HW6_Madhu

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```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.0.5     v dplyr   1.0.5
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1

## Warning: package 'dplyr' was built under R version 4.0.4

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(MASS)
```

```
##
## Attaching package: 'MASS'

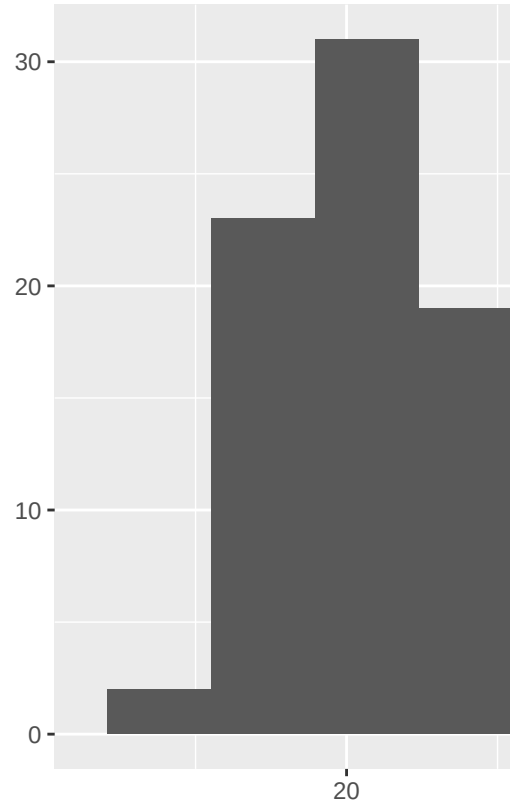
## The following object is masked from 'package:dplyr':
##
##     select
```

Problem Part 1

1.Manipulating data frames

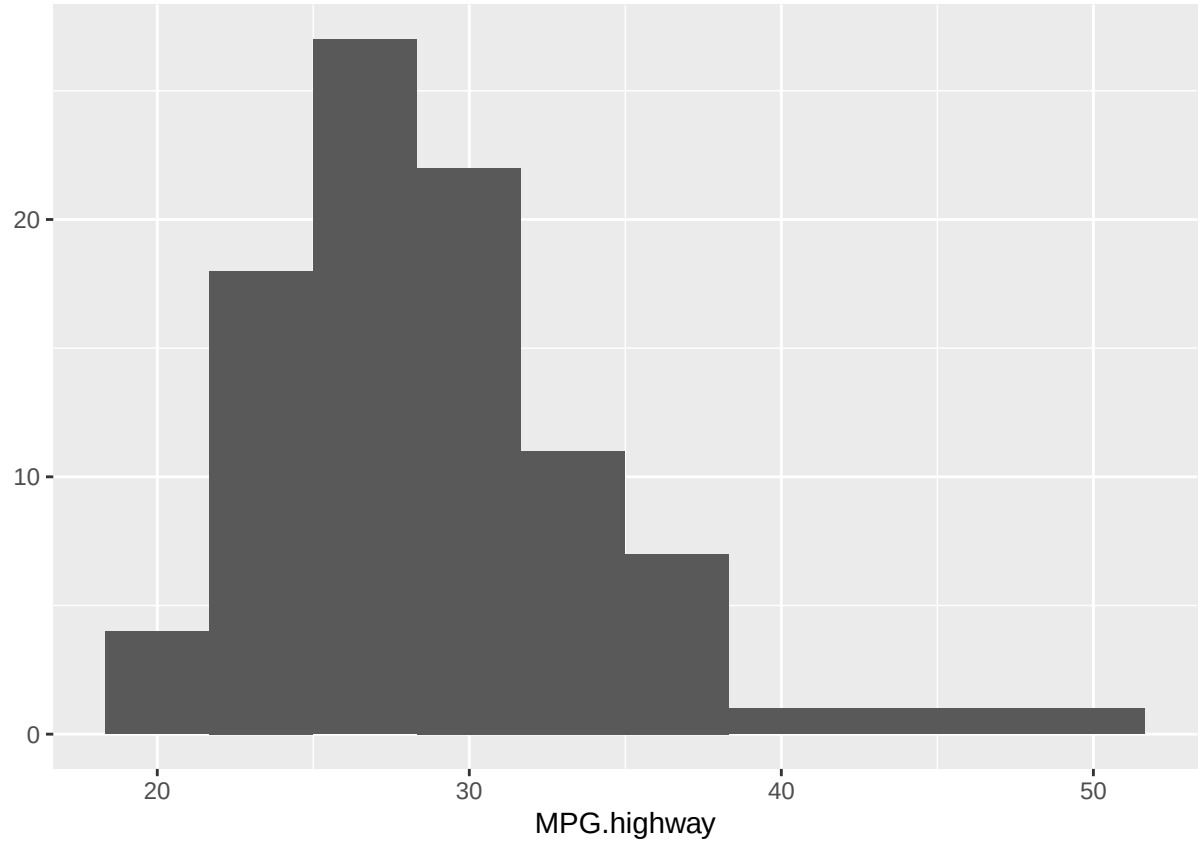
There are certain situations where we want to transform right-skewed data before analysing it. Taking the log of right-skewed data often helps to make it more normally distributed.

```
qplot(MPG.city, data = Cars93, bins = 10)
```



Here are histograms of the MPG.highway and MPG.city variables.

