

# STAC51 TUT02 Week2

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# Tutorial Overview

- TA: Lehang Zhong (lehang.zhong@mail.utoronto.ca)
- PhD Student in Biostatistics (Statistical Genetics)
- Goal:
  - Answer questions
  - R help session
  - Practice problems
- Attendance: Google Forms
- Communication: interactive and efficient

# (Tentative) Weekly Schedule



	Week	Tutorial Activity
1	Jan. 11 – Jan. 15	No Tutorial
2	Jan. 18 – Jan. 22	How to make R Markdown File
3	Jan. 25 – Jan. 29	Likelihood function demonstration, Binomial Test
4	Feb. 1 – Feb. 5	Assignment 1 deadline, Quiz1
5	Feb. 8 – Feb. 12	Contingency tables – Chi-square test
6	Feb. 15 – Feb. 19	Reading week
7	Feb. 22 – Feb. 26	Assignment 2 deadline, Quiz2
8	Mar. 1 – Mar. 5	Generalized linear model – Poisson regression
9	Mar. 8 – Mar. 12	Simple or multiple logistic regression
10	Mar. 15 – Mar. 19	Assignment 3 deadline Quiz3
11	Mar. 22 – Mar. 26	Logistic regression model selection
12	Mar. 29 – Apr. 2	Logistic regression model diagnostics
13	Apr. 5 – Apr. 9	Final Project Help Hour

- R Markdown is an integrated tool for
  - Analysis: save and execute code
  - Report: generate high quality reports that can be shared with an audience
- Embed R code in a  $\text{\LaTeX}$ (pdf)/html/word document
  - Show R results (in figures and tables)
- Pandoc's markdown requires less formatting than  $\text{\LaTeX}$ 
  - Can always use latex code in markdown document for customized options

# What do you need to make an R Markdown file?

- Rstudio
- Some great R packages: `tidyverse` & `knitr`
- TinyTeX
- Some great resources:
  - R Markdown lessons: (<https://rmarkdown.rstudio.com/lesson-1.html>)
  - Cheatsheet: (<https://github.com/rstudio/cheatsheets/raw/master/rmarkdown-2.0.pdf>)
  - Reference: (<https://rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>)

# Demo on generating reports using R Markdown

- Create a Rmd document

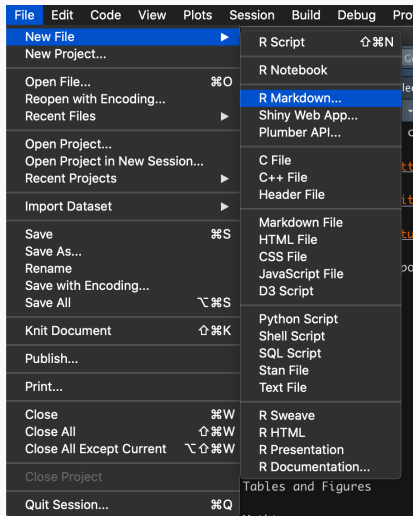


Figure 1: Create a RMarkdown Document in RStudio

## Pandoc's Markdown

Write with syntax on the left to create effect on right (after render)

Plain text  
End a line with two spaces  
to start a new paragraph.  
"italics" and "bold"  
`verbatim code`  
sub/superscript<sup>2</sup>~<sup>2</sup>~  
~strikethrough~  
escaped: \^ \\_ \\  
endash: --, emdash: ---  
equation:  $\$A = \pi r^{(2)}\$$   
equation block:  
$$E = mc^2$$
  
> block quote  
# Header1 {#anchor}  
## Header 2 {#css\_id}  
### Header 3 {,css\_class}  
#### Header 4  
##### Header 5  
##### Header 6  
<!--Text comment-->  
\textbf{Tex ignored in HTML}  
<em>HTML ignored in pdfs</em>  
<http://www.rstudio.com>  
[link](www.rstudio.com)  
Jump to [Header 1](#anchor)  
image:  
![Caption](smallorb.png)  
\* unordered list  
+ sub-item 1  
+ sub-item 2  
- sub-sub-item 1  
\* item 2  
Continued (indent 4 spaces)  
1. ordered list  
2. item 2  
i) sub-item 1

