Data Wrangling Part2: dplyr

Installing Packages

- To use an R package, you must first **install** it on your computer
- **install.packages()**
- Package names should be in quotes
- Search CRAN server, download, and install

```
install.packages("<package name>")
```

- Multiple packages? Vectorize c().

```
install.packages(c("ggplot2", "data.table", "dplyr"))
```

Loading Packages

- To actually use the packages, we have to **load** them first
- `library()`
- Every new R session -> Fresh -> Have to load packages again
- Goes at the top
- Quotation marks are optional for `library()`, but personally I use them every time
- Load everything in the package
  - datasets, functions, objects, help documents

```
library(<package name>)
library("<package name>")
```

Loading Packages

- Loading everything may not be a good news:
  - Takes up computing resources (RAM)
  - Some R objects have same names -> mask the previously loaded ones
- You can manually use R object inside a package by `package_name::object_name`
- Usually, do not have to worry about this

```
# Use lag function from dplyr
lag_gdp <- dplyr::lag(df$gdp)

# Use lag function from stats
lag_gdp <- stats::lag(df$gdp)
```

Help Documents

- help() or ?

```
help(lm)
help("lm") # quotation marks are optional
?lm
?"lm"
?sample

# Specific function inside a specific package
help(rlm, package = "MASS")
# For packages
help(package="MASS")
```

Help Documents

- Description: sometimes helpful
- Arguments
- Values: these are outputs
- **Examples**: very useful

In-class exercises:

1. Install the packages **dplyr** and **ggplot2**.
2. Load the packages into your current R Session.

Data Wrangling Part 2: `dplyr`

- We have learn how to play or wrangle with R data in base R way:
  - `object[row, col]`
- `dplyr` package offer some convenient alternatives

dplyr Verbs

1. Rows:
   - `filter()` chooses rows based on column values.
   - `slice()` chooses rows based on location.
   - `arrange()` changes the order of the rows.
2. Columns:
   - `select()` changes whether or not a column is included.
   - `rename()` changes the name of columns.
   - `mutate()` changes the values of columns and creates new columns.
   - `relocate()` changes the order of the columns.

3 Groups of rows:

- `summarise()` collapses a group into a single row.

The Pipe

- The single most important feature of `dplyr`
- %>% or |>
- `x %>% function(y)`: Passes A as **the first argument** of the `function()`
- Same as `function(x, y)`
- You can *chain* functions

```
data <- original %>%
  filter() %>% # pass filtered data to select()
  select() %>% # pass selected data to group_by()
  group_by() %>% # pass grouped data to summarize()
  summarize()
```

Filter rows with `filter()`

- `filter(data, index / conditions)` subset rows
- For example, we can select all rows with Year is 1950:

```
library("dplyr")
worldTFR <- read.csv('./worldTFR.csv')
```

```
filter(worldTFR, Year == "1950")

worldTFR %>%
  filter(Year == "1950")
```

- This is roughly equivalent to this base R code:

```
worldTFR[worldTFR$Year == "1950", ] # Don't forget the comma!
```

Filter rows with `filter()`

- More conditions

```
worldTFR %>%
  filter(
         Year == "1950",
         TFR >= 7.5,
         Uncode > 500
  )
```

- Filter NAs

```
worldTFR %>%
  filter(!is.na(GDPpc))

# With other conditions here:
worldTFR %>%
  filter(!is.na(GDPpc), TFR > 5)
```

Arrange rows with arrange()

- `arrange()`: reorders rows

```
worldTFR.na <- worldTFR %>%
  filter(complete.cases(.)) # na.omit()
worldTFR.na %>%
  arrange(Year, TFR)
```

- Use `desc()` to order a column in descending order:

```
# desc in Year, but still ascending in TFR
worldTFR.na %>%
  arrange(desc(Year), TFR) %>%
  head(2)
```

Choose rows using their position with `slice()`

- `slice()`: index rows by their (integer) locations

```
worldTFR.na %>%
  slice(5:10)

worldTFR[5:10, ]
```

