Stat 302
Statistical Software and Its Applications
Data Import and Export

Yen-Chi Chen

Department of Statistics, University of Washington

Spring 2017

Getting Started

1. Go to Canvas $\Longrightarrow$ Module $\Longrightarrow$ Week 3.
2. Download files `ReactionTime.txt`, `ReactionTime.csv`, and `ReactionTime_no_header.txt`.
3. In your Desktop, create a folder called `data_S302` and put these three files into this folder.

- This dataset is about EMS[1] call.
- For each EMS call, these variables are the reaction time to get out the fire station door, the fire station, and the crew shift.
- The first 3 and last line of the text file `ReactionTime.txt` are given below.

```
Reaction,Station,Shift
86,ST64,B
182,ST64,B
...
189,ST64,B
```

[1] Emergency Medical Service

General Remarks on I/O (Import/Export)

- We generally don't type data manually into R.
- In earlier times data came to us in ASCII files.
  ASCII = American Standard Code for Information Interchange.
- Items had to be in some logical order so that they could be arranged properly for use in software.
- Data items were separated by spaces or tabs (`\t`) or other special characters that are not used as part of data items.
- Nowadays the most common form of a data file is a `filename.csv` file as provided by Excel or OpenOffice Calc.
  `csv` = comma-separated values.
- Many software platforms can export and import data formats for other platform, e.g., R $\longleftrightarrow$ SAS.
- After I/O verify that the data are in the correct form.

Using `read.table`

```
> ReactionTime <- read.table("ReactionTime.txt",
                             sep=",",header=T)

> str(ReactionTime)
'data.frame':   2028 obs. of  3 variables:
 $ Reaction: int  86 182 132 196 160 3 0 0 95 152 .
 $ Station : Factor w/ 3 levels "ST63","ST64",..: 2
 $ Shift   : Factor w/ 4 levels "A","B","C","D": 2

> ReactionTime[c(1,2,2028),]
     Reaction Station Shift
1          86    ST64     B
2         182    ST64     B
2028      189    ST64     B
```

Location of file

- You need to specify the location of the file for the `read.table` function.
- Use `getwd()` to check current directory address.
- Use `setwd("<location of your dataset>")` to change your directory address.
- Or you can use *Session* $\Longrightarrow$ *Set Working Directory* $\Longrightarrow$ *Choose Directory* to change.

Features of `read.table`

- It imports the data as a `data.frame`.
- There are many arguments in `read.table`.
- Generally we use only the first three arguments.
- The first argument `file` is the location of the file.
- The second argument `header` is a logical argument; `TRUE` if the file contains a header for each variable.
- The third argument `sep` is how the variables for one observation are separated.

read.table: header – 1

```
> is.data.frame(ReactionTime)
[1] TRUE
> ReactionTime_1 <- read.table("ReactionTime.txt",
+                                        header=F,sep=",")
> head(ReactionTime_1)
        V1       V2    V3
1 Reaction Station Shift
2       86    ST64     B
3      182    ST64     B
4      132    ST64     B
5      196    ST64     B
6      160    ST64     A
```

read.table: header – 2

```
> ReactionTime_1 <-
+   read.table("ReactionTime_no_header.txt",
+                                        header=F,sep=",")
>
> head(ReactionTime_1)
   V1   V2 V3
1  86 ST64  B
2 182 ST64  B
3 132 ST64  B
4 196 ST64  B
5 160 ST64  A
6   3 ST65  A
> # if the file has no header: OK
```

