

Sample homework report (STP 533, SoMSS @ ASU)

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Section: X (X=2 or 4)

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Department: Math & Stats

Question 1 (Proof of conditional MVN)

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

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

Now 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

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

Look for [Latex Cheatsheet](#) or other online tutorial for more details on L^AT_EX!

Question 2 (example of the MVN)

We first specify the mean μ and variance 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 probability

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

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

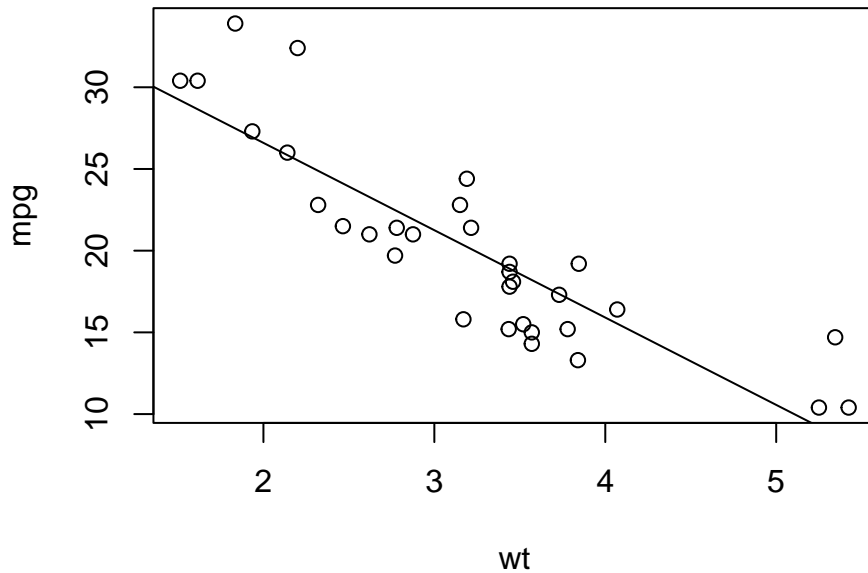
Question 3 (let's do a plot)

We first load the package and the dataset

```
data(mtcars)
```

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

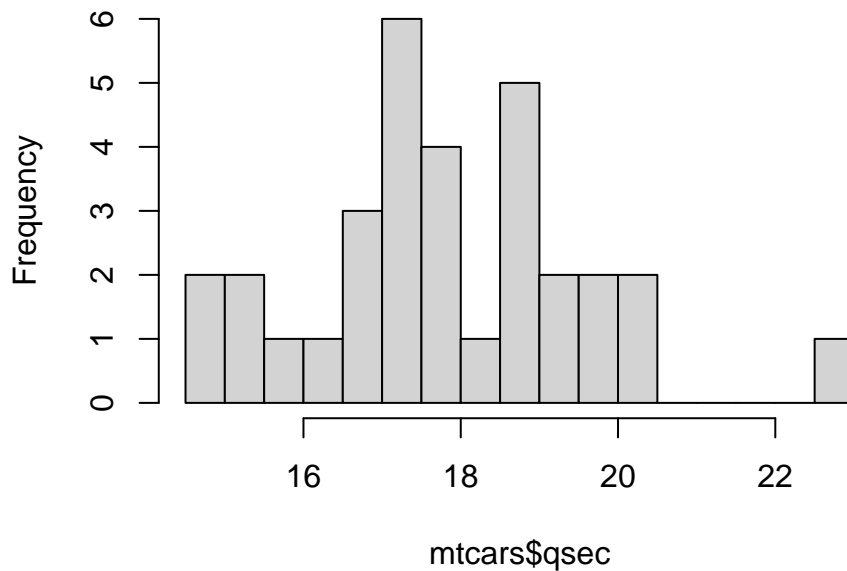
```
plot(mpg ~ wt, data= mtcars)
abline(lm(mpg ~ wt, data= mtcars))
```



Produce a histogram of the outcome variable, what does “breaks”’ do?

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

Histogram of mtcars\$qsec



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

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

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

The mean of x is 1.8.

x_1 and x^2 .

RStudio webpage

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

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