STAT 2450 Assignment 1

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1. there are approximately 8 kilometres in 5 miles. There are approximately 4.55 litres in one imperial gallon. An automobile uses 9.5 litres of gasoline while traveling 100 kilometers. What is the mileage in miles per gallon?

```
Nk=100 # number of kilometres travelled
Lg=9.5 # number of litres of gasoline used
Nm=100*5/8 #number of miles travelled
Gg= Lg/4.55 #number of gallons used. currently set to missing. replace with appropriate formula.
MPG=Nm/Gg #replace with appropriate formula
MPG # (2 points)
```

```
## [1] 29.93421
```

2. The probability that an exponential random variable T with mean θ is greater than t_0 is given by

$$P(T > t_0) = e^{-t_0/\theta}$$

Calculate the probability that an exponential random variable with mean 10 is greater than 20.

```
theta=10
t0=20
prob=exp(-t0/theta) #enter the appropriate formula here
prob # (2 points)
```

```
## [1] 0.1353353
```

3. The probability density function of a χ^2 random variable with k degrees of freedom, evaluated at the point x, is given by

$$f(x) = \frac{x^{k/2-1}e^{-x/2}}{2^{(k/2)}((k/2)-1)!}$$

where $(k-1)!$ is “k-1 factorial”, which in R is given by “factorial(k-1)”

Use R to calculate the probability density function of a χ^2 random variable with 6 degrees of freedom, evaluated at the point $x = 4$.

```
x=4
k=6
#write the R expression for $f(x)$ here, using
#the "factorial" and "exp" functions, and other arithmetic operations
fx=x^(k/2-1) *exp(-x/2)/(2^(k/2)*factorial(k/2-1))
fx  # (5 points)
```

```
## [1] 0.1353353
```

Note: you can check your result using the builtin R function “dchisq”, using the syntax “dchisq(4,6)”.

4. The file https://mathstat.dal.ca/~fullsack/DATA/A14.txt (https://mathstat.dal.ca/~fullsack/DATA/A14.txt) contains a sequence of 12 numbers.
    - Read the numbers into a vector using the “scan” command. Print the vector.
    - Arrange the 12 numbers into a matrix with 3 rows and 4 columns, where the first 4 numbers in the vector are in the first row, the next 4 numbers in the second row, and so on. Use the matrix command, with the “byrow=T” argument. Print the matrix.
    - Arrange the 12 numbers into a 4 by 3 matrix, where the first 3 numbers in the vector are in the first row, the next 3 numbers in the second row. Print the matrix.
    - Calculate, and print, the matrix product of the the first and second matrices, using the matrix multiplication operator "%*%.
    - Use the “det” command to calculate and print the determinant of the product matrix
    - Use the “dim” command to get the dimensions of the product matrix.
    - extract the second row of the product matrix into a vector V2, and print

```
V=scan("https://mathstat.dal.ca/~fullsack/DATA/A14.txt")
#Show V

#Show M1
M1=matrix(V,byrow=T,nrow=3)
M1
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    5    8    9    1
## [2,]    8    2    4    8
## [3,]    7    7    2    9
```

```
#Show M2
M2= matrix(V,byrow=T,ncol=3)
M2
```

```
##      [,1] [,2] [,3]
## [1,]    5    8    9
## [2,]    1    8    2
## [3,]    4    8    7
## [4,]    7    2    9
```

```
#Show Mprod
Mprod = M1%*%M2
Mprod
```

```
##      [,1] [,2] [,3]
## [1,]   76  178  133
## [2,]  114  128  176
## [3,]  113  146  172
```

```
#det to calculate
det(Mprod) #calculate the determinant (10 points)
```

```
## [1] 60100
```

```
Mdim= dim(Mprod)
Mdim # (1 point)
```

```
## [1] 3 3
```

```
#print V2
V2= Mprod[2,]
V2#(2 points)
```

```
## [1] 114 128 176
```

5. The file

   http://faculty.marshall.usc.edu/gareth-james/ISL/Auto.csv (http://faculty.marshall.usc.edu/gareth-james/ISL/Auto.csv)

   contains data on an outcome variable “mpg”, which is automobile mileage in miles per gallon, and a number of other variables which can be used to predict mileage.

