \ldots \ldots = \beta_{11} = 0$

H_1: *at least* one of them $\neq 0$

R output:

```
> summary(model2)

Call:
lm(formula = price ~ Make + Type + Cylinder)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.31274 -0.31633 -0.00772  0.28194  1.84948 

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)    
(Intercept)        5.0449     0.2228  22.643  < 2e-16 ***
MakeCadillac      -1.0827     0.1879  -5.762 3.35e-08 ***
MakeChevrolet      0.2715     0.1405   1.933  0.05473 .  
MakePontiac        0.1058     0.1453   0.728  0.46737    
MakeSAAB          -2.4765     0.1826 -13.563  < 2e-16 ***
MakeSaturn         0.2331     0.2046   1.139  0.25612    
TypeCoupe          0.6039     0.1985   3.042  0.00269 ** 
TypeHatchback      1.2605     0.2238   5.633 6.37e-08 ***
TypeSedan          0.8543     0.1757   4.862 2.45e-06 ***
TypeWagon          0.2372     0.2149   1.104  0.27116    
Cylinderlow        2.7387     0.1659  16.512  < 2e-16 ***
Cylindermoderate   1.1489     0.1493   7.695 7.78e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.502 on 188 degrees of freedom
Multiple R-squared:  0.8749,	Adjusted R-squared:  0.8676 
F-statistic: 119.5 on 11 and 188 DF,  p-value: < 2.2e-16
```

Interpretations:

Intercept ($\hat{\beta}_0$): the mean price of the car whose manufacture is Buick, its body type is convertible and its engine capacity is high is 5.0449 thousand $.

$\hat{\beta}_1 =$ the mean price of the car whose manufacture is Cadillac is less than the mean price of the car whose manufacture is Buick by 1.0827 thousand $, holding the body type and engine capacity is constant.

$\hat{\beta}_2 =$ the mean price of the car whose manufacture is Chevrolet is not greater than the mean price of the car whose manufacture is Buick by 0.2715 thousand $, holding the body type and engine capacity is constant. (not significance)

$\hat{\beta}_3 =$ the mean price of the car whose manufacture is Pontiac is not greater than the mean price of the car whose manufacture is Buick by 0.1058 thousand $, holding the body type and engine capacity is constant. (not significance)

$\hat{\beta}_4 =$ the mean price of the car whose manufacture is SAAB is less than the mean price of the car whose manufacture is Buick by 2.4765 thousand $, holding the body type and engine capacity is constant.

$\hat{\beta}_5 =$ the mean price of the car whose manufacture is Saturn is not greater than the mean price of the car whose manufacture is Buick by 0.2331 thousand $, holding the body type and engine capacity is constant. (not significance)

$\hat{\beta}_6 =$ the mean price of the car of type coupe is greater than the mean price of the car of type convertible by 0.6039 thousand $, holding the manufacturer of the car and engine capacity is constant.

$\hat{\beta}_7 =$ the mean price of the car of type hatchback is greater than the mean price of the car of type convertible by 1.2605 thousand $, holding the manufacturer of the car and engine capacity is constant.

$\hat{\beta}_8 =$ the mean price of the car of type Sedan is greater than the mean price of the car of type convertible by 0.8543 thousand $, holding the manufacturer of the car and engine capacity is constant.

$\hat{\beta}_9 =$ the mean price of the car of type Wagon is not greater than the mean price of the car of type convertible by 0.2372 thousand $, holding the manufacturer of the car and engine capacity is constant. (not significance)

$\hat{\beta}_{10} =$ the mean price of the car which its engine capacity is low greater than the mean price of the car which its engine capacity is high by 2.7387 thousand $, holding the manufacturer of the car and the body type of the car constant.

$\hat{\beta}_{11}$ = the mean price of the car which its engine capacity is moderate greater than the mean price of the car which its engine capacity is high by 1.1489 thousand $, holding the manufacturer of the car and the body type of the car constant.

Model (3):

Desired model: Price=$\beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \beta_5 D_{5i} + \beta_6 D_{6i} + \beta_7 D_{1i} D_{5i} + \beta_8 D_{2i} D_{5i} + \beta_9 D_{3i} D_{5i} + \beta_{10} D_{4i} D_{5i} + \beta_{11} D_{1i} D_{6i} + \beta_{12} D_{2i} D_{6i} + \beta_{13} D_{3i} D_{6i} + \beta_{14} D_{4i} D_{6i} + u_t$

Type: will have 4 dummies variables and the base category will be ‘convertible’.

$$D_{1i} = \begin{cases} 1 & ,if\ the\ type\ is\ coupe \\ 0 & ,o.w \end{cases} \qquad D_{2i} = \begin{cases} 1 & ,if\ the\ type\ is\ hatchbach \\ 0 & ,o.w \end{cases}$$

$$D_{3i} = \begin{cases} 1 & ,if\ the\ type\ is\ sedan \\ 0 & ,o.w \end{cases} \qquad D_{4i} = \begin{cases} 1 & ,if\ the\ type\ is\ wagon \\ 0 & ,o.w \end{cases}$$

Cylinder: will have 2 dummy variables and the base category will be ‘high’

$$D_{5i} = \begin{cases} 1 & ,if\ the\ type\ is\ low \\ 0 & ,o.w \end{cases} \qquad D_{6i} = \begin{cases} 1 & ,if\ the\ type\ is\ moderate \\ 0 & ,o.w \end{cases}$$

The hypothesis:

$H_0: \beta_7 = \beta_8 \dots \dots \dots \dots = \beta_{14} = 0$

H_1: $at\ least$ one of them $\neq 0$

R output:

```
> summary(model3)

Call:
lm(formula = price ~ Type - Cylinder + Type * Cylinder)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.5651 -0.3448  0.0340  0.6618  2.7043 

Coefficients: (4 not defined because of singularities)
                               Estimate Std. Error t value Pr(>|t|)    
(Intercept)                     4.51531    0.41497  10.881  < 2e-16 ***
TypeCoupe                       0.84782    0.58686   1.445 0.150205    
TypeHatchback                   1.16782    0.59466   1.964 0.051016 .  
TypeSedan                       0.75085    0.48342   1.553 0.122052    
TypeWagon                       1.54004    0.44062   3.495 0.000590 ***
Cylinderlow                     1.00799    0.56187   1.794 0.074414 .  
Cylindermoderate                1.80515    0.27166   6.645 3.15e-10 ***
TypeCoupe:Cylinderlow           2.30406    0.77170   2.986 0.003204 ** 
TypeHatchback:Cylinderlow       2.89606    0.78748   3.678 0.000307 ***
TypeSedan:Cylinderlow           1.78053    0.62890   2.831 0.005140 ** 
TypeWagon:Cylinderlow                NA         NA      NA       NA    
TypeCoupe:Cylindermoderate      0.04542    0.55878   0.081 0.935297    
TypeHatchback:Cylindermoderate       NA         NA      NA       NA    
TypeSedan:Cylindermoderate           NA         NA      NA       NA    
TypeWagon:Cylindermoderate           NA         NA      NA       NA    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9279 on 189 degrees of freedom
Multiple R-squared:  0.5702,	Adjusted R-squared:  0.5475 
F-statistic: 25.08 on 10 and 189 DF,  p-value: < 2.2e-16
```

Interpretation:

Intercept($\hat{\beta}_0$): the mean price of the car of type convertible, where its engine capacity is high, is 4.54531 thousand $.

$\hat{\beta}_2 =$ the mean price of the car of type coupe is not greater than the car of type convertible by 0.84782 thousand $, holding the engine capacity is constant. (not significant)

$\hat{\beta}_3 =$ the mean price of the car of type hatchback is not greater than the car of type convertible by 1.16782 thousand $, holding the engine capacity is constant. (not significant)

$\hat{\beta}_4 =$ the mean price of the car of type sedan is not greater than the car of type convertible by 0.75085 thousand $, holding the engine capacity is constant. (not significant)

$\hat{\beta}_5 =$ the mean price of the car of type wagon is greater than the car of type convertible by 1.54004 thousand $, holding the engine capacity is constant.

$\hat{\beta}_6 =$ the mean price of the car which its engine capacity is low is not greater than the car which its engine capacity is high by 1.00799 thousand $, holding the type of car constant. (not significance)

$\hat{\beta}_7 =$ the mean price of the car which its engine capacity is moderate is greater than the car which its engine capacity is high by 1.80515 thousand $, holding the type of car constant.

$\hat{\beta}_8 =$ the effect of the type of the car on the mean price of the car (coupe) is differ among cylinder size. (high or moderate) (significant)

$\hat{\beta}_9 =$ the effect of the type of the car on the mean price of the car (hatchback) is differ among cylinder size. (significant)

$\hat{\beta}_{10} =$ the effect of the type of the car on the mean price of the car (sedan) is differ among cylinder size. (significant)

$\hat{\beta}_{11} =$ the effect of the type of the car on the mean price of the car (coupe) doesn't differ among cylinder size. (high or low) (insignificant)

For not available coefficients (N/A):

The absence of coefficients occurs because of perfect collinearity, which results from insufficient observations to estimate the parameters when the number of predictors exceeds the number of observations (p > n). This situation also indicates the absence of observations with certain combinations of factor levels which is represented by the zeros in the cross table.

	Cylinder		
Type	high	low	moderate
Convertible	5	6	0
Coupe	5	8	13
Hatchback	0	7	8
Sedan	14	47	70
Wagon	0	17	0

Model (4):

Desired model: Price=$\beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{4i} + \beta_5 D_{5i} + \beta_6 X_1 + \beta_7 X_2 + u_t$

Make: will have 5 dummies and the base category will be 'Buick'.

$$D_{1i} = \begin{cases} 1 & , if\ the\ make\ is\ cadillac \\ 0 & , o.w \end{cases} \qquad D_{2i} = \begin{cases} 1 & , if\ the\ make\ is\ chevrolet \\ 0 & , o.w \end{cases}$$

$$D_{3i} = \begin{cases} 1 & , if\ the\ make\ is\ pontiac \\ 0 & , o.w \end{cases} \qquad D_{4i} = \begin{cases} 1 & , if\ the\ make\ is\ SAAB \\ 0 & , o.w \end{cases}$$

$$D_{5i} = \begin{cases} 1 & , if\ the\ make\ is\ saturn \\ 0 & , o.w \end{cases}$$

Mileage (X1) and doors(X2)

The hypothesis:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

H_1: $at\ least$ one of them $\neq 0$

R output:

```
> summary(model4)

Call:
lm(formula = price ~ Make + Mileage + Doors)

Residuals:
     Min       1Q   Median       3Q      Max 
-2.23404 -0.45310 -0.09905  0.37713  2.43771 

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)    
(Intercept)     4.191e+00  4.079e-01  10.274  < 2e-16 ***
MakeCadillac   -1.740e+00  2.617e-01  -6.651 2.95e-10 ***
MakeChevrolet   1.186e+00  2.107e-01   5.628 6.39e-08 ***
MakePontiac     6.242e-01  2.271e-01   2.749 0.006552 ** 
MakeSAAB       -8.746e-01  2.488e-01  -3.515 0.000549 ***
MakeSaturn      1.899e+00  2.947e-01   6.445 9.10e-10 ***
Mileage         3.687e-05  8.011e-06   4.602 7.58e-06 ***
Doors           5.037e-01  7.714e-02   6.530 5.74e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8209 on 192 degrees of freedom
Multiple R-squared:  0.6583,	Adjusted R-squared:  0.6458 
F-statistic: 52.84 on 7 and 192 DF,  p-value: < 2.2e-16
```

Interpretation:

Intercept ($\hat{\beta}_0$): the mean price of the car whose manufacture is Buick is 4.191 thousand $, holding mileage and doors constant.

$\hat{\beta}_1 =$ the mean price of the car whose manufacture is Cadillac is less than the mean price of the car whose manufacture is Buick by 1.740 thousand $, holding mileage and doors constant.

