Introduction to R for Plant Breeding Applications

September 5, 2019
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Downloading R and Rstudio

- **R** is the statistical software

https://cran.r-project.org/mirrors.html

- **Rstudio** is an environment that will make it easier for you to develop R code

https://www.rstudio.com/products/rstudio/download

Suggested reference books

- O'Reilly *Learning R*
  - Best for an overview of the different components of R, when learning for the first time

- O'Reilly *R Cookbook*
  - Have a specific problem? Look here!

I'll reference specific chapters here on each slide if you want to learn more

Why do we use R?

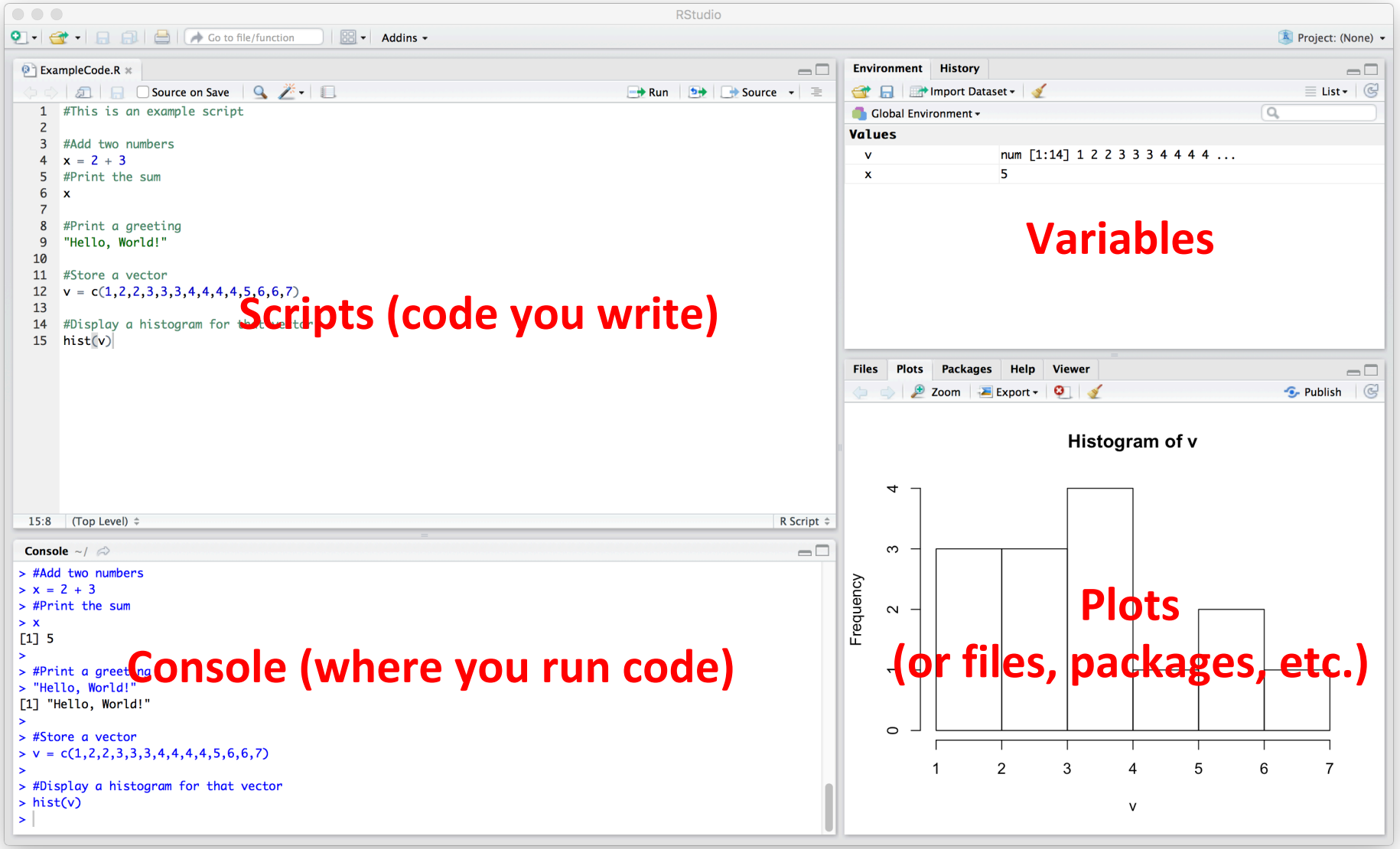
...instead of Microsoft Excel or JMP?

- Ability to perform repeated statistical tests without lots of clicking around!
- Much prettier graphs
- It's free!

...instead of another programming language (Python, Perl, Java, etc?)

- R is specifically designed for data manipulation and statistics

RStudio Layout



Overview

- Part I: Basics
  - R data structures
  - R operations
  - Reading and writing to files
  - Plotting data

- Part II: Application

  Analyzing potato variety trial data

Comments are important!!

```
#This is a comment
code
```

- Comments will help you and others understand what your code does
- Add them as you are writing! Don’t wait until later

Data Structures

Scalar	Vector	Matrix
x = 3	v = c(1,2,3)	m = matrix(c(1,2,3,4,5,6), nrow = 2)
x 3	v 1 2 3	m 1 2 3 4 5 6

Learning R Ch. 2-4

Data Structures

Scalar	Vector	Matrix
x = “hello”	v = c(“hello”, “greetings”, “good morning”)	m = matrix(c(“a”, “e”, “i” ,“o”, “u”, “y”), nrow = 2)
x “hello”	v “hello” “greetings” “good morning”	m “a” “e” “i” “o” “u” “y”

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Basic operations on scalars

x + y

x – y

x * y

x / y

x % y (modulo)

sqrt(x)

x^ y

Exercise 1

See “Exercises.R” code

Solutions can be found in “Exercises_solutions.R”

