Sample homework report (STP 530, SoMSS @ ASU)

Name: Shiwei Lan (slan@asu.edu)

Section: X (X=2 or 4)

NetID: slan7; UIN: XXXX

Department: Math & Stats

Question 1 (Proof of conditional MVN)

We are given the PDF of general MVN in the lecture note 1

$$\frac{1}{(2\pi)^{p/2}|\boldsymbol{\Sigma}|^{1/2}}\exp\left\{-\frac{1}{2}(\mathbf{x}-\boldsymbol{\mu})^\top\boldsymbol{\Sigma}^{-1}(\mathbf{x}-\boldsymbol{\mu})\right\}$$

Nowe we need to make use of the conditional PDF of $f(x|y)$ and try to identify it as PDF of MVN with μ_* and Σ_* specified in the given formula. In the process you will need the following block inverse formula

$$\begin{bmatrix}\boldsymbol{\Sigma}_{xx} & \boldsymbol{\Sigma}_{xy}\\ \boldsymbol{\Sigma}_{yx} & \boldsymbol{\Sigma}_{yy}\end{bmatrix}^{-1}=\begin{bmatrix}(\boldsymbol{\Sigma}_{xx}-\boldsymbol{\Sigma}_{xy}\boldsymbol{\Sigma}_{yy}^{-1}\boldsymbol{\Sigma}_{yx})^{-1} & -(\boldsymbol{\Sigma}_{xx}-\boldsymbol{\Sigma}_{xy}\boldsymbol{\Sigma}_{yy}^{-1}\boldsymbol{\Sigma}_{yx})^{-1}\boldsymbol{\Sigma}_{xy}\boldsymbol{\Sigma}_{yy}^{-1}\\ -\boldsymbol{\Sigma}_{yy}^{-1}\boldsymbol{\Sigma}_{yx}(\boldsymbol{\Sigma}_{xx}-\boldsymbol{\Sigma}_{xy}\boldsymbol{\Sigma}_{yy}^{-1}\boldsymbol{\Sigma}_{yx})^{-1} & (\boldsymbol{\Sigma}_{yy}-\boldsymbol{\Sigma}_{yx}\boldsymbol{\Sigma}_{xx}^{-1}\boldsymbol{\Sigma}_{xy})^{-1}\end{bmatrix}$$

Look for Latex Cheatsheet or other online tutorial for more details on LaTeX!

Question 2 (see example of the MVN in the lecture notes)

We first specify the mean μ and varaince Σ of X in R:

```
mu = matrix(c(5, 3, 7))
Sigma = matrix(c(4, -1, 0, -1, 4, 2, 0, 2, 9), 3, 3)
A = matrix(c(4, -3, 5))
```

We know that linear combinations of X also follow the MVN distribution, and we can calculate its mean and variance by

```
Mean.AX = t(A) %*% mu
Var.AX = t(A) %*% Sigma %*% A
```

Based on this distribution, we can calculate the probablity

```
a=pnorm(63, mean = Mean.AX, sd = sqrt(Var.AX))
```

Hence the probability $P(4X_1 - 3X_2 + 5X_3 < 63) = 0.8413447$

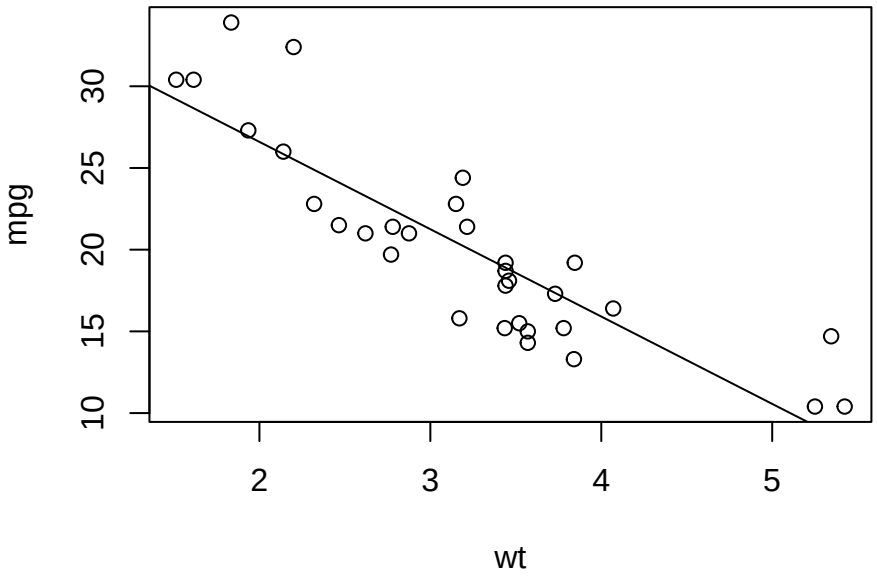
Question 3 (let's do a plot)

We first load the package and the dataset

```
data(mtcars)
```

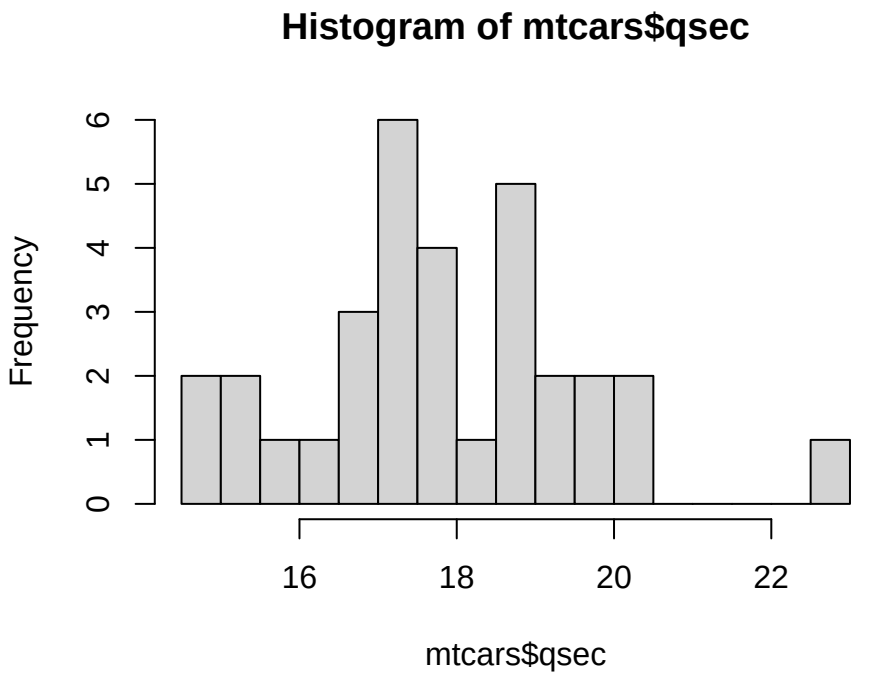
We first produce a simple plot, and add a line to it

```r
plot(mpg ~ wt, data= mtcars)
abline(lm(mpg ~ wt, data= mtcars))
```



Produce a histgram of the outcome variable, what does "breaks' ' do?

```r
hist(mtcars$qsec, breaks = 15)
```




```r
x = c(2.2, 7, 4, -6)
mean(x)
```

```
## [1] 1.8
```

```r
# knitr::include_graphics()
```

The mean of x is 1.8.

x_1 and x^2.

RStudio webpage

$\frac{24}{3} = 8 = \frac{24}{3}$

$\alpha, \beta, \beta_0, \epsilon, \varepsilon, \phi, \varphi, \chi^2_d$