read.table: header – 3

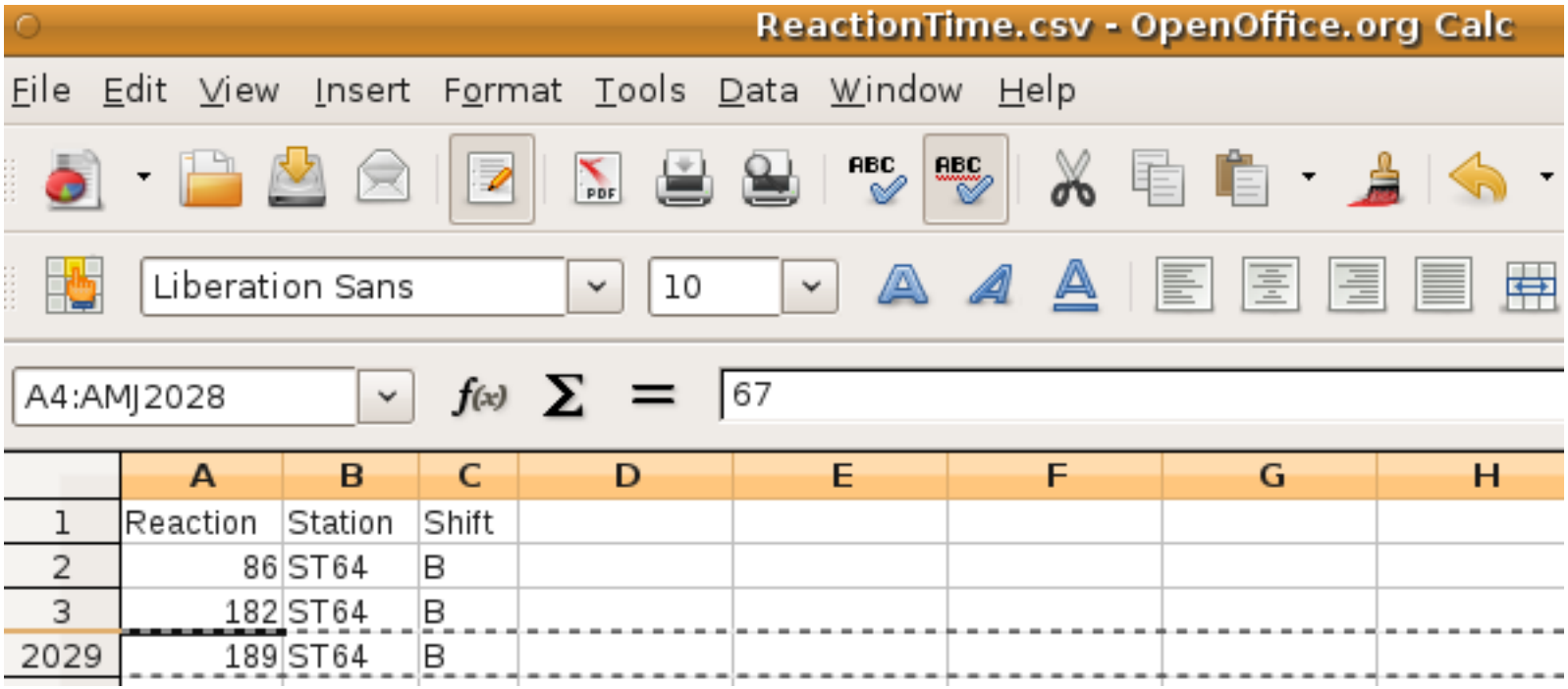
```
> ReactionTime_1 <-
+   read.table("ReactionTime_no_header.txt",
+                                        header=T,sep=",")
>
> head(ReactionTime_1)
  X86 ST64 B
1 182 ST64 B
2 132 ST64 B
3 196 ST64 B
4 160 ST64 A
5   3 ST65 A
6   0 ST64 A
>   # if no header but header=T: the first
>   # observation is treated as the header
```

read.table: sep

```
> ReactionTime_1 <- read.table("ReactionTime.txt",
+                              header=T,sep="")
>
> head(ReactionTime_1)
  Reaction.Station.Shift
1              86,ST64,B
2             182,ST64,B
3             132,ST64,B
4             196,ST64,B
5             160,ST64,A
6               3,ST65,A
>   # the wrong "sep" will merge variables...
> length(ReactionTime_1)
[1] 1
```

Importing from a `.csv` File

- It is possible to import directly from an Excel spreadsheet, but the advice is to convert it to a single sheet `.csv` file.
- The first 3 and last line of the file `ReactionTime.csv` are shown below



	A	B	C	D	E	F	G	H
1	Reaction	Station	Shift					
2	86	ST64	B					
3	182	ST64	B					
2029	189	ST64	B					