$\hat{\beta}_2 =$ the mean price of the car whose manufacture is Chevrolet is greater than the mean price of the car whose manufacture is Buick by 1.186 thousand $, holding mileage and doors constant.

$\hat{\beta}_3 =$ the mean price of the car whose manufacture is Pontiac is greater than the mean price of the car whose manufacture is Buick by 6.242 thousand $, holding mileage and doors constant.

$\hat{\beta}_4 =$ the mean price of the car whose manufacture is SAAB is less than the mean price of the car whose manufacture is Buick by 8.746 thousand $, holding mileage and doors constant.

$\hat{\beta}_5 =$ the mean price of the car whose manufacture is Saturn is greater than the mean price of the car whose manufacture is Buick by 1.899 thousand $, holding mileage and doors constant.

$\hat{\beta}_6 =$ when the number of miles the car has been driven increased by 1 mile the mean price of the car is increased by 3.687 thousand $, holding doors and the car manufacture is constant.

$\hat{\beta}_7 =$ when the number of doors in car increased by 1 door the mean price of the car is increased by 5.037 thousand $, mileage and the car manufacture is constant.

And from the output we see that the p- values of all the coefficients are significant at α=0.05 this means that there is a statistically significant effect from changing the number of miles the car makes and the number of the doors the car has on the price of the car.

Model (5):

Desired model:

Price=β_0+$\beta_1 X_1 + \beta_2 D_{1i} + \beta_3 D_{2i} + \beta_4 D_{3i} + \beta_5 D_{4i} + \beta_6 X_1 D_{1i} + \beta_7 X_1 D_{2i} + \beta_8 X_1 D_{3i} + \beta_9 X_1 D_{4i} + u_t$

Type: will have 4 dummies variables and the base category will be ‘convertible’.

$$D_{1i} = \begin{cases} 1 & ,if\ the\ type\ is\ coupe \\ 0 & ,o.w \end{cases} \qquad D_{2i} = \begin{cases} 1 & ,if\ the\ type\ is\ hatchbach \\ 0 & ,o.w \end{cases}$$

$$D_{3i} = \begin{cases} 1 & ,if\ the\ type\ is\ sedan \\ 0 & ,o.w \end{cases} \qquad D_{4i} = \begin{cases} 1 & ,if\ the\ type\ is\ wagon \\ 0 & ,o.w \end{cases}$$

Mileage (X1)

The hypothesis:

$H_0: \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$

H_1: $at\ least$ one of them $\neq 0$

R output:

```
> summary(model5)

Call:
lm(formula = price ~ Mileage + Type + Mileage * Type)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.5707 -0.8508 -0.0373  0.8796  3.2958 

Coefficients:
                       Estimate Std. Error t value Pr(>|t|)    
(Intercept)           4.596e+00  9.272e-01   4.957 1.58e-06 ***
Mileage               2.321e-05  4.212e-05   0.551   0.5824    
TypeCoupe             1.779e+00  1.241e+00   1.433   0.1534    
TypeHatchback         2.571e+00  1.304e+00   1.971   0.0502 .  
TypeSedan             1.745e+00  9.722e-01   1.795   0.0743 .  
TypeWagon             4.155e-01  1.762e+00   0.236   0.8138    
Mileage:TypeCoupe     2.240e-05  5.713e-05   0.392   0.6953    
Mileage:TypeHatchback 4.678e-05  6.265e-05   0.747   0.4562    
Mileage:TypeSedan     2.131e-05  4.427e-05   0.481   0.6308    
Mileage:TypeWagon     7.341e-05  8.097e-05   0.907   0.3657    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.212 on 190 degrees of freedom
Multiple R-squared:  0.2625,	Adjusted R-squared:  0.2276 
F-statistic: 7.515 on 9 and 190 DF,  p-value: 2.188e-09
```

Interpretation:

Intercept: the mean price of the car whose body type is convertible is 4.596 thousand $, holding the mileage constant.

$\hat{\beta}_1 =$ for a car whose body type is convertible, when the mileage increase by 1 mile, the mean price of the car increase by 2.321 thousand $.

$\hat{\beta}_2 =$ holding the mileage constant, the mean price of the car of type coupe is more than the price of the car of type convertible by 1.779 thousand $,

$\hat{\beta}_3 =$ holding the mileage constant, the mean price of the car of type hatchback is more than the price of the car of type convertible by 2.571 thousand $.

$\hat{\beta}_4 =$ holding the mileage constant, the mean price of the car of type sedan is more than the price of the car of type convertible by 1.745 thousand $.

$\hat{\beta}_5 =$ holding the mileage constant, the mean price of the car of type wagon is more than the price of the car of type convertible by 4.155 thousand $.

$\hat{\beta}_6 =$ the change in the mean price of the car of type coupe, when the mileage increase by 1 mile, is higher than the change in the mean price of the car of type convertible by 2.24 thousand $.

$\hat{\beta}_7 =$ the change in the mean price of the car of type hatchback, when the mileage increase by 1 mile, is higher than the change in the mean price of the car of type convertible by 4.678 thousand $.

$\hat{\beta}_8 =$ the change in the mean price of the car of type sedan, when the mileage increase by 1 mile, is higher than the change in the mean price of the car of type convertible by 2.131 thousand $.

$\hat{\beta}_9 =$ the change in the mean price of the car of type wagon, when the mileage increase by 1 mile, is higher than the change in the mean price of the car of type convertible by 7.341 thousand $.

By looking at the output, we found that the p values of the interaction terms are not significant which means that we don't need to add them in the model.