```
qplot(MPG.highway, data = Cars93, bins = 10)
```



(a) Do the city and highway gas-mileage figures appear to have right-skewed distributions?

Answer: Yes,the city and highway gas-mileage figures appear to have right-skewed distributions.We can see the mean is greater than the median as per the histogram because there are some large values on the right side which increases the mean but do not affect the median. The left side of the histogram is longer than the right side.

(b) Use the mutate() and log() functions to create a new data frame called Cars93.log that has MPG.highway and MPG.city replaced with log(MPG.highway) and log(MPG.city), respectively.

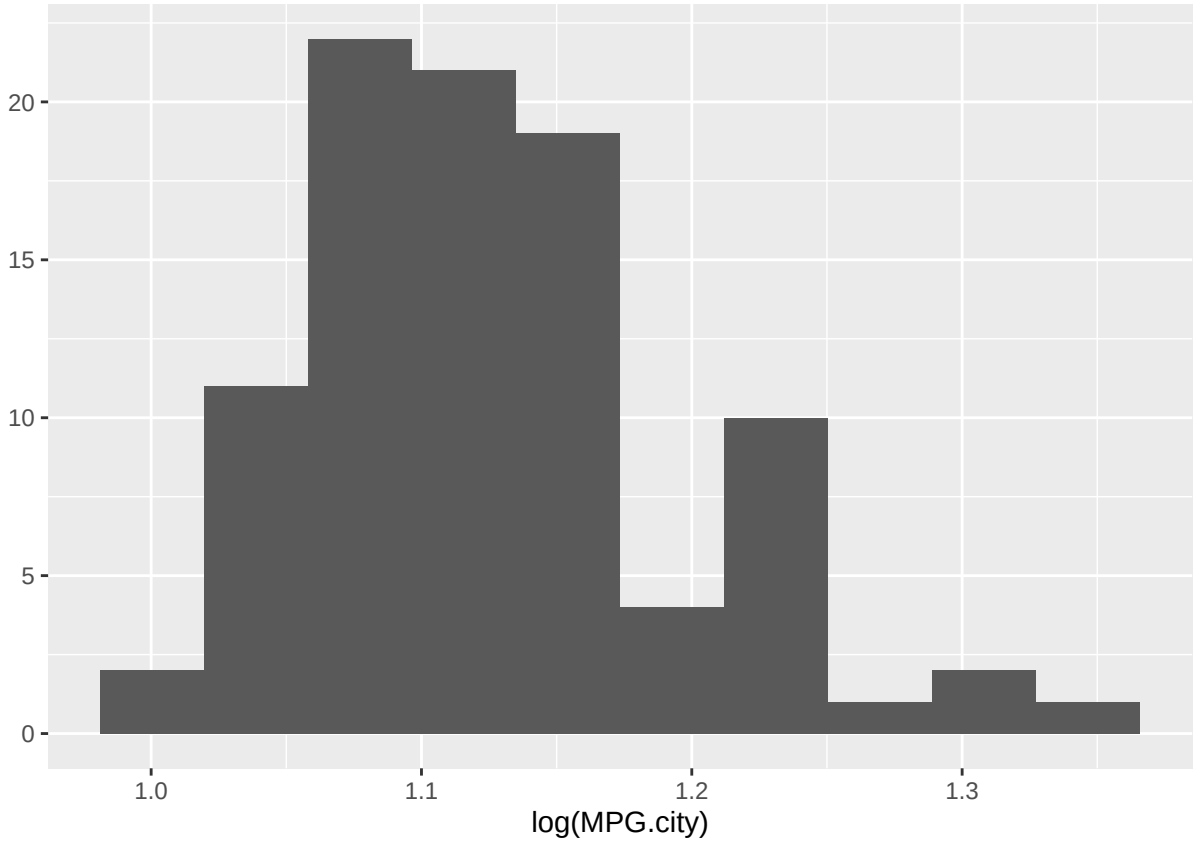
```
library(dplyr)

Cars93.log=mutate(Cars93,MPG.highway=log(MPG.highway),MPG.city=log(MPG.city))
```

Answer:

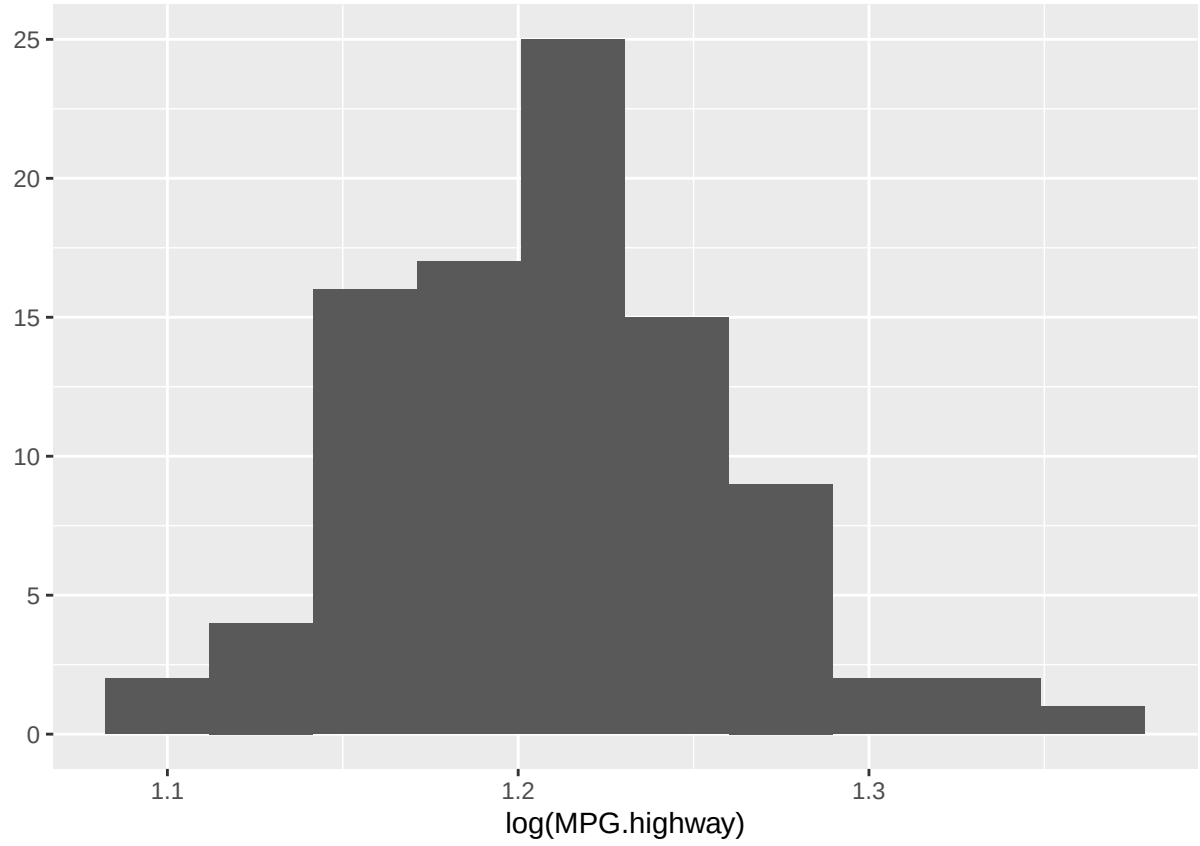
(c) Run the histogram plotting commands again, this time using your new Cars93.log dataset instead of Cars93.

