Lecture 6 Slides

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Setup

- Etherpad page
  `https://etherpad.net/ecog314_2017-10-06`
- Create a directory for today's session
- Download lecture notes
  `https://github.com/wampeh1/Ecog314_Fall2017/`

Introduction

- About the instructor
- Announcements

Objectives

- Write a program and present results using R Markdown
- Define reproduciblity and explain the benefits
- Review R programming topics
- Illustrate financial literacy concepts
- List investment strategies for ordinary investors

Financial Literacy Topics

- Interest rates and inflation
- Risk and diversification
- The relationship between bond prices and interest rates
- The impact that a shorter term can have on total interest payments

Programming Topics

- Reproducible Research
- R Markdown

Reproducibile Research

Reproduciblity

The ability to repeat an analysis and get the same result with the same data

- *What did you do? What did you use?*
- Repeatable

Literate Programming

A programming paradigm where programs are written with a mix of natural language explanations of the steps taken and computer code to carry it out.

- *What were you thinking? Did you explain your decisions?*
- Communicate

Replicability

The ability to duplicate an analysis and get the same results with new data

- Were your results a fluke? Do your findings hold using different statistical samples?
- Corroborate

Introduce R Markdown

R Markdown package:

- Combine R code, output, and formatted text
- Encourages Reproducible Research through Literate Programming.
- Creates nicely formatted documents that include output from R
- Useful for communicating results, collaborating with others, and documenting your work

References

- `http://rstudio.com/cheatsheets`
- `http://r4ds.had.co.nz/r-markdown.html`

Live coding

- Create an R Markdown Document in RStudio
- Demonstrate R Markdown features

Create an R Markdown Document in RStudio

1. From the menu: File >> New >> R Markdown
2. Take the defaults
3. Click OK

This opens a new file in the source pane, with a template created by RStudio.

Main parts of an R Markdown document

1. YAML header
2. R code chunks
3. Markdown text

Rendering a document

1. Save the file with `.Rmd` file extension
2. Knit the document
   - Click on the "Knit" button,
   - Type `Ctrl + Shift + K`
   - Use the menu: File >> Knit Document
   - console command

Editing a Document

Refer to `http://rstudio.com/cheatsheets`

Header

- title
- date
- author
- change the output format
  - `html_document`
  - `pdf_document`
  - `beamer_presentation`

Markdown text

Add text to the body

- Add / delete text
- bold, italics, underline
- headings
- lists
- links
- tables

LaTeX (Math)

Reference:
`https://en.wikibooks.org/wiki/LaTeX/Mathematics`

- Add an inline equation: `$ E = mc^{2} $`
- Add a centered Equation: `$$ y = \beta_{0} + \beta_{1}x_{1} + \beta_{2}x_{2} + \epsilon $$`
- Complex math: $\forall x \in \mathbb{R}^1, \sqrt{x} = i \implies x = -1$

Code Blocks

Edit the code block with the summary

- change the data frame to `mtcars`
- run the `str` function
- print the data frame

Edit the code block with the plot

- load ggplot2 library
- create a scatterplot of speed vs stopping distance

Run code blocks interactively

- line-by-line
- entire code block

Code block options

- specify programming language
- code chunk name
- `echo = TRUE` – Show the code
- `results = "hide"` – run the code, show the code, but do not show the results
- `include = FALSE` – run the code, but do not show either the code or the results
- `eval = FALSE` – show the code, but do not run it
- `cache = TRUE` – save the output
- `results = "asis"`

Inline R Code

Enclose the expression in backticks `` `r `` with the name of the language

```
Pick a random number between 1 and 10: `r sample(1:10, size = 1)`
```

Renders as:

Pick a random number between 1 and 10: 10

Start new document

- Create a new R Markdown file
- Take the defaults
- Clear the template

Add an introduction

What do we intend to do?

The FINRA Investor Education Foundation conducted a survey to study how people manage their resources and make financial decisions. The survey includes several benchmark questions to assess understanding of key financial concepts. In today's class we will try a few of these benchmark questions, illustrate the concepts using R code, and explore the nationwide survey results.

- Insert a link to the FINRA homepage: `http://www.usfinancialcapability.org/`
- Save the file, knit it, and click on the link in the rendered document

Take the quiz

http://www.usfinancialcapability.org/quiz.php

Take notes

Describe what we are doing: taking the quiz, getting familiar with the survey.

- Add two sections with headings to the document:

1. "Taking the online survey", "About the survey", etc.

   In order to familiarize ourselves with the survey, we took the online financial literacy quiz. The first question deals with interest earning savings...

2. "References"

   "Financial Literacy Quiz," Take the Financial Literacy Quiz, FINRA Investor Education Foundation, Accessed October 6, 2017, `http://www.usfinancialcapability.org/quiz.php`.

Question 1

Suppose you have $100 in a savings account earning 2 percent interest a year. After five years, how much would you have?

1. More than $102
2. Exactly $102
3. Less than $102
4. Don't Know

- Key concept: interest earning assets gain value as time passes

Question 1: Model

To show that we have answered correctly, we will model the accumulation of interest using R

Given:

- r is the interest rate where $r \in [0, 1]$
- b is a vector of account balances
- $b_t = b_{t-1} + (rb_{t-1})$

$$b = \begin{bmatrix} b_t \\ b_{t+1} \\ \vdots \\ b_{t+n} \end{bmatrix}$$

Goal: create a vector where each element is the account balance at a different point in time

Question 1: R code

Use a for-loop to compute the interest in each period

Let's visualize these results.

Question 2

Imagine that the interest rate on your savings account is 1 percent a year and inflation is 2 percent a year. After one year, would the money in the account buy more than it does today, exactly the same or less than today?

- Inflation reduces the buying power of the savings account. The nominal value is not the same thing as real value.
- Let's compute the Inflation adjusted returns. Using the investopedia rule.
- Add a reference to the source at the end of the document

  "Inflation-Adjusted Returns", Inflation-Adjusted Returns, accessed 2017-10-07, `http://www.investopedia.com/terms/i/inflation_adjusted_return.asp`

Question 2: R code

Survey Data

Let's look at the data and see how people responded to these questions in the survey.

Create a new section heading

Create a section entitled “Data”. Add text to describe where we are getting our data

Data for the 2015 National Financial Capability Study (NFCS) are available for download from the foundation’s website. To keep track of what we are doing we will use R to download the 2015 State-by-State Respondent-Level Data.

Create directories

Store raw data separately. To maintain reproducibility, do not alter the raw input data.

Download the raw data, unzip

```r
# Source data
link <- "http://www.usfinancialcapability.org/downloads/NFC

# Path for a local copy of the file
save_as <- file.path(raw_dir, basename(link))



# Conditionally downlad and unzip the file
if ( !file.exists(save_as) ) {

    # Download the raw data file if we don't already have
    download.file(link, save_as)
    unzip(save_as, exdir = raw_dir)

} else if ( !file.exists(file.path(raw_dir, "NFCS 2015 Stat

    # Extract all raw data files from an existing zip file
    unzip(zip_file, exdir = raw_dir)
```

Import the raw data

Clean the data, filter an reformat variables

Explore the data