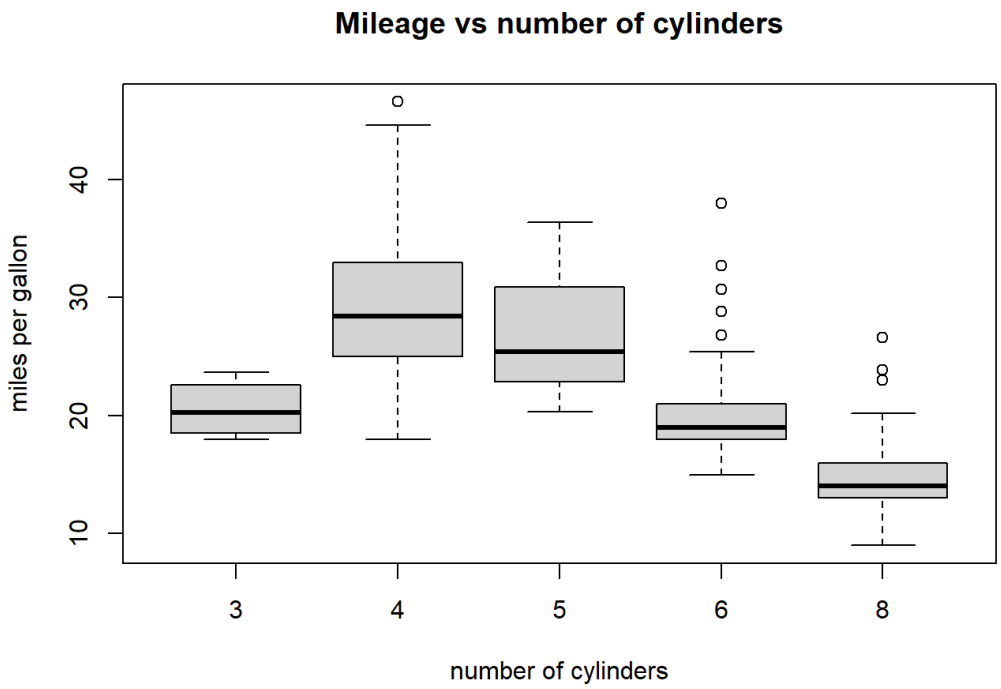
   - Use the **read.csv** command to read the data into a data frame. The syntax for this is in the notes “myR_Basics1”.
   - Use the summary command to get summary statistics for all of the variables in the data set. For example, if you read the data into a dataframe named “mydata”, then you would type summary(mydata) to get the
   - Make boxplots of the mileage values for the different numbers of cylinders. Make sure to add appropriate labels to the X and Y axes, and add a title to the plot. The syntax for the boxplot command is in the Rintro notes. In order to do this, you need to either attach the created data frame prior to using the plot command, or include the “data=mydata” option on the boxplot command

- Make a scatterplot with miles per gallon on the Y axis and displacement on the X axis. Once again, make sure to label the axes and add a title. If you have “attached” the data frame, you won’t need the “data=mydata” syntax on the command line. Otherwise, you will.