```
qplot(log(MPG.city), data = Cars93.log, bins = 10)
```



Answer:

```
qplot(log(MPG.highway), data = Cars93.log, bins = 10)
```



(d) Do the distributions appear less skewed than before?

Answer: mutate() function is used to change and create variables. After using the log function the distributions appear less skewed than before. log() is used to calculate natural logarithmic and to give a normal pattern to the data when data is skewed.

2. Table function

(a) Use the table() function to tabulate the data by DriveTrain and Origin.

Answer:

```
table( Cars93$Origin, Cars93$DriveTrain )
```

```
##
##            4WD Front Rear
##   USA        5    34    9
##   non-USA    5    33    7
```

(b) Repeat part (a), this time using the count() function

```
count(Cars93, Cars93$Origin, Cars93$DriveTrain )
```

Answer:

```
##   Cars93$Origin Cars93$DriveTrain  n
## 1           USA               4WD  5
## 2           USA             Front 34
## 3           USA              Rear  9
## 4       non-USA               4WD  5
## 5       non-USA             Front 33
## 6       non-USA              Rear  7
```

(c) Does it looks like foreign car manufacturers had different Drivetrain preferences compared to US manufacturers?

Answer: The above table shows the almost same count of DriveTrain preferences for the both foreign car manufactures and US manufacturers.

3. Functions, lists, and if-else practice

(a) Write a function called isPassingGrade whose input x is a number, and which returns FALSE if x is lower than 50 and TRUE otherwise.

```
isPassingGrade <- function(x){
  if (x<50)
  {
    Result <- "FALSE"
  }
  else
  {
    Result <- "TRUE"
  }
  return(Result)

}

isPassingGrade(70)
```

Answer:

```
## [1] "TRUE"
```

```
isPassingGrade(30)
```

```
## [1] "FALSE"
```

(b) Write a function called sendMessage whose input x is a number, and which prints Congratulations if isPassingGrade(x) is TRUE and prints Oh no! if isPassingGrade(x) is FALSE.

```
sendMessage <- function(x){
  if (isPassingGrade(x)=="TRUE")
  {
    return("Congratulations")
  }
  else
  {
    return("Oh no!")
  }
}

sendMessage(70)
```

Answer:

```
## [1] "Congratulations"
```

```
sendMessage(30)
```

```
## [1] "Oh no!"
```

(c) Write a function called gradeSummary whose input x is a number. Your function will return a list with two elements, named letter.grade and passed. The letter grade will be "A" if x is at least 90. The letter grade will be "B" if x is between 80 and 90. The letter grade will be "F" if x is lower than "80". If the student's letter grade is an A or B, passed should be TRUE; passed should be FALSE otherwise.

```
gradeSummary <- function(x){


  if(x>=90)
  {
    letter.grade <- "A"
    passed <- "TRUE"
  }
  else if (x>=80)
  {
    letter.grade <- "B"
    passed <- "TRUE"
  }
  else
  {
    letter.grade <- "F"
```

```
    passed <- "FALSE"
  }

  summary.list <- list (letter.grade=letter.grade,passed=passed)
  return(summary.list)
}

gradeSummary(85)
```

Answer:

```
## $letter.grade
## [1] "B"
##
## $passed
## [1] "TRUE"
```

```
gradeSummary(93)
```

```
## $letter.grade
## [1] "A"
##
## $passed
## [1] "TRUE"
```

```
gradeSummary(77)
```

```
## $letter.grade
## [1] "F"
##
## $passed
## [1] "FALSE"
```

Problems, part 2

1. Loop practice

(a) Write a function called calculateRowMeans that uses a for loop to calculate the row means of a matrix x.

```
calculateRowMeans <- function(x) {
  row.means <- numeric(nrow(x))
  for(i in 1:nrow(x)) {
    row.means[i] <- mean(x[i,])
  }
  row.means
}
```

Answer: Method 1:

```
calculateRowMeans1 <- function(x)
 {
  sum <- c(rep(0,nrow(x)))
  mean <- c(rep(0,nrow(x)))
  for (i in 1:nrow(x))
  {

    for(j in 1:ncol(x))
    {
      sum[i] <- sum[i] + x[i,j]

    }

  mean[i]=sum[i]/ncol(x)
  }
  return(mean)
}
```

Method 2:

(b) Try out your function on the random matrix fake.data defined below.

```
set.seed(12345) # Set seed of random number generator
fake.data <- matrix(runif(800), nrow=25)
calculateRowMeans(fake.data)
```

Answer:

```
##  [1] 0.5339087 0.6259388 0.4966049 0.5399315 0.5049318 0.5633372 0.4686503
##  [8] 0.4196579 0.5273801 0.4639143 0.5472661 0.5043049 0.6169601 0.4690874
## [15] 0.4920191 0.5841288 0.6108891 0.4879246 0.5401770 0.5223512 0.5086669
## [22] 0.4643891 0.5250635 0.4791480 0.5795024
```

(c) Use the apply() function to calculate the row means of the matrix fake.data

```
apply(fake.data, MARGIN=1, FUN=mean)
```

Answer:

```
##  [1] 0.5339087 0.6259388 0.4966049 0.5399315 0.5049318 0.5633372 0.4686503
##  [8] 0.4196579 0.5273801 0.4639143 0.5472661 0.5043049 0.6169601 0.4690874
## [15] 0.4920191 0.5841288 0.6108891 0.4879246 0.5401770 0.5223512 0.5086669
## [22] 0.4643891 0.5250635 0.4791480 0.5795024
```

(d) Compare this to the output of the rowMeans() function to check that your calculation is correct.

```
identical(calculateRowMeans(fake.data), apply(fake.data, MARGIN=1, FUN=mean))
```

Answer:

```
## [1] TRUE
```

2. summarize() practice

(a) Use group_by() and summarize() commands on the Cars93 data set to create a table showing the average Turn.circle of cars, broken down by vehicle Type and DriveTrain

```
Cars93 %>%
  group_by(Type, DriveTrain) %>%
  summarize(average = mean(Turn.circle))
```

Answer:

```
## `summarise()` has grouped output by 'Type'. You can override using the `.groups` argument.
```

```
## # A tibble: 14 x 3
## # Groups:   Type [6]
##    Type    DriveTrain average
##    <fct>   <fct>        <dbl>
##  1 Compact 4WD           37
##  2 Compact Front         38.8
##  3 Compact Rear          35.5
##  4 Large   Front         42
##  5 Large   Rear          43.8
##  6 Midsize Front         40.5
##  7 Midsize Rear          39
##  8 Small   4WD           33.5
##  9 Small   Front         35.3
## 10 Sporty  4WD           39.5
## 11 Sporty  Front         37
## 12 Sporty  Rear          41.2
## 13 Van     4WD           41.8
## 14 Van     Front         41.8
```

(b) Are all combinations of Type and DriveTrain shown in the table? If not, which ones are missing? Why are they missing?