Using `read.csv`

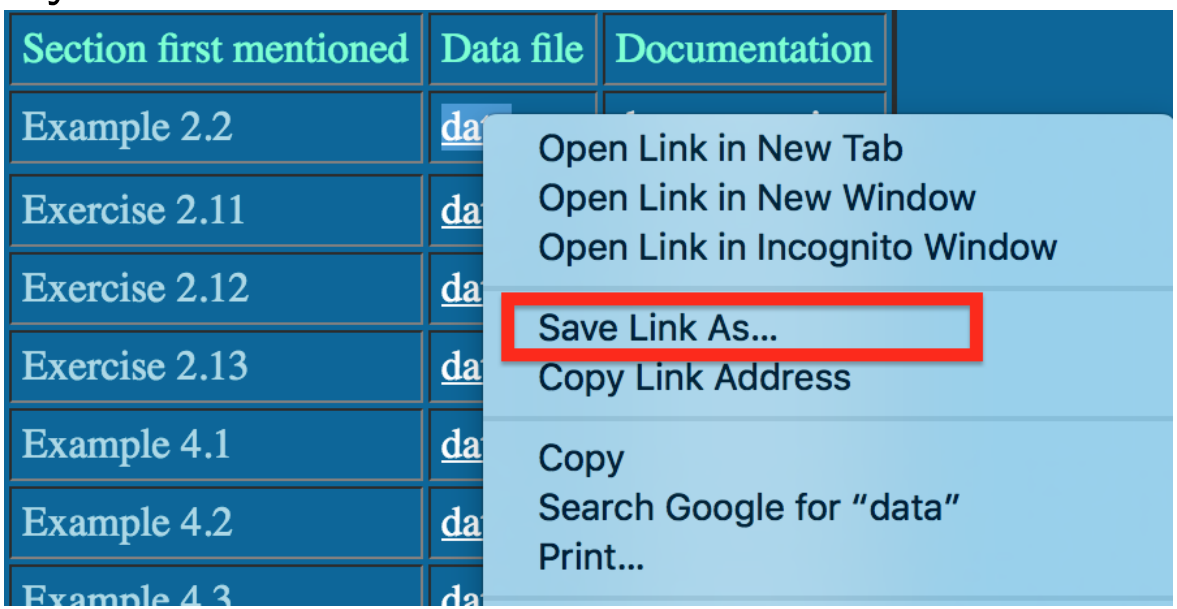
```
> ReactionTimecsv <- read.csv("ReactionTime.csv",
+                             header=T,sep=",")
>
> head(ReactionTimecsv)
  Reaction Station Shift
1       86    ST64     B
2      182    ST64     B
3      132    ST64     B
4      196    ST64     B
5      160    ST64     A
6        3    ST65     A
```

Features of `read.csv`

- If variables are separated by semicolon `;`, then use `read.csv2`.
- `read.csv` and `read.csv2` are identical to read.table except for the defaults.
- In addition to `read.csv`, there are many other data import approach based on `read.table`.
- Try help(read.table).

Getting Data from the Internet

- In many cases, you can download the data by clicking the link.
- But sometimes you may need to *right click* the link and choose *Save Link As ....*
- As an example, go to http://www.stat.cmu.edu/ larry/all-of-nonpar/data.html and try to download a dataset:



In-class Exercises - 1

1. Go to the website http://www-bcf.usc.edu/ gareth/ISL/data.html.
2. Download the data `Advertising.csv` and put it in a good place.
3. In R, read this dataset.
4. Use `head` function to check the first few observations and make sure you do successfully import the data.

Using `write.table`

```
> write.table(ReactionTime,"xx.txt",sep=",")

# produces a file xx.txt with first 3 lines

"Reaction","Station","Shift"
"1",86,"ST64","B"
"2",182,"ST64","B"
```

Read the documentation on `write.table` and `read.table`.

Features of `write.table`

- There are many arguments in `read.table`.
- Here are some commonly used arguments:
  - `x`: the data you want to export.
  - `file`: the file name (and location) you want to output to.
  - `quote`: adding quotes to the character/factor variables.
  - `sep`: how different variables are separated.
  - `row.names/col.names`: output the name of row/the name of column.
- Read the documentation on `write.table` and `read.table`.

Using `write.table`: quote

```
> write.table(ReactionTime,"xx.txt",sep=",",
                                  quote=F)
# produces a file xx.txt with first 3 lines

Reaction,Station,Shift
1,86,ST64,B
2,182,ST64,B
```

Using `write.table`: row.name

```
> write.table(ReactionTime,"xx.txt",sep=",",
+             quote=F, row.name=F)

# produces a file xx.txt with first 3 lines

Reaction,Station,Shift
86,ST64,B
182,ST64,B
```

Using `write.table`: col.name

```
> write.table(ReactionTime,"xx.txt",sep=",",
+             quote=F, row.name=F)

# produces a file xx.txt with first 3 lines

1,86,ST64,B
2,182,ST64,B
3,132,ST64,B
```