Model (6):

Desired model: Price=$\beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + \beta_4 D_{1i} D_{2i} + \beta_5 D_{1i} D_{3i} + \beta_6 D_{2i} D_{3i} + u_t$

$D_{1i} = \begin{cases} 1 & ,if\ it\ has\ cruise \\ 0 & ,o.w \end{cases}$ $D_{2i} = \begin{cases} 1 & ,if\ it\ has\ upgraded \\ 0 & ,o.w \end{cases}$ $D_{3i} \begin{cases} 1 & ,if\ it\ has\ leather \\ 0 & ,o.w \end{cases}$

The hypothesis:

$H_0: \beta_4 = \beta_5 = \beta_6$=0 (there is no significant effect)

H_1: $at\ least$ one of them $\neq 0$ (there is significant effect)

R output:

```
> summary(model6)

Call:
lm(formula = price ~ Cruise + Sound + Leather + Cruise * Sound +
    Cruise * Leather + Sound * Leather)

Residuals:
    Min      1Q  Median      3Q     Max
-2.8643 -0.8498 -0.0904  0.7696  4.0631

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)     9.16192    0.40572  22.582  < 2e-16 ***
Cruise         -1.96055    0.45873  -4.274 3.02e-05 ***
Sound          -0.42457    0.53550  -0.793    0.429
Leather        -0.79562    0.53095  -1.498    0.136
Cruise:Sound    0.59472    0.50681   1.173    0.242
Cruise:Leather -0.05489    0.54022  -0.102    0.919
Sound:Leather   0.29882    0.39112   0.764    0.446
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.178 on 193 degrees of freedom
Multiple R-squared:  0.2925,    Adjusted R-squared:  0.2705
F-statistic:  13.3 on 6 and 193 DF,  p-value: 1.362e-12
```

Interpretation:

$\hat{\beta}_0 =$ 9.16192, the mean price of the car that lacks all three features (cruise control, upgraded speakers, and leather seats).

$\hat{\beta}_1 =$ -1.96055, difference between the mean price of the car that has cruise control and the one that hasn't when it is without upgraded speakers and leather seats. β1 is negative and statistically significant, it indicates that cars with cruise control tend to have lower prices compared to those without cruise control, by 1.96 thousand $, all else being constant.

$\hat{\beta}_2$ =-0.42457, difference between the mean price of the car that has upgraded speakers and the car without upgraded speakers when it is without cruise control, leather seats. the mean price of the car that has upgraded speakers is less than the one without by 0.42457 thousand dollars.

$\hat{\beta}_3$ = -0.79562, difference between the mean price of the car with and without leather seats and when it is without cruise control and upgraded speakers.

$\hat{\beta}_4$ = 0.59472, the differential effect of a car that has cruise control and upgraded speakers on the price compared to when it doesn't have upgraded speakers.

$\hat{\beta}_5$ = -0.05489 the differential effect of a car that has cruise control and leather seats on the price compared to when it doesn't have leather seats.

$\hat{\beta}_6$ = 0.29882 the differential effect of a car that has upgraded speakers and leather seats on the price compared to when it doesn't have leather seats.

$\hat{\beta}_1 + \hat{\beta}_4$ = the difference between the mean car price if the car has cruise control or not ,if it has leather seats and upgraded speakers.

$\hat{\beta}_2 + \hat{\beta}_5$ = the difference between the mean car price if the car has upgraded speakers.

or not ,if it has leather seats and cruise control.

$\hat{\beta}_3 + \hat{\beta}_6$ = the difference between the mean car price if the car has leather seats or not ,if it has cruise control and upgraded speakers.

By looking at the p values, we can say that the there is no interaction between cruise control, leather seats and upgraded speakers, since the parameters of the interaction terms are not statistically significant.

Model (7):

Desired model: Price=$\beta_0 + \beta_1 X_i + \beta_2 (X_i - x*) D_i + u_t$

Mileage (X), Dummy = $\begin{cases} 1\ , & \text{if } x > x* \\ 0\ , & O.W \end{cases}$

The hypothesis:

$H_0 : \beta_2$=0 (no break in the line)

H_1: $at\ least$ one of them $\neq 0$ (break in the line)

R output:

```
> summary(model7)

Call:
lm(formula = price ~ Mileage + new)

Residuals:
    Min      1Q  Median      3Q     Max 
-3.5193 -0.9789 -0.0202  0.9467  3.3300 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) 6.487e+00  4.407e-01  14.719   <2e-16 ***
Mileage     2.873e-05  3.574e-05   0.804    0.422    
new         2.132e-05  5.079e-05   0.420    0.675    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.349 on 197 degrees of freedom
Multiple R-squared:  0.05282,	Adjusted R-squared:  0.0432 
F-statistic: 5.493 on 2 and 197 DF,  p-value: 0.00477
```

Interpretation:

$\hat{\beta}_0 =$ the intercept for the 1st part where x < 15000 will be equal 6.487.

$\hat{\beta}_1 = 2.87\ e^{-0.5}$, the slope for the 1st part where x < 15000 , when the number of miles increase by 1 mile, on average the price will increase by 2.87 $e^{-0.5}$ thousand $,before the number of miles achieves 15 thousand miles.

$\hat{\beta}_1 + \hat{\beta}_2 = 3.033$, the slope for the 2nd part where x < 15000, when the number of miles increase by 1 mile, on average the price will increase by 3.033 thousand $, before the number of miles achieves 15 thousand miles.

$\hat{\beta}_2 = 2.132\ e^{-0.5}$, the differential change in the slope as the number of miles in the 2nd part in greater than the number of miles in the 1st part by about 2.132 $e^{-0.5}$ thousand $.

Conclusion:

Inconclusion, we went through a comprehensive analysis of factors influencing car prices using a dataset comprising 200 observations sourced from the "car" dataset. Our investigation unfolded across several stages, each designed to address specific hypotheses and different facets of car pricing dynamics. We proceeded to estimate various models while formulating and testing hypotheses to answer key questions. Our analyses delved into diverse aspects such as the impact of car type, make, cylinder size, mileage, and features like cruise, sound, and leather on car prices. Through statistical methods and software output from R-software, we uncovered insightful relationships within the dataset. From assessing mean price differences across car types to exploring interactions between variables and dissecting the effects of mileage increments and feature presence, our findings offer valuable insights for understanding the complexities of car pricing dynamics.