```
sum(Cars93$Type == "Van" & Cars93$DriveTrain == "Rear")
```

Answer: Not all combinations of type and driveTrain are shown in the table. Large type of cars are not shown with 4WD drive train. Van and small type of vehicles are not shown with rear driveTrain. Because there are no vehicles with this type.

```
## [1] 0
```

```
sum(Cars93$Type == "Large" & Cars93$DriveTrain == "4WD")
```

```
## [1] 0
```

```
sum(Cars93$Type == "small" & Cars93$DriveTrain == "Rear")
```

```
## [1] 0
```

(c) Having a car with a small turn radius makes city driving much easier. What Type of car should city drivers opt for?

Answer: A car with a small turn radius makes city driving easier so small type of car should city drivers opt for.

(d) Does the vehicle's DriveTrain appear to have an impact on turn radius?

Answer: There are no consistent relation between vehicles DriveTrain and turn radius.

3. map() and _at() practice

(a) The nlevels command tells you the number of levels in a factor variable. Use this function in combination with summarize_if() to produce an integer vector showing the number of levels for each factor variables in the Cars93 data.

```
Cars93 %>%
  summarize_if(is.factor, nlevels)
```

Answer:

```
##   Manufacturer Model Type AirBags DriveTrain Cylinders Man.trans.avail Origin
## 1           32    93    6       3          3         6               2      2
##   Make
## 1   93
```

(b) levels() returns the possible levels of a factor variable. Use this function in combination with select and map to create a list of all the levels of the Manufacturer, AirBags, DriveTrain, and Man.trans.avail variables.

```
Cars93 %>%
  dplyr::select(Manufacturer, AirBags, DriveTrain, Man.trans.avail) %>%
  map(levels)
```

Answer:

```
## $Manufacturer
##  [1] "Acura"         "Audi"          "BMW"           "Buick"
##  [5] "Cadillac"      "Chevrolet"     "Chrylser"      "Chrysler"
##  [9] "Dodge"         "Eagle"         "Ford"          "Geo"
## [13] "Honda"         "Hyundai"       "Infiniti"      "Lexus"
## [17] "Lincoln"       "Mazda"         "Mercedes-Benz" "Mercury"
## [21] "Mitsubishi"    "Nissan"        "Oldsmobile"    "Plymouth"
## [25] "Pontiac"       "Saab"          "Saturn"        "Subaru"
## [29] "Suzuki"        "Toyota"        "Volkswagen"    "Volvo"
##
## $AirBags
## [1] "Driver & Passenger" "Driver only"        "None"
##
## $DriveTrain
## [1] "4WD"   "Front" "Rear"
##
## $Man.trans.avail
## [1] "No"  "Yes"
```

(c) Use the toupper() command in combination with mutate_if() to produce a new version of Cars93 where every factor variable has been converted to upper case.

```
Cars93 %>%
  mutate_if(is.factor, toupper)
```

Answer:

```
##     Manufacturer          Model    Type Min.Price Price Max.Price MPG.city
## 1          ACURA        INTEGRA   SMALL      12.9  15.9      18.8       25
## 2          ACURA         LEGEND MIDSIZE      29.2  33.9      38.7       18
## 3           AUDI            90 COMPACT      25.9  29.1      32.3       20
## 4           AUDI           100 MIDSIZE      30.8  37.7      44.6       19
## 5            BMW          535I MIDSIZE      23.7  30.0      36.2       22
## 6          BUICK       CENTURY MIDSIZE      14.2  15.7      17.3       22
## 7          BUICK       LESABRE   LARGE      19.9  20.8      21.7       19
## 8          BUICK     ROADMASTER   LARGE      22.6  23.7      24.9       16
## 9          BUICK        RIVIERA MIDSIZE      26.3  26.3      26.3       19
```

```
## 10      CADILLAC        DEVILLE   LARGE      33.0  34.7      36.3       16
## 11      CADILLAC        SEVILLE MIDSIZE      37.5  40.1      42.7       16
## 12     CHEVROLET       CAVALIER COMPACT       8.5  13.4      18.3       25
## 13     CHEVROLET        CORSICA COMPACT      11.4  11.4      11.4       25
## 14     CHEVROLET         CAMARO  SPORTY      13.4  15.1      16.8       19
## 15     CHEVROLET         LUMINA MIDSIZE      13.4  15.9      18.4       21
## 16     CHEVROLET     LUMINA_APV     VAN      14.7  16.3      18.0       18
## 17     CHEVROLET          ASTRO     VAN      14.7  16.6      18.6       15
## 18     CHEVROLET        CAPRICE   LARGE      18.0  18.8      19.6       17
## 19     CHEVROLET       CORVETTE  SPORTY      34.6  38.0      41.5       17
## 20      CHRYLSER       CONCORDE   LARGE      18.4  18.4      18.4       20
## 21      CHRYSLER        LEBARON COMPACT      14.5  15.8      17.1       23
## 22      CHRYSLER       IMPERIAL   LARGE      29.5  29.5      29.5       20
## 23         DODGE           COLT   SMALL       7.9   9.2      10.6       29
## 24         DODGE         SHADOW   SMALL       8.4  11.3      14.2       23
## 25         DODGE         SPIRIT COMPACT      11.9  13.3      14.7       22
## 26         DODGE        CARAVAN     VAN      13.6  19.0      24.4       17
## 27         DODGE        DYNASTY MIDSIZE      14.8  15.6      16.4       21
## 28         DODGE        STEALTH  SPORTY      18.5  25.8      33.1       18
## 29         EAGLE         SUMMIT   SMALL       7.9  12.2      16.5       29
## 30         EAGLE         VISION   LARGE      17.5  19.3      21.2       20
## 31          FORD        FESTIVA   SMALL       6.9   7.4       7.9       31
## 32          FORD         ESCORT   SMALL       8.4  10.1      11.9       23
## 33          FORD          TEMPO COMPACT      10.4  11.3      12.2       22
## 34          FORD       MUSTANG  SPORTY      10.8  15.9      21.0       22
## 35          FORD          PROBE  SPORTY      12.8  14.0      15.2       24
## 36          FORD       AEROSTAR     VAN      14.5  19.9      25.3       15
## 37          FORD         TAURUS MIDSIZE      15.6  20.2      24.8       21
## 38          FORD CROWN_VICTORIA   LARGE      20.1  20.9      21.7       18
## 39           GEO          METRO   SMALL       6.7   8.4      10.0       46
## 40           GEO          STORM  SPORTY      11.5  12.5      13.5       30
## 41         HONDA        PRELUDE  SPORTY      17.0  19.8      22.7       24
## 42         HONDA          CIVIC   SMALL       8.4  12.1      15.8       42
## 43         HONDA         ACCORD COMPACT      13.8  17.5      21.2       24
## 44       HYUNDAI          EXCEL   SMALL       6.8   8.0       9.2       29
## 45       HYUNDAI        ELANTRA   SMALL       9.0  10.0      11.0       22
## 46       HYUNDAI         SCOUPE  SPORTY       9.1  10.0      11.0       26
## 47       HYUNDAI         SONATA MIDSIZE      12.4  13.9      15.3       20
## 48      INFINITI            Q45 MIDSIZE      45.4  47.9      50.4       17
## 49         LEXUS          ES300 MIDSIZE      27.5  28.0      28.4       18
## 50         LEXUS          SC300 MIDSIZE      34.7  35.2      35.6       18
## 51       LINCOLN    CONTINENTAL MIDSIZE      33.3  34.3      35.3       17
## 52       LINCOLN       TOWN_CAR   LARGE      34.4  36.1      37.8       18
## 53         MAZDA            323   SMALL       7.4   8.3       9.1       29
## 54         MAZDA        PROTEGE   SMALL      10.9  11.6      12.3       28
## 55         MAZDA            626 COMPACT      14.3  16.5      18.7       26
## 56         MAZDA            MPV     VAN      16.6  19.1      21.7       18
## 57         MAZDA          RX-7  SPORTY      32.5  32.5      32.5       17
## 58 MERCEDES-BENZ          190E COMPACT      29.0  31.9      34.9       20
## 59 MERCEDES-BENZ          300E MIDSIZE      43.8  61.9      80.0       19
## 60       MERCURY         CAPRI  SPORTY      13.3  14.1      15.0       23
## 61       MERCURY        COUGAR MIDSIZE      14.9  14.9      14.9       19
## 62    MITSUBISHI        MIRAGE   SMALL       7.7  10.3      12.9       29
## 63    MITSUBISHI       DIAMANTE MIDSIZE      22.4  26.1      29.9       18
```