Using `write.table`: sep – 1

```
> write.table(ReactionTime,"xx.txt",sep=" ",
+             quote=F)

# produces a file xx.txt with first 3 lines

Reaction Station Shift
1 86 ST64 B
2 182 ST64 B
```

Using `write.table`: sep – 2

```
> write.table(ReactionTime,"xx.txt",sep="--",
+             quote=F)

# produces a file xx.txt with first 3 lines

Reaction--Station--Shift
1--86--ST64--B
2--182--ST64--B
```

In-class Exercises - 2

Now we will practice exporting the data `Advertising.csv` we just imported in Exercise-1.

1. Exporting the dataset as a file named `Adata01.csv` such that variables are separated by comma ",".
2. Exporting the dataset as a file named `Adata02.txt` such that variables are separated by `--`, three hyphens.
3. Exporting the dataset as a file named `Adata03.txt` such that variables are separated by `--`, three hyphens, and no variable's name.

Manipulating Data – 1

We can do some analysis and add extra columns to the original data.

```
> new_time <- ReactionTime$Reaction/10
>
> ReactionTime_new <- cbind(ReactionTime, new_time)
>
> colnames(ReactionTime_new)[4] = "RT_mins"
>
> head(ReactionTime_new)
  Reaction Station Shift RT_mins
1       86    ST64     B     8.6
2      182    ST64     B    18.2
3      132    ST64     B    13.2
> write.table(ReactionTime_new,"new_RT.txt",
+             sep=",",quote=F, row.names=F)
```

Manipulating Data – 2

We may remove columns or rows in the data.

```
> ReactionTime_rm <- ReactionTime[,-3]
>   # this removes the third column.
> head(ReactionTime_rm)
  Reaction Station
1       86    ST64
2      182    ST64
3      132    ST64
4      196    ST64
5      160    ST64
6        3    ST65
```

Summarizing Data – 1

`summary(x)`: a function that provides summary information for the object `x`.

```
> summary(ReactionTime)
    Reaction      Station    Shift
 Min.   :  0.0   ST63:498   A:477
 1st Qu.: 73.0   ST64:902   B:531
 Median : 99.0   ST65:628   C:479
 Mean   :100.3              D:541
 3rd Qu.:132.0
 Max.   :318.0
```

Summarizing Data – 2

`table(x)`: a function that creates a table for summarizing information. Particularly useful for objects whose structure is `factor`.

```
> table(ReactionTime$Station)
ST63 ST64 ST65
 498  902  628
>
> table(ReactionTime$Station,ReactionTime$Shift)
          A   B   C   D
  ST63 120 133 117 128
  ST64 205 216 221 260
  ST65 152 182 141 153
```

Built-in Datasets in R

R has many built-in datasets. Try `data()`.

```
> data()
>
> head(iris)
>   # 'iris' is a well-known dataset in R.
```

Interfacing with other Packages

- R has a base package called `foreign`, that interfaces with other packages, such as SPSS, SAS, Systat, Octave, Stata, Minitab.
- To activate its commands you first have to issue the command `library(foreign)`.
- Under `help.start()`, html help interface, read the documentation for functions in `foreign`.
- They mostly concern reading exports from these other packages for use in R.

Working with Databases

- Packages are available to connect to some databases such as
  - MySQL
  - Oracle
  - PostgreSQL
  - SQLite
- Consult Chapter 4 of the R manual R-Data Import/Export.
- Consult this manual on all other issues concerning I/O.

Packages

- Previously we referred to the package `foreign`.
- To use any function in it you need to execute `library(foreign)`.
- That works because `foreign` is in the base distribution of R.
- For other packages (there are over 9000) you need to first install it on your system via `install.packages("packageName")`.
- When prompted choose a distribution site near you.
- You only need to do this install step once.
- The `library` command needs to be done anew for each new R session that wants to use the package functions.

In-class Exercises - 3

1. `cars` is a built-in dataset in R.
2. To explore this dataset, try `summary(cars)` and `head(cars)`.
3. Now declare two new variables by

```
speed2 <- cars$speed^1.5
res <- speed2-cars$dist
```

4. Create a new data.frame whose first two columnas are the same as `cars` and the third column is the vector `speed2` and the last column is the vector `res`.
5. Ouput the dataset with file name `cars_new.txt`.