Other `slice-likes()`

- `slice_head()` and `slice_tail()` select the first or last rows
- `slice_sample(n, prop, replace)`
- `slice_min()` and `slice_max()` select rows with highest or lowest values of a variable
  - Watch out for missing values (NAs)

Select columns with `select()` by Names

```
worldTFR %>% select(CountryCode, Year, TFR)
```

- WARNING: `MASS` package also has `select()` function
- Load `dplyr` later than `MASS`
- Or use `dplyr::select()` and `MASS::select()`

Select all columns between two columns

- Select all columns between Year and LifeExpB

```
worldTFR.na %>%
  select(Year:LifeExpB)
```

Select all columns except some

Select all columns except those from Year to LifeExpB

```
worldTFR.na %>%
  select(!(Year:LifeExpB))
```

Select columns with an expression

```
worldTFR.na %>% select(starts_with("Country"))
worldTFR.na %>% select(ends_with("e"))
worldTFR.na %>% select(contains("Country"))
```

Add new columns with mutate()

- mutate()

```
worldTFR.na %>%
  mutate(ChildBearing_r = round(ChildBearing, 0))

worldTFR$ChildBearing_r = round(worldTFR$ChildBearing, 0)
```

Group operation

- You can group the data and operate based on the group.

```
# Create new variable based on Pop1564Female
worldTFR <- worldTFR %>%
  mutate(female50 = ifelse(Pop1564Female > 50, 1, 0))

# Now calculate group mean of LifeExpB based on the female 50
worldTFR %>%
  group_by(female50) %>%
  summarize(mean(LifeExpB))
```

In-class exercises:

Let's apply the tools we learned with the **worldTFR** dataset!

1. Select all rows where Year is 1951 and TFR is greater than 6.
2. Select all columns except CountryCode.
3. Create a new column called **ChildBearing_sd** where you subtract the mean of the column from its original value and divide the result by the standard deviation of the column.

Intro to R Markdown

- Markdown + R output
- Problem sets -> probably in this format
- Easy to convert into different output formats:
  - HTML, PDF, LaTex, Beamer, etc.
- `knitr` package is needed
- A good guide: https://bookdown.org/yihui/rmarkdown/

Compile

- Hit the “knit” button in Rstudio
- `rmarkdown::render(file.rmd)`

The YAML Header

- The beginning of the R markdown
- Includes metadata
- Surrounded by three dashes
- All are optional

```
---
title: "TITLE"
author: "AUTHOR"
date: "DATE"
output:
 pdf_document / html_document / beamer_presentation:
  output_options such as toc
---
```

Markdown part

- `knitr` uses `pandoc` in as its backend
- pandoc markdown style will mostly be respected
- Headings

```
# Header 1
## Header 2
### Header 3
#### Header 4
```

Markdown part

- italic with `*asterisks*`
- bold with `**double asterisks**`
- List

```
1. item 1
  1. Second level
  - Or this
2. item 2
3. item 3
```

- List 2

```
* item 1
* item 2
* item 3
```

Markdown part

- LaTex style math
  - `$inline_math$`
  - `$$display_math$$`

R code chunks

- Similar to plain markdown codechunk, but the outputs will be executed
- Three backticks followed by `{r}`
- Without `{r}` it will be treated as normal code chunk and will not be executed

````
```{r}
# you code
```
````

Code chunk options

- You can set options for code chunks
  - name, execute or not, display or not etc
- For global setting,

````
```{r}
knitr::opts_chunk$set(options)
```
````

- For a code chunk

````
```{r codechuck_name, option1 = TRUE, option2 = FALSE}
# you code
```
````

Code chunk options

option	default	effect
eval	TRUE	Whether to evaluate
echo	TRUE	Whether to display code
include	TRUE	Whether to include the code and its results
results	TRUE	How to show results
warning	TRUE	Whether to display warnings
error	FALSE	Whether to display errors
message	TRUE	Whether to display messages
cache	FALSE	Whether to save cache files