Plain text  
End a line with two spaces  
to start a new paragraph.  
*italics* and **bold**  
`verbatim code`  
sub/superscript<sup>2</sup>  
~~strikethrough~~  
escaped: \^ \\_ \\  
endash: --, emdash: ---  
equation:  $\hat{A} = \pi * r^2$   
equation block:  
$$E = mc^2$$
  
block quote  
Header1  
Header 2  
Header 3  
Header 4  
Header 5  
Header 6  
HTML ignored in pdfs  
<http://www.rstudio.com>  
link  
Jump to Header 1  
image:  
  
Caption  
\* unordered list  
o sub-item 1  
o sub-item 2  
▪ sub-sub-item 1  
\* item 2  
Continued (indent 4 spaces)  
1. ordered list  
2. item 2  
i. sub-item 1

- complex equations may require `\usepackage{amsmath}` and `\usepackage{mathtools}`
- inline math mode: `$...$`

```
$\ell(\pi \mid y)=\left(\begin{array}{l}n \\ y\end{array}\right) \pi^y(1-\pi)^{n-y}$
```

- likelihood function of  $Bin(n, \pi)$ :  $\ell(\pi \mid y) = \binom{n}{y} \pi^y (1 - \pi)^{n-y}$
- `$$...$$` equation block

$$\ell(\pi \mid y) = \binom{n}{y} \pi^y (1 - \pi)^{n-y}$$



$$z_{\alpha/2} \sqrt{\frac{1}{n+z_{\alpha/2}^2} \left[ \hat{\pi} \left( \frac{n}{n+z_{\alpha/2}^2} \right) + \frac{1}{2} \left( \frac{z_{\alpha/2}^2}{n+z_{\alpha/2}^2} \right) \pm \right]}$$

```


$$z_{\alpha/2} \sqrt{\frac{1}{n+z_{\alpha/2}^2} \left[ \hat{\pi} \left( \frac{n}{n+z_{\alpha/2}^2} \right) + \frac{1}{2} \left( \frac{z_{\alpha/2}^2}{n+z_{\alpha/2}^2} \right) \pm \right]}$$


```

## Code Chunks:

- Lecture 2 page 2 example:

```
```${r ex1, echo=T}  
set.seed(123)  
dbinom(0:5, 5, p=1/4)  
```
```

```
set.seed(123)  
dbinom(0:5, 5, p=1/4)
```

```
## [1] 0.2373046875 0.3955078125 0.2636718750 0.0878906250  
## [6] 0.0009765625
```

## Basic code chunk options

- `echo = FALSE`: prevents code, but not the results from appearing in the finished file. This is a useful way to embed figures.
- `include = FALSE` prevents code and results from appearing in the finished file. R Markdown still runs the code in the chunk, and the results can be used by other chunks.

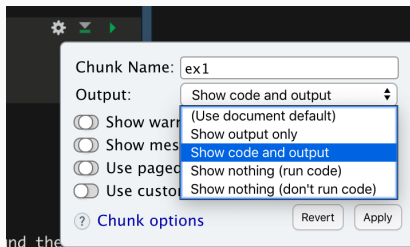
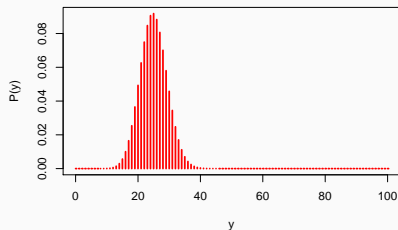
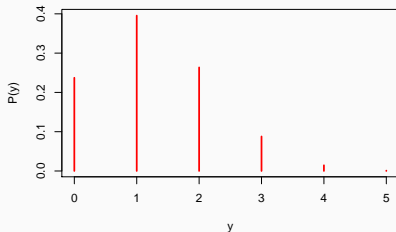