Overall, We can draw several conclusions from our analysis of the different models:

In model (1), the null hypothesis is rejected, indicating that the variable "type" significantly contributes to the model's identification. For model (2), although some parameters are significant, we do not reject the null hypothesis. In model (3), where we introduced an interaction term to assess the combined effect of car type and cylinder, the decision on the null hypothesis is nuanced. While some types show significance with changes in cylinder, the overall hypothesis is not rejected. Moving to model (4), where we examined the impact of the "make" variable on the number of doors and mileage, we reject the null hypothesis as all coefficients demonstrate significance. Model (5) aimed to explore the relationship between mileage and car type. Here, the null hypothesis is rejected since all interaction terms are insignificant. In model (6), investigating the relations between cruise, leather, and sound variables, we find no significant relationship, leading us to retain the null hypothesis. Finally, in model (7), examining mileage differences before and after 15,000 miles, we find no obvious variation, resulting in the rejection of the null hypothesis.

Appendix

Here find attached the links for the:

R-script: **https://drive.google.com/file/d/1JIuByFCnU0x08E7ni2Nn00_-Wh8ac0VR/view?usp=drivesdk**

Sample excel:

https://docs.google.com/spreadsheets/d/1J79NZUWOKmGCsB04qJ7X9WvgY8ui8g1P/edit?usp=drivesdk&ouid=112026743259827629896&rtpof=true&sd=true

```
library(readxl)
data_car_project <- read_excel("~/Downloads/data car project.xls")
View(data_car_project)

mysample=data_car_project[sample(1:nrow(data_car_project),size=200,replace = F),]
install.packages('writexl')
library(writexl)
write_xlsx(mysample,'/Users/nadajamiel/Desktop/econometrics proj//mysample.xlsx')

attach(mysample)


model1=lm(price~Type)
summary(model1)
#base variable convertible

model2=lm(price~Make+Type+Cylinder)
summary(model2)

model3=lm(price~Type-Cylinder+Type*Cylinder)
summary(model3)
table(Type,Cylinder)


model4=lm(price~Make+Mileage+Doors)
summary(model4)

model5=lm(price~Mileage+Type+Mileage*Type)
summary(model5)

model6=lm(price~Cruise+Sound+Leather+Cruise*Sound+Cruise*Leath Show in new window )
summary(model6)

mysample$dummy = ifelse(Mileage> 15000 , c(1), c(0))
mysample$minus = Mileage-15000
mysample$new =mysample$minus*mysample$dummy
attach(mysample)
model7=lm(price~Mileage+new)
summary(model7)
```

mysample

Filter

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
1	7.148831	2189	Pontiac	Sedan	moderate	4	1	1	1	0	-12811	0
2	5.319551	25163	Cadillac	Sedan	high	4	1	0	1	1	10163	10163
3	7.456414	17488	Chevrolet	Hatchback	moderate	4	0	1	1	1	2488	2488
4	7.801893	9882	Chevrolet	Sedan	low	4	0	1	1	0	-5118	0
5	8.030822	24239	Pontiac	Wagon	low	4	1	0	0	1	9239	9239
6	8.127557	32462	Chevrolet	Sedan	moderate	4	0	1	1	1	17462	17462
7	5.183702	22211	Cadillac	Sedan	high	4	1	0	1	1	7211	7211
8	7.316949	16496	Pontiac	Sedan	moderate	4	1	1	0	1	1496	1496
9	7.671053	23621	Chevrolet	Sedan	moderate	4	0	1	1	1	8621	8621
10	9.336412	19699	Chevrolet	Hatchback	low	4	0	0	1	1	4699	4699
11	7.493591	32896	Buick	Sedan	moderate	4	1	1	0	1	17896	17896
12	8.592311	27431	Chevrolet	Sedan	low	4	0	1	1	1	12431	12431
13	6.902954	27096	Buick	Sedan	moderate	4	1	0	0	1	12096	12096
14	8.957153	21891	Pontiac	Coupe	low	2	1	1	1	1	6891	6891
15	8.007464	18315	Pontiac	Coupe	moderate	2	0	1	1	1	3315	3315
16	6.725971	9049	Pontiac	Sedan	moderate	4	1	1	1	0	-5951	0
17	5.742751	16225	SAAB	Wagon	low	4	1	1	1	1	1225	1225
18	5.824049	21822	SAAB	Wagon	low	4	1	1	1	1	6822	6822
19	6.024902	26126	Pontiac	Coupe	high	2	1	1	1	1	11126	11126
20	5.456511	18930	SAAB	Convertible	low	2	1	0	1	1	3930	3930
21	5.028518	23826	Chevrolet	Convertible	high	2	1	1	1	1	8826	8826
22	8.917949	25048	Chevrolet	Sedan	low	4	1	1	1	1	10048	10048
23	6.954485	18021	Chevrolet	Coupe	moderate	2	1	0	1	1	3021	3021
24	6.962657	20770	Pontiac	Sedan	moderate	4	1	1	1	1	5770	5770
25	5.077033	13973	Cadillac	Sedan	moderate	4	1	1	1	0	-1027	0
26	6.802914	11069	Pontiac	Sedan	moderate	4	1	0	1	0	-3931	0
27	6.073513	22598	SAAB	Sedan	low	4	1	0	1	1	7598	7598
28	9.461827	22380	Chevrolet	Sedan	low	4	0	1	0	1	7380	7380
29	5.683554	10625	Cadillac	Sedan	moderate	4	1	1	1	0	-4375	0
30	7.568329	15144	Chevrolet	Sedan	moderate	4	1	1	1	1	144	144
31	6.808007	20137	Buick	Sedan	moderate	4	1	1	0	1	5137	5137
32	4.727211	12115	Chevrolet	Convertible	high	2	1	0	1	0	-2885	0
33	5.743412	23635	SAAB	Convertible	low	2	1	0	0	1	8635	8635
34	6.343296	22814	SAAB	Sedan	low	4	1	1	1	1	7814	7814
35	7.232692	26252	Pontiac	Sedan	moderate	4	1	0	1	1	11252	11252