```
## 64        NISSAN         SENTRA   SMALL       8.7  11.8      14.9       29
## 65        NISSAN         ALTIMA COMPACT      13.0  15.7      18.3       24
## 66        NISSAN          QUEST     VAN      16.7  19.1      21.5       17
## 67        NISSAN         MAXIMA MIDSIZE      21.0  21.5      22.0       21
## 68    OLDSMOBILE        ACHIEVA COMPACT      13.0  13.5      14.0       24
## 69    OLDSMOBILE CUTLASS_CIERA MIDSIZE      14.2  16.3      18.4       23
## 70    OLDSMOBILE     SILHOUETTE     VAN      19.5  19.5      19.5       18
## 71    OLDSMOBILE   EIGHTY-EIGHT   LARGE      19.5  20.7      21.9       19
## 72      PLYMOUTH          LASER  SPORTY      11.4  14.4      17.4       23
## 73       PONTIAC         LEMANS   SMALL       8.2   9.0       9.9       31
## 74       PONTIAC        SUNBIRD COMPACT       9.4  11.1      12.8       23
## 75       PONTIAC       FIREBIRD  SPORTY      14.0  17.7      21.4       19
## 76       PONTIAC     GRAND_PRIX MIDSIZE      15.4  18.5      21.6       19
## 77       PONTIAC     BONNEVILLE   LARGE      19.4  24.4      29.4       19
## 78          SAAB            900 COMPACT      20.3  28.7      37.1       20
## 79        SATURN             SL   SMALL       9.2  11.1      12.9       28
## 80        SUBARU          JUSTY   SMALL       7.3   8.4       9.5       33
## 81        SUBARU         LOYALE   SMALL      10.5  10.9      11.3       25
## 82        SUBARU         LEGACY COMPACT      16.3  19.5      22.7       23
## 83        SUZUKI          SWIFT   SMALL       7.3   8.6      10.0       39
## 84        TOYOTA         TERCEL   SMALL       7.8   9.8      11.8       32
## 85        TOYOTA         CELICA  SPORTY      14.2  18.4      22.6       25
## 86        TOYOTA          CAMRY MIDSIZE      15.2  18.2      21.2       22
## 87        TOYOTA         PREVIA     VAN      18.9  22.7      26.6       18
## 88    VOLKSWAGEN            FOX   SMALL       8.7   9.1       9.5       25
## 89    VOLKSWAGEN        EUROVAN     VAN      16.6  19.7      22.7       17
## 90    VOLKSWAGEN         PASSAT COMPACT      17.6  20.0      22.4       21
## 91    VOLKSWAGEN        CORRADO  SPORTY      22.9  23.3      23.7       18
## 92         VOLVO            240 COMPACT      21.8  22.7      23.5       21
## 93         VOLVO            850 MIDSIZE      24.8  26.7      28.5       20
##    MPG.highway            AirBags DriveTrain Cylinders EngineSize Horsepower
## 1           31               NONE      FRONT         4        1.8        140
## 2           25 DRIVER & PASSENGER      FRONT         6        3.2        200
## 3           26        DRIVER ONLY      FRONT         6        2.8        172
## 4           26 DRIVER & PASSENGER      FRONT         6        2.8        172
## 5           30        DRIVER ONLY       REAR         4        3.5        208
## 6           31        DRIVER ONLY      FRONT         4        2.2        110
## 7           28        DRIVER ONLY      FRONT         6        3.8        170
## 8           25        DRIVER ONLY       REAR         6        5.7        180
## 9           27        DRIVER ONLY      FRONT         6        3.8        170
## 10          25        DRIVER ONLY      FRONT         8        4.9        200
## 11          25 DRIVER & PASSENGER      FRONT         8        4.6        295
## 12          36               NONE      FRONT         4        2.2        110
## 13          34        DRIVER ONLY      FRONT         4        2.2        110
## 14          28 DRIVER & PASSENGER       REAR         6        3.4        160
## 15          29               NONE      FRONT         4        2.2        110
## 16          23               NONE      FRONT         6        3.8        170
## 17          20               NONE        4WD         6        4.3        165
## 18          26        DRIVER ONLY       REAR         8        5.0        170
## 19          25        DRIVER ONLY       REAR         8        5.7        300
## 20          28 DRIVER & PASSENGER      FRONT         6        3.3        153
## 21          28 DRIVER & PASSENGER      FRONT         4        3.0        141
## 22          26        DRIVER ONLY      FRONT         6        3.3        147
## 23          33               NONE      FRONT         4        1.5         92
```