Figure 3: Simple code chunk setting

# Code Chunks with figures

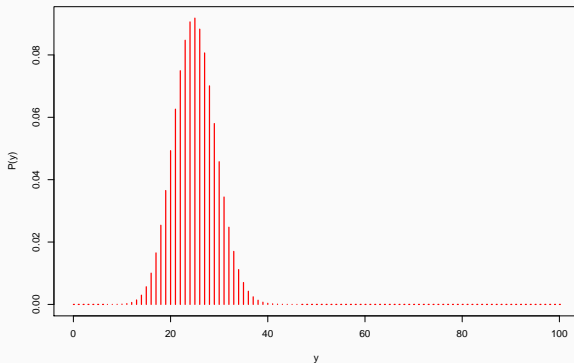
```
`r p30,echo=F`  
par(mfrow=c(2,2))  
plot(0:5, dbinom(0:5, 5, 1/4), type="h", xlab="y",  
      ylab="P(y)",col="red", lwd=2)  
plot(0:100, dbinom(0:100, 100, 1/4), type="h", xlab="y",  
      ylab="P(y)", col="red", lwd=2)  
pbinom(2, 5, 1/4)  
`r`
```

```
## [1] 0.8964844
```



# More figure code chunk options

```
```{r p31,echo=FALSE,fig.cap= "This is a figure caption", out.width='0.7\\textwidth'}  
plot(0:100, dbinom(0:100, 100, 1/4), type="h", xlab="y",  
     ylab="P(y)", col="red", lwd=2)  
```
```



**Figure 4:** This is a figure caption.

# Multiple figures with captions

- Only supported in L<sup>A</sup>T<sub>E</sub>Xpdf output, requires LaTeX package subfig

```
```{r, fig.cap='Combine multiple plots with subcaptions', fig.subcap=c('F1','F2','F3','F4'), fig.ncol = 4, out.width = "25%", fig.align = 'center'}
plot(0:5, dbinom(0:5, 5, 1/4), type="h", xlab="y", ylab="P(y)", col="red", lwd=2)
plot(0:100, dbinom(0:100, 100, 1/4), type="h", xlab="y", ylab="P(y)", col="red", lwd=2)
plot(cars, pch = 19)
boxplot(Sepal.Width ~ Species, data = iris)
```
```

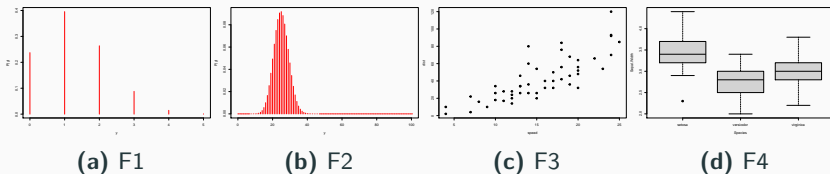


Figure 5: Combine multiple plots with subcaptions

# Tables

- `knitr::kable` function format R output into tables.
- `format="latex"` should be consistent with your file.

Table 1: Example from Lec4 page 4

| method        | x | n   | mean | lower  | upper  |
|---------------|---|-----|------|--------|--------|
| agresti-coull | 4 | 400 | 0.01 | 0.0029 | 0.0264 |
| exact         | 4 | 400 | 0.01 | 0.0027 | 0.0254 |
| lrt           | 4 | 400 | 0.01 | 0.0031 | 0.0231 |
| wilson        | 4 | 400 | 0.01 | 0.0039 | 0.0254 |

```
```{r,out.width='0.5\\textwidth'}  
library(binom)  
knitr::kable(binom.confint(x=4, n=400, conf.level=.95, methods =c("ac","wilson", "lrt","exact")),  
             format="latex",digits=4,caption = 'Example from Lec3 page 10')  
...`
```