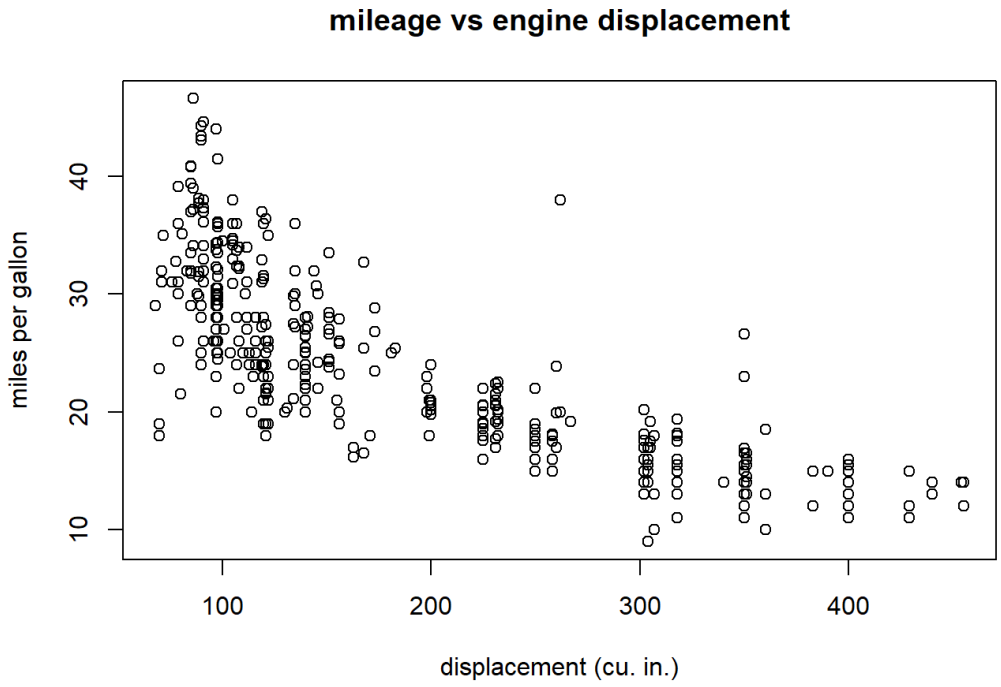
```
mydata=read.csv("http://faculty.marshall.usc.edu/gareth-james/ISL/Auto.csv")
summary(mydata) # (3 points)
```

```
##       mpg          cylinders      displacement    horsepower
##  Min.   : 9.00   Min.   :3.000   Min.   : 68.0   Length:397
##  1st Qu.:17.50   1st Qu.:4.000   1st Qu.:104.0   Class :character
##  Median :23.00   Median :4.000   Median :146.0   Mode  :character
##  Mean   :23.52   Mean   :5.458   Mean   :193.5
##  3rd Qu.:29.00   3rd Qu.:8.000   3rd Qu.:262.0
##  Max.   :46.60   Max.   :8.000   Max.   :455.0
##      weight      acceleration        year           origin
##  Min.   :1613   Min.   : 8.00   Min.   :70.00   Min.   :1.000
##  1st Qu.:2223   1st Qu.:13.80   1st Qu.:73.00   1st Qu.:1.000
##  Median :2800   Median :15.50   Median :76.00   Median :1.000
##  Mean   :2970   Mean   :15.56   Mean   :75.99   Mean   :1.574
##  3rd Qu.:3609   3rd Qu.:17.10   3rd Qu.:79.00   3rd Qu.:2.000
##  Max.   :5140   Max.   :24.80   Max.   :82.00   Max.   :3.000
##      name
##  Length:397
##  Class :character
##  Mode  :character
##
##
##
```

```
# (5 points)
boxplot(mpg~cylinders, data=mydata,xlab="number of cylinders",
ylab="miles per gallon",
main="Mileage vs number of cylinders")
```




```
# (5 points)
plot(mpg~displacement, data=mydata,xlab="displacement (cu. in.)",
ylab="miles per gallon",main="mileage vs engine displacement")
```



The displacement values are in cubic inches, where 1 cubic inch equals `6.4516` cubic centimetres, so a 400 cubic inch engine had a displacement of `6554.826` . The mileage was correspondingly dismal. You could refer back to question 1 to see what 10 mpg, pretty common back in the day, corresponds to in litres per 100 kilometres. Conservation of resources wasn't high on the typical consumer's prioity list.