```
## 24          29         DRIVER ONLY      FRONT         4        2.2         93
## 25          27         DRIVER ONLY      FRONT         4        2.5        100
## 26          21         DRIVER ONLY        4WD         6        3.0        142
## 27          27         DRIVER ONLY      FRONT         4        2.5        100
## 28          24         DRIVER ONLY        4WD         6        3.0        300
## 29          33                NONE      FRONT         4        1.5         92
## 30          28 DRIVER & PASSENGER      FRONT         6        3.5        214
## 31          33                NONE      FRONT         4        1.3         63
## 32          30                NONE      FRONT         4        1.8        127
## 33          27                NONE      FRONT         4        2.3         96
## 34          29         DRIVER ONLY       REAR         4        2.3        105
## 35          30         DRIVER ONLY      FRONT         4        2.0        115
## 36          20         DRIVER ONLY        4WD         6        3.0        145
## 37          30         DRIVER ONLY      FRONT         6        3.0        140
## 38          26         DRIVER ONLY       REAR         8        4.6        190
## 39          50                NONE      FRONT         3        1.0         55
## 40          36         DRIVER ONLY      FRONT         4        1.6         90
## 41          31 DRIVER & PASSENGER      FRONT         4        2.3        160
## 42          46         DRIVER ONLY      FRONT         4        1.5        102
## 43          31 DRIVER & PASSENGER      FRONT         4        2.2        140
## 44          33                NONE      FRONT         4        1.5         81
## 45          29                NONE      FRONT         4        1.8        124
## 46          34                NONE      FRONT         4        1.5         92
## 47          27                NONE      FRONT         4        2.0        128
## 48          22         DRIVER ONLY       REAR         8        4.5        278
## 49          24         DRIVER ONLY      FRONT         6        3.0        185
## 50          23 DRIVER & PASSENGER       REAR         6        3.0        225
## 51          26 DRIVER & PASSENGER      FRONT         6        3.8        160
## 52          26 DRIVER & PASSENGER       REAR         8        4.6        210
## 53          37                NONE      FRONT         4        1.6         82
## 54          36                NONE      FRONT         4        1.8        103
## 55          34         DRIVER ONLY      FRONT         4        2.5        164
## 56          24                NONE        4WD         6        3.0        155
## 57          25         DRIVER ONLY       REAR    ROTARY        1.3        255
## 58          29         DRIVER ONLY       REAR         4        2.3        130
## 59          25 DRIVER & PASSENGER       REAR         6        3.2        217
## 60          26         DRIVER ONLY      FRONT         4        1.6        100
## 61          26                NONE       REAR         6        3.8        140
## 62          33                NONE      FRONT         4        1.5         92
## 63          24         DRIVER ONLY      FRONT         6        3.0        202
## 64          33         DRIVER ONLY      FRONT         4        1.6        110
## 65          30         DRIVER ONLY      FRONT         4        2.4        150
## 66          23                NONE      FRONT         6        3.0        151
## 67          26         DRIVER ONLY      FRONT         6        3.0        160
## 68          31                NONE      FRONT         4        2.3        155
## 69          31         DRIVER ONLY      FRONT         4        2.2        110
## 70          23                NONE      FRONT         6        3.8        170
## 71          28         DRIVER ONLY      FRONT         6        3.8        170
## 72          30                NONE        4WD         4        1.8         92
## 73          41                NONE      FRONT         4        1.6         74
## 74          31                NONE      FRONT         4        2.0        110
## 75          28 DRIVER & PASSENGER       REAR         6        3.4        160
## 76          27                NONE      FRONT         6        3.4        200
## 77          28 DRIVER & PASSENGER      FRONT         6        3.8        170
```

```
## 78          26        DRIVER ONLY      FRONT         4        2.1        140
## 79          38        DRIVER ONLY      FRONT         4        1.9         85
## 80          37               NONE        4WD         3        1.2         73
## 81          30               NONE        4WD         4        1.8         90
## 82          30        DRIVER ONLY        4WD         4        2.2        130
## 83          43               NONE      FRONT         3        1.3         70
## 84          37        DRIVER ONLY      FRONT         4        1.5         82
## 85          32        DRIVER ONLY      FRONT         4        2.2        135
## 86          29        DRIVER ONLY      FRONT         4        2.2        130
## 87          22        DRIVER ONLY        4WD         4        2.4        138
## 88          33               NONE      FRONT         4        1.8         81
## 89          21               NONE      FRONT         5        2.5        109
## 90          30               NONE      FRONT         4        2.0        134
## 91          25               NONE      FRONT         6        2.8        178
## 92          28        DRIVER ONLY       REAR         4        2.3        114
## 93          28 DRIVER & PASSENGER      FRONT         5        2.4        168
##     RPM Rev.per.mile Man.trans.avail Fuel.tank.capacity Passengers Length
## 1  6300         2890             YES                13.2          5    177
## 2  5500         2335             YES                18.0          5    195
## 3  5500         2280             YES                16.9          5    180
## 4  5500         2535             YES                21.1          6    193
## 5  5700         2545             YES                21.1          4    186
## 6  5200         2565              NO                16.4          6    189
## 7  4800         1570              NO                18.0          6    200
## 8  4000         1320              NO                23.0          6    216
## 9  4800         1690              NO                18.8          5    198
## 10 4100         1510              NO                18.0          6    206
## 11 6000         1985              NO                20.0          5    204
## 12 5200         2380             YES                15.2          5    182
## 13 5200         2665             YES                15.6          5    184
## 14 4600         1805             YES                15.5          4    193
## 15 5200         2595              NO                16.5          6    198
## 16 4800         1690              NO                20.0          7    178
## 17 4000         1790              NO                27.0          8    194
## 18 4200         1350              NO                23.0          6    214
## 19 5000         1450             YES                20.0          2    179
## 20 5300         1990              NO                18.0          6    203
## 21 5000         2090              NO                16.0          6    183
## 22 4800         1785              NO                16.0          6    203
## 23 6000         3285             YES                13.2          5    174
## 24 4800         2595             YES                14.0          5    172
## 25 4800         2535             YES                16.0          6    181
## 26 5000         1970              NO                20.0          7    175
## 27 4800         2465              NO                16.0          6    192
## 28 6000         2120             YES                19.8          4    180
## 29 6000         2505             YES                13.2          5    174
## 30 5800         1980              NO                18.0          6    202
## 31 5000         3150             YES                10.0          4    141
## 32 6500         2410             YES                13.2          5    171
## 33 4200         2805             YES                15.9          5    177
## 34 4600         2285             YES                15.4          4    180
## 35 5500         2340             YES                15.5          4    179
## 36 4800         2080             YES                21.0          7    176
## 37 4800         1885              NO                16.0          5    192
```