Showing 1 to 36 of 200 entries, 12 total columns

mysample

Filter

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
36	7.146280	7645	Chevrolet	Hatchback	moderate	4	0	1	1	0	-7355	0
37	8.018165	33357	Chevrolet	Sedan	moderate	4	1	1	1	1	18357	18357
38	7.898962	22889	Chevrolet	Hatchback	moderate	4	0	1	1	1	7889	7889
39	6.897235	25550	Chevrolet	Coupe	moderate	2	1	1	1	1	10550	10550
40	6.870764	21394	Buick	Sedan	moderate	4	1	0	0	1	6394	6394
41	7.460020	34665	Buick	Sedan	moderate	4	1	1	1	1	19665	19665
42	7.776336	24218	Chevrolet	Sedan	moderate	4	1	1	1	1	9218	9218
43	6.006894	5379	Chevrolet	Sedan	moderate	4	1	1	0	0	-9621	0
44	7.497561	26980	Chevrolet	Sedan	moderate	4	1	1	0	1	11980	11980
45	4.898690	20575	Cadillac	Sedan	high	4	1	0	1	1	5575	5575
46	9.395178	39946	Chevrolet	Sedan	low	4	1	1	1	1	24946	24946
47	8.005344	5788	Pontiac	Sedan	low	4	1	1	1	0	-9212	0
48	9.462698	4716	Chevrolet	Hatchback	low	4	1	1	0	0	-10284	0
49	8.130083	13828	Chevrolet	Sedan	low	4	1	1	1	0	-1172	0
50	7.950053	14304	Pontiac	Wagon	low	4	0	0	1	0	-696	0
51	8.103078	22576	Buick	Sedan	moderate	4	1	1	0	1	7576	7576
52	5.470286	6598	Cadillac	Sedan	moderate	4	1	1	1	0	-8402	0
53	6.815928	25020	Chevrolet	Coupe	moderate	2	1	1	1	1	10020	10020
54	9.004405	21877	Saturn	Sedan	low	4	0	0	0	1	6877	6877
55	6.724655	21992	Chevrolet	Coupe	moderate	2	1	1	0	1	6992	6992
56	7.823210	19832	Buick	Sedan	moderate	4	1	0	1	1	4832	4832
57	5.395168	17711	SAAB	Convertible	low	2	1	1	0	1	2711	2711
58	4.857692	18581	Cadillac	Sedan	high	4	1	0	1	1	3581	3581
59	8.090586	16951	Saturn	Coupe	low	2	0	1	0	1	1951	1951
60	7.886331	22779	Pontiac	Wagon	low	4	0	0	1	1	7779	7779
61	7.664256	30404	Pontiac	Sedan	moderate	4	1	0	0	1	15404	15404
62	7.635017	21567	Chevrolet	Sedan	moderate	4	1	0	1	1	6567	6567
63	7.084513	19800	Buick	Sedan	moderate	4	1	1	1	1	4800	4800
64	6.707026	22102	Buick	Sedan	moderate	4	1	0	1	1	7102	7102
65	8.117924	27887	Pontiac	Wagon	low	4	0	0	0	1	12887	12887
66	8.000737	23217	Pontiac	Wagon	low	4	1	1	1	1	8217	8217
67	8.361034	21128	Chevrolet	Sedan	low	4	0	1	1	1	6128	6128
68	6.120121	23055	SAAB	Sedan	low	4	1	1	1	1	8055	8055
69	9.032438	21492	Chevrolet	Sedan	low	4	1	1	1	1	6492	6492
70	8.398950	21627	Chevrolet	Sedan	low	4	0	1	1	1	6627	6627

Showing 35 to 70 of 200 entries, 12 total columns

mysample

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
71	7.189936	23765	Buick	Sedan	moderate	4	1	1	0	1	8765	8765
72	8.155958	19455	Saturn	Coupe	low	2	0	0	1	1	4455	4455
73	8.543877	25845	Chevrolet	Coupe	low	2	1	1	1	1	10845	10845
74	7.600025	21420	Chevrolet	Sedan	moderate	4	1	1	1	1	6420	6420
75	7.102725	1592	Pontiac	Sedan	moderate	4	1	1	0	0	-13408	0
76	6.928592	19419	Pontiac	Sedan	moderate	4	1	1	0	1	4419	4419
77	5.007777	7054	Chevrolet	Coupe	high	2	1	0	1	0	-7946	0
78	6.854803	17417	Pontiac	Sedan	moderate	4	1	1	1	1	2417	2417
79	6.202118	21433	SAAB	Sedan	low	4	1	1	1	1	6433	6433
80	8.009031	21307	Pontiac	Wagon	low	4	0	0	0	1	6307	6307
81	6.516734	16235	Buick	Sedan	moderate	4	1	1	0	1	1235	1235
82	7.783322	17451	Chevrolet	Sedan	moderate	4	0	1	1	1	2451	2451
83	5.847430	3907	SAAB	Sedan	low	4	1	0	1	0	-11093	0
84	7.440549	27574	Pontiac	Sedan	moderate	4	1	0	0	1	12574	12574
85	9.091279	22758	Saturn	Sedan	low	4	1	1	0	1	7758	7758
86	5.259204	25339	Cadillac	Sedan	high	4	1	1	1	1	10339	10339
87	5.399705	24259	Chevrolet	Coupe	high	2	1	0	1	1	9259	9259
88	8.280947	7115	Chevrolet	Sedan	low	4	1	1	1	0	-7885	0
89	8.285143	18511	Saturn	Sedan	low	4	0	1	1	1	3511	3511
90	7.879434	19465	Pontiac	Wagon	low	4	1	0	0	1	4465	4465
91	8.975735	24664	Saturn	Sedan	low	4	0	1	1	1	9664	9664
92	7.445262	11647	Chevrolet	Coupe	moderate	2	1	0	1	0	-3353	0
93	5.489591	9795	SAAB	Sedan	low	4	1	1	1	0	-5205	0
94	5.640531	11013	Cadillac	Sedan	moderate	4	1	1	1	0	-3987	0
95	8.144042	13262	Pontiac	Sedan	low	4	0	1	1	0	-1738	0
96	6.125267	22590	SAAB	Sedan	low	4	1	1	1	1	7590	7590
97	8.433153	4922	Chevrolet	Sedan	low	4	0	1	1	0	-10078	0
98	8.334413	31424	Pontiac	Wagon	low	4	0	0	0	1	16424	16424
99	6.778288	25794	Pontiac	Sedan	high	4	1	0	1	1	10794	10794
100	6.741243	15516	Pontiac	Sedan	moderate	4	1	1	1	1	516	516
101	9.492924	20334	Chevrolet	Hatchback	low	4	1	0	0	1	5334	5334
102	9.308935	22405	Chevrolet	Coupe	low	2	0	1	1	1	7405	7405
103	7.734994	26328	Chevrolet	Sedan	moderate	4	1	1	1	1	11328	11328
104	8.102238	32535	Chevrolet	Sedan	moderate	4	0	1	1	1	17535	17535
105	8.416470	12878	Saturn	Sedan	low	4	1	0	0	0	-2122	0