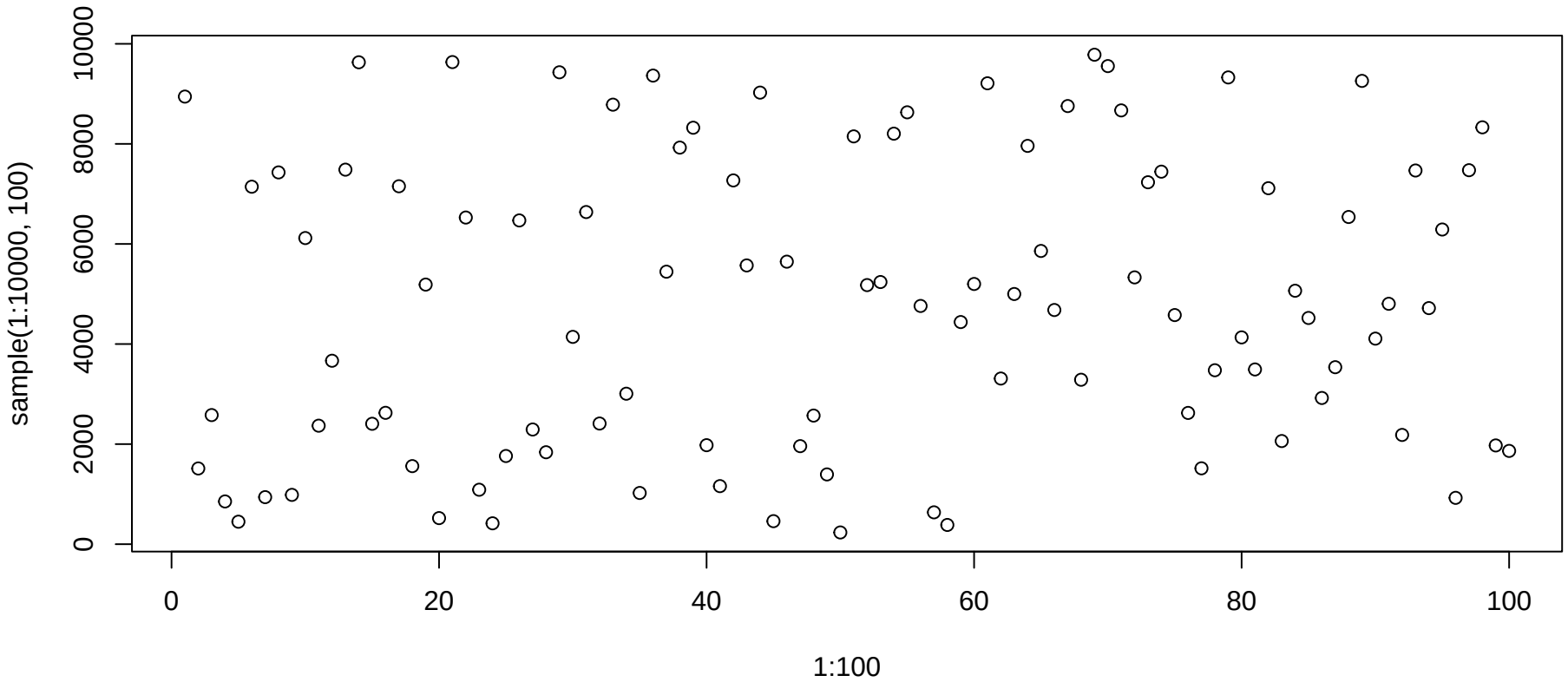
- The full list of options are available here: https://yihui.org/knitr/options/

Adding Images

- When you create an image in your code block in R Markdown

For example,

```
plot(1:100, sample(1:10000, 100))
```



Adding Images

- External image files:

```
![name of your image](path-to-image-here)
```

Figure 1: Sunni is Here!