```
## 38 4200         1415          NO          20.0         6    212
## 39 5700         3755         YES          10.6         4    151
## 40 5400         3250         YES          12.4         4    164
## 41 5800         2855         YES          15.9         4    175
## 42 5900         2650         YES          11.9         4    173
## 43 5600         2610         YES          17.0         4    185
## 44 5500         2710         YES          11.9         5    168
## 45 6000         2745         YES          13.7         5    172
## 46 5550         2540         YES          11.9         4    166
## 47 6000         2335         YES          17.2         5    184
## 48 6000         1955          NO          22.5         5    200
## 49 5200         2325         YES          18.5         5    188
## 50 6000         2510         YES          20.6         4    191
## 51 4400         1835          NO          18.4         6    205
## 52 4600         1840          NO          20.0         6    219
## 53 5000         2370         YES          13.2         4    164
## 54 5500         2220         YES          14.5         5    172
## 55 5600         2505         YES          15.5         5    184
## 56 5000         2240          NO          19.6         7    190
## 57 6500         2325         YES          20.0         2    169
## 58 5100         2425         YES          14.5         5    175
## 59 5500         2220          NO          18.5         5    187
## 60 5750         2475         YES          11.1         4    166
## 61 3800         1730          NO          18.0         5    199
## 62 6000         2505         YES          13.2         5    172
## 63 6000         2210          NO          19.0         5    190
## 64 6000         2435         YES          13.2         5    170
## 65 5600         2130         YES          15.9         5    181
## 66 4800         2065          NO          20.0         7    190
## 67 5200         2045          NO          18.5         5    188
## 68 6000         2380          NO          15.2         5    188
## 69 5200         2565          NO          16.5         5    190
## 70 4800         1690          NO          20.0         7    194
## 71 4800         1570          NO          18.0         6    201
## 72 5000         2360         YES          15.9         4    173
## 73 5600         3130         YES          13.2         4    177
## 74 5200         2665         YES          15.2         5    181
## 75 4600         1805         YES          15.5         4    196
## 76 5000         1890         YES          16.5         5    195
## 77 4800         1565          NO          18.0         6    177
## 78 6000         2910         YES          18.0         5    184
## 79 5000         2145         YES          12.8         5    176
## 80 5600         2875         YES           9.2         4    146
## 81 5200         3375         YES          15.9         5    175
## 82 5600         2330         YES          15.9         5    179
## 83 6000         3360         YES          10.6         4    161
## 84 5200         3505         YES          11.9         5    162
## 85 5400         2405         YES          15.9         4    174
## 86 5400         2340         YES          18.5         5    188
## 87 5000         2515         YES          19.8         7    187
## 88 5500         2550         YES          12.4         4    163
## 89 4500         2915         YES          21.1         7    187
## 90 5800         2685         YES          18.5         5    180
## 91 5800         2385         YES          18.5         4    159
```

```
## 92 5400         2215             YES              15.8          5    190
## 93 6200         2310             YES              19.3          5    184
##    Wheelbase Width Turn.circle Rear.seat.room Luggage.room Weight  Origin
## 1        102    68          37           26.5           11   2705 NON-USA
## 2        115    71          38           30.0           15   3560 NON-USA
## 3        102    67          37           28.0           14   3375 NON-USA
## 4        106    70          37           31.0           17   3405 NON-USA
## 5        109    69          39           27.0           13   3640 NON-USA
## 6        105    69          41           28.0           16   2880     USA
## 7        111    74          42           30.5           17   3470     USA
## 8        116    78          45           30.5           21   4105     USA
## 9        108    73          41           26.5           14   3495     USA
## 10       114    73          43           35.0           18   3620     USA
## 11       111    74          44           31.0           14   3935     USA
## 12       101    66          38           25.0           13   2490     USA
## 13       103    68          39           26.0           14   2785     USA
## 14       101    74          43           25.0           13   3240     USA
## 15       108    71          40           28.5           16   3195     USA
## 16       110    74          44           30.5           NA   3715     USA
## 17       111    78          42           33.5           NA   4025     USA
## 18       116    77          42           29.5           20   3910     USA
## 19        96    74          43             NA           NA   3380     USA
## 20       113    74          40           31.0           15   3515     USA
## 21       104    68          41           30.5           14   3085     USA
## 22       110    69          44           36.0           17   3570     USA
## 23        98    66          32           26.5           11   2270     USA
## 24        97    67          38           26.5           13   2670     USA
## 25       104    68          39           30.5           14   2970     USA
## 26       112    72          42           26.5           NA   3705     USA
## 27       105    69          42           30.5           16   3080     USA
## 28        97    72          40           20.0           11   3805     USA
## 29        98    66          36           26.5           11   2295     USA
## 30       113    74          40           30.0           15   3490     USA
## 31        90    63          33           26.0           12   1845     USA
## 32        98    67          36           28.0           12   2530     USA
## 33       100    68          39           27.5           13   2690     USA
## 34       101    68          40           24.0           12   2850     USA
## 35       103    70          38           23.0           18   2710     USA
## 36       119    72          45           30.0           NA   3735     USA
## 37       106    71          40           27.5           18   3325     USA
## 38       114    78          43           30.0           21   3950     USA
## 39        93    63          34           27.5           10   1695 NON-USA
## 40        97    67          37           24.5           11   2475 NON-USA
## 41       100    70          39           23.5            8   2865 NON-USA
## 42       103    67          36           28.0           12   2350 NON-USA
## 43       107    67          41           28.0           14   3040 NON-USA
## 44        94    63          35           26.0           11   2345 NON-USA
## 45        98    66          36           28.0           12   2620 NON-USA
## 46        94    64          34           23.5            9   2285 NON-USA
## 47       104    69          41           31.0           14   2885 NON-USA
## 48       113    72          42           29.0           15   4000 NON-USA
## 49       103    70          40           27.5           14   3510 NON-USA
## 50       106    71          39           25.0            9   3515 NON-USA
## 51       109    73          42           30.0           19   3695     USA
```