Showing 70 to 105 of 200 entries, 12 total columns

mysample

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
106	9.302721	13404	Chevrolet	Sedan	low	4	1	1	0	0	-1596	0
107	7.956279	26700	Chevrolet	Coupe	moderate	2	1	1	0	1	11700	11700
108	5.665327	18805	SAAB	Wagon	low	4	1	1	1	1	3805	3805
109	9.006582	19347	Chevrolet	Coupe	low	2	0	1	1	1	4347	4347
110	8.369702	18533	Chevrolet	Sedan	low	4	1	1	1	1	3533	3533
111	6.791098	26779	Buick	Sedan	moderate	4	1	1	0	1	11779	11779
112	7.772934	19531	Pontiac	Wagon	low	4	1	1	1	1	4531	4531
113	6.111320	16688	SAAB	Sedan	low	4	1	0	0	1	1688	1688
114	6.779536	1853	Chevrolet	Sedan	moderate	4	1	0	0	0	-13147	0
115	5.365250	25747	Chevrolet	Coupe	high	2	1	0	1	1	10747	10747
116	7.630711	18721	Chevrolet	Hatchback	moderate	4	0	1	1	1	3721	3721
117	5.603379	16956	SAAB	Wagon	low	4	1	0	1	1	1956	1956
118	8.910765	26328	Saturn	Sedan	low	4	0	0	1	1	11328	11328
119	6.608989	26272	Chevrolet	Sedan	moderate	4	1	1	1	1	11272	11272
120	5.905069	25380	SAAB	Wagon	low	4	1	0	1	1	10380	10380
121	7.223539	1480	Chevrolet	Sedan	moderate	4	1	1	1	0	-13520	0
122	9.019241	17139	Saturn	Sedan	low	4	1	0	1	1	2139	2139
123	7.278385	27218	Chevrolet	Coupe	moderate	2	1	1	0	1	12218	12218
124	6.053966	14281	SAAB	Sedan	low	4	1	1	1	0	-719	0
125	6.772983	24439	Buick	Sedan	moderate	4	1	0	0	1	9439	9439
126	6.544478	24027	Buick	Sedan	moderate	4	1	0	1	1	9027	9027
127	8.716457	21145	Chevrolet	Sedan	low	4	1	1	1	1	6145	6145
128	6.579229	5653	Pontiac	Sedan	moderate	4	1	0	0	0	-9347	0
129	6.519436	14948	Chevrolet	Coupe	moderate	2	1	1	0	0	-52	0
130	6.954245	11204	Pontiac	Sedan	moderate	4	1	1	0	0	-3796	0
131	9.367959	25107	Chevrolet	Hatchback	low	4	0	1	1	1	10107	10107
132	6.726668	12314	Pontiac	Sedan	moderate	4	1	1	0	0	-2686	0
133	5.970284	26276	SAAB	Sedan	low	4	1	1	1	1	11276	11276
134	7.389839	17441	Chevrolet	Hatchback	moderate	4	0	1	1	1	2441	2441
135	8.165542	8880	Chevrolet	Sedan	low	4	0	1	1	0	-6120	0
136	4.840609	24052	Cadillac	Sedan	high	4	1	0	1	1	9052	9052
137	8.524031	18040	Chevrolet	Sedan	low	4	1	1	1	1	3040	3040
138	5.017992	8967	Chevrolet	Coupe	high	2	1	1	1	0	-6033	0
139	8.509127	26236	Saturn	Coupe	low	2	0	1	1	1	11236	11236
140	7.476098	17020	Chevrolet	Hatchback	moderate	4	0	1	1	1	2020	2020

Showing 106 to 141 of 200 entries, 12 total columns

mysample
Filter

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
141	9.309257	24163	Chevrolet	Sedan	low	4	0	1	1	1	9163	9163
142	5.667545	23124	Cadillac	Sedan	high	4	1	1	1	1	8124	8124
143	5.526116	7924	SAAB	Sedan	low	4	1	0	1	0	-7076	0
144	7.264153	8687	Chevrolet	Hatchback	moderate	4	0	1	1	0	-6313	0
145	6.348849	16111	Chevrolet	Sedan	moderate	4	1	0	0	1	1111	1111
146	5.424504	25420	SAAB	Convertible	low	2	1	0	0	1	10420	10420
147	7.836461	26511	Pontiac	Sedan	moderate	4	1	0	1	1	11511	11511
148	10.269398	24842	Chevrolet	Sedan	low	4	1	0	0	1	9842	9842
149	7.782964	27460	Chevrolet	Sedan	moderate	4	1	1	1	1	12460	12460
150	6.012083	35157	SAAB	Convertible	low	2	1	0	0	1	20157	20157
151	9.067655	21770	Saturn	Sedan	low	4	0	1	0	1	6770	6770
152	6.104920	4695	Buick	Sedan	moderate	4	1	1	0	0	-10305	0
153	8.043314	29925	Pontiac	Sedan	moderate	4	1	1	0	1	14925	14925
154	4.979148	14743	Cadillac	Sedan	high	4	1	0	1	0	-257	0
155	8.829172	19081	Pontiac	Coupe	low	2	1	1	1	1	4081	4081
156	7.215975	26477	Pontiac	Sedan	moderate	4	1	0	1	1	11477	11477
157	5.766204	22052	SAAB	Sedan	low	4	1	1	1	1	7052	7052
158	4.239455	31805	Cadillac	Convertible	high	2	1	0	1	1	16805	16805
159	9.521163	20156	Chevrolet	Hatchback	low	4	0	1	1	1	5156	5156
160	7.810611	18096	Pontiac	Wagon	low	4	1	1	0	1	3096	3096
161	7.726094	18562	Chevrolet	Sedan	moderate	4	1	1	1	1	3562	3562
162	6.845261	25212	Buick	Sedan	moderate	4	1	1	1	1	10212	10212
163	5.860639	21960	SAAB	Wagon	low	4	1	0	1	1	6960	6960
164	10.413938	29992	Chevrolet	Hatchback	low	4	1	0	1	1	14992	14992
165	6.891123	24469	Buick	Sedan	moderate	4	1	1	1	1	9469	9469
166	6.732169	27384	Chevrolet	Sedan	moderate	4	1	1	1	1	12384	12384
167	7.791391	21675	Chevrolet	Sedan	moderate	4	1	1	1	1	6675	6675
168	5.736077	18449	Cadillac	Sedan	moderate	4	1	1	1	1	3449	3449
169	9.323093	33962	Saturn	Sedan	low	4	0	0	0	1	18962	18962
170	7.004465	25240	Chevrolet	Coupe	moderate	2	1	1	1	1	10240	10240
171	7.062606	24665	Chevrolet	Coupe	moderate	2	1	1	0	1	9665	9665
172	10.758953	25216	Chevrolet	Sedan	low	4	0	0	0	1	10216	10216
173	5.108107	12090	SAAB	Convertible	low	2	1	1	1	0	-2910	0
174	7.751219	22383	Chevrolet	Sedan	moderate	4	1	1	1	1	7383	7383
175	6.512459	19148	Pontiac	Sedan	high	4	1	0	1	1	4148	4148

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Filter

	price	Mileage	Make	Type	Cylinder	Doors	Cruise	Sound	Leather	dummy	minus	new
166	6.732169	27384	Chevrolet	Sedan	moderate	4	1	1	1	1	12384	12384
167	7.791391	21675	Chevrolet	Sedan	moderate	4	1	1	1	1	6675	6675
168	5.736077	18449	Cadillac	Sedan	moderate	4	1	1	1	1	3449	3449
169	9.323093	33962	Saturn	Sedan	low	4	0	0	0	1	18962	18962
170	7.004465	25240	Chevrolet	Coupe	moderate	2	1	1	1	1	10240	10240
171	7.062606	24665	Chevrolet	Coupe	moderate	2	1	1	0	1	9665	9665
172	10.758953	25216	Chevrolet	Sedan	low	4	0	0	0	1	10216	10216
173	5.108107	12090	SAAB	Convertible	low	2	1	1	1	0	-2910	0
174	7.751219	22383	Chevrolet	Sedan	moderate	4	1	1	1	1	7383	7383
175	6.512459	19148	Pontiac	Sedan	high	4	1	0	1	1	4148	4148
176	7.293232	5827	Chevrolet	Coupe	moderate	2	1	0	0	0	-9173	0
177	8.987833	31199	Chevrolet	Sedan	low	4	1	1	1	1	16199	16199
178	8.822974	27560	Chevrolet	Sedan	low	4	1	1	1	1	12560	12560
179	4.625834	3625	Chevrolet	Convertible	high	2	1	1	1	0	-11375	0
180	5.697968	8017	SAAB	Sedan	low	4	1	0	1	0	-6983	0
181	7.048716	18419	Pontiac	Sedan	moderate	4	1	1	1	1	3419	3419
182	7.191012	27966	Pontiac	Sedan	moderate	4	1	0	1	1	12966	12966
183	7.051719	22891	Pontiac	Sedan	moderate	4	1	1	1	1	7891	7891
184	9.515136	24568	Chevrolet	Hatchback	low	4	1	0	1	1	9568	9568
185	7.818708	23491	Chevrolet	Coupe	moderate	2	1	1	0	1	8491	8491
186	8.132798	25979	Saturn	Sedan	moderate	4	1	1	0	1	10979	10979
187	6.826294	19467	Buick	Sedan	moderate	4	1	0	1	1	4467	4467
188	5.278129	23056	Cadillac	Sedan	moderate	4	1	1	1	1	8056	8056
189	5.683292	17673	SAAB	Wagon	low	4	1	1	1	1	2673	2673
190	4.506143	6685	Cadillac	Sedan	high	4	1	0	1	0	-8315	0
191	7.175299	25557	Pontiac	Sedan	moderate	4	1	0	1	1	10557	10557
192	4.907836	23861	Cadillac	Sedan	high	4	1	1	1	1	8861	8861
193	8.789213	21684	Chevrolet	Sedan	low	4	0	1	1	1	6684	6684
194	8.151922	22964	Buick	Sedan	moderate	4	1	1	0	1	7964	7964
195	10.177591	19183	Chevrolet	Sedan	low	4	0	0	0	1	4183	4183
196	7.074406	24323	Buick	Sedan	moderate	4	1	1	0	1	9323	9323
197	7.643812	24461	Chevrolet	Hatchback	moderate	4	0	1	1	1	9461	9461
198	3.955533	18200	Cadillac	Convertible	high	2	1	1	1	1	3200	3200
199	4.762719	21367	Cadillac	Sedan	high	4	1	1	1	1	6367	6367
200	5.252608	26250	Cadillac	Sedan	high	4	1	1	1	1	11250	11250

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