```
## 52       117    77          45          31.5          22   4055     USA
## 53        97    66          34          27.0          16   2325 NON-USA
## 54        98    66          36          26.5          13   2440 NON-USA
## 55       103    69          40          29.5          14   2970 NON-USA
## 56       110    72          39          27.5          NA   3735 NON-USA
## 57        96    69          37            NA          NA   2895 NON-USA
## 58       105    67          34          26.0          12   2920 NON-USA
## 59       110    69          37          27.0          15   3525 NON-USA
## 60        95    65          36          19.0           6   2450     USA
## 61       113    73          38          28.0          15   3610     USA
## 62        98    67          36          26.0          11   2295 NON-USA
## 63       107    70          43          27.5          14   3730 NON-USA
## 64        96    66          33          26.0          12   2545 NON-USA
## 65       103    67          40          28.5          14   3050 NON-USA
## 66       112    74          41          27.0          NA   4100 NON-USA
## 67       104    69          41          28.5          14   3200 NON-USA
## 68       103    67          39          28.0          14   2910     USA
## 69       105    70          42          28.0          16   2890     USA
## 70       110    74          44          30.5          NA   3715     USA
## 71       111    74          42          31.5          17   3470     USA
## 72        97    67          39          24.5           8   2640     USA
## 73        99    66          35          25.5          17   2350     USA
## 74       101    66          39          25.0          13   2575     USA
## 75       101    75          43          25.0          13   3240     USA
## 76       108    72          41          28.5          16   3450     USA
## 77       111    74          43          30.5          18   3495     USA
## 78        99    67          37          26.5          14   2775 NON-USA
## 79       102    68          40          26.5          12   2495     USA
## 80        90    60          32          23.5          10   2045 NON-USA
## 81        97    65          35          27.5          15   2490 NON-USA
## 82       102    67          37          27.0          14   3085 NON-USA
## 83        93    63          34          27.5          10   1965 NON-USA
## 84        94    65          36          24.0          11   2055 NON-USA
## 85        99    69          39          23.0          13   2950 NON-USA
## 86       103    70          38          28.5          15   3030 NON-USA
## 87       113    71          41          35.0          NA   3785 NON-USA
## 88        93    63          34          26.0          10   2240 NON-USA
## 89       115    72          38          34.0          NA   3960 NON-USA
## 90       103    67          35          31.5          14   2985 NON-USA
## 91        97    66          36          26.0          15   2810 NON-USA
## 92       104    67          37          29.5          14   2985 NON-USA
## 93       105    69          38          30.0          15   3245 NON-USA
##                      Make
## 1          ACURA INTEGRA
## 2           ACURA LEGEND
## 3                AUDI 90
## 4               AUDI 100
## 5               BMW 535I
## 6          BUICK CENTURY
## 7          BUICK LESABRE
## 8       BUICK ROADMASTER
## 9          BUICK RIVIERA
## 10      CADILLAC DEVILLE
## 11      CADILLAC SEVILLE
```

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## 12       CHEVROLET CAVALIER
## 13        CHEVROLET CORSICA
## 14         CHEVROLET CAMARO
## 15         CHEVROLET LUMINA
## 16     CHEVROLET LUMINA_APV
## 17          CHEVROLET ASTRO
## 18        CHEVROLET CAPRICE
## 19       CHEVROLET CORVETTE
## 20        CHRYLSER CONCORDE
## 21         CHRYSLER LEBARON
## 22        CHRYSLER IMPERIAL
## 23               DODGE COLT
## 24             DODGE SHADOW
## 25             DODGE SPIRIT
## 26            DODGE CARAVAN
## 27            DODGE DYNASTY
## 28            DODGE STEALTH
## 29             EAGLE SUMMIT
## 30             EAGLE VISION
## 31             FORD FESTIVA
## 32              FORD ESCORT
## 33                FORD TEMPO
## 34             FORD MUSTANG
## 35               FORD PROBE
## 36            FORD AEROSTAR
## 37              FORD TAURUS
## 38     FORD CROWN_VICTORIA
## 39               GEO METRO
## 40               GEO STORM
## 41           HONDA PRELUDE
## 42             HONDA CIVIC
## 43            HONDA ACCORD
## 44           HYUNDAI EXCEL
## 45         HYUNDAI ELANTRA
## 46          HYUNDAI SCOUPE
## 47          HYUNDAI SONATA
## 48            INFINITI Q45
## 49             LEXUS ES300
## 50             LEXUS SC300
## 51     LINCOLN CONTINENTAL
## 52        LINCOLN TOWN_CAR
## 53                MAZDA 323
## 54           MAZDA PROTEGE
## 55                MAZDA 626
## 56                MAZDA MPV
## 57               MAZDA RX-7
## 58      MERCEDES-BENZ 190E
## 59      MERCEDES-BENZ 300E
## 60           MERCURY CAPRI
## 61          MERCURY COUGAR
## 62       MITSUBISHI MIRAGE
## 63     MITSUBISHI DIAMANTE
## 64           NISSAN SENTRA
## 65           NISSAN ALTIMA
```

```
## 66             NISSAN QUEST
## 67            NISSAN MAXIMA
## 68       OLDSMOBILE ACHIEVA
## 69 OLDSMOBILE CUTLASS_CIERA
## 70    OLDSMOBILE SILHOUETTE
## 71  OLDSMOBILE EIGHTY-EIGHT
## 72           PLYMOUTH LASER
## 73           PONTIAC LEMANS
## 74          PONTIAC SUNBIRD
## 75         PONTIAC FIREBIRD
## 76       PONTIAC GRAND_PRIX
## 77       PONTIAC BONNEVILLE
## 78                SAAB 900
## 79               SATURN SL
## 80             SUBARU JUSTY
## 81            SUBARU LOYALE
## 82            SUBARU LEGACY
## 83             SUZUKI SWIFT
## 84            TOYOTA TERCEL
## 85            TOYOTA CELICA
## 86             TOYOTA CAMRY
## 87            TOYOTA PREVIA
## 88           VOLKSWAGEN FOX
## 89       VOLKSWAGEN EUROVAN
## 90        VOLKSWAGEN PASSAT
## 91       VOLKSWAGEN CORRADO
## 92                VOLVO 240
## 93                VOLVO 850
```