Basic operations on vectors

```
mean(v)
median(v)
max(v)
min(v)
length(v)   # Gives number of elements in vector
v + 2       # Adds 2 to every value in the vector
c(v1, v2)   # Concatenates vectors
```

Basic operations on matrices

```
m + 1        #Add 1 to every element of matrix m
mean(m)  #Calculate mean of all elements in m

cbind(m1, m2)       #Concatenate by columns
rbind(m1, m2)       #Concatenate by rows

dim(m)                    #Gives dimensions of m
```

Element operations on matrices

Find a certain row or column:

```
m[3,] # get the third row
m[,5] # get the fifth column
```

Change one element:

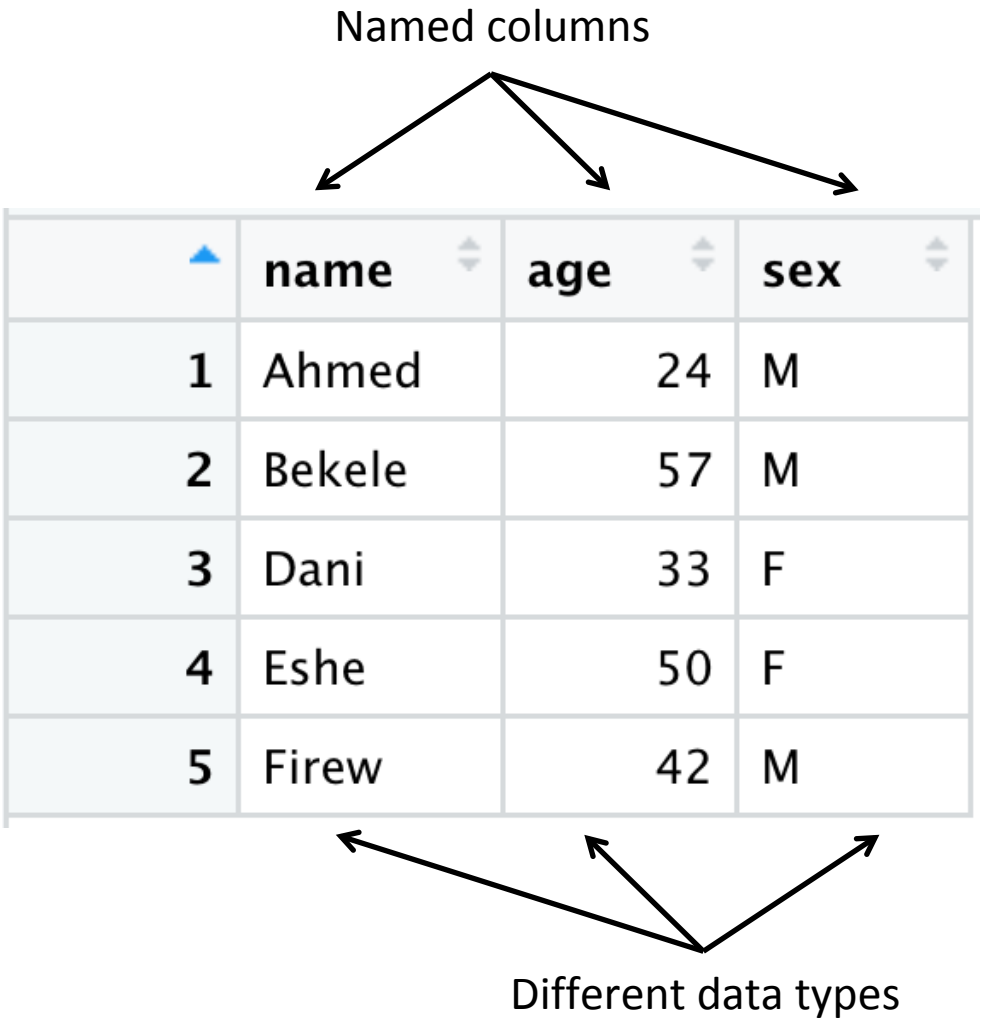
```
m[4,7] <- 8 # change the element in
            # row 4, col 7 to the value 8
```

Exercise 2

See “Exercises.R” code

Solutions can be found in “Exercises_solutions.R”

R's special data structure: data frames



	name	age	sex
1	Ahmed	24	M
2	Bekele	57	M
3	Dani	33	F
4	Eshe	50	F
5	Firew	42	M

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Data frames: $ notation

- Data frames allow you to name each column (e.g. variety, yield, color)
- You can then access that column with the column name as shown:

```
> df$variety
[1] ”Lehigh"  ”Eva"   ”YukonGold"
”Burbank" ”Belete”
```

Exercise 3

See “Exercises.R” code

Solutions can be found in “Exercises_solutions.R”

Working directory

- R always needs to know where to read files from and print new files

- To get your current working directory:

getwd()

- To set a new working directory:

setwd(*pathname*)

e.g. setwd("C:/users/Hannah/Rfolder")

Reading and writing to files

- Many times, we don't want to type out all the data we have into the R code
- Instead, we can import data from a pre-existing file
- Most common formats are "tab-delimited text" (tdt or txt) and "comma-separated values" (csv)
- We also want to store our analyzed data in new files

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Formatting a file for import to R

- Make sure your data is “rectangular”- all rows and columns are the same length
- Fill in missing values with “NA”
- No funny symbols ($, %, #, etc.) in data- periods and underscores OK
- Better if no spaces
- Save Excel file as csv or tdt

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Code to read in a file

```
data <- read.table(
                    filename,
                    header = T,
                    sep = “\t”
                    )
```

Code to write to a file

```
write.table(
        data,
        filename = “datafile.txt”,
        sep = “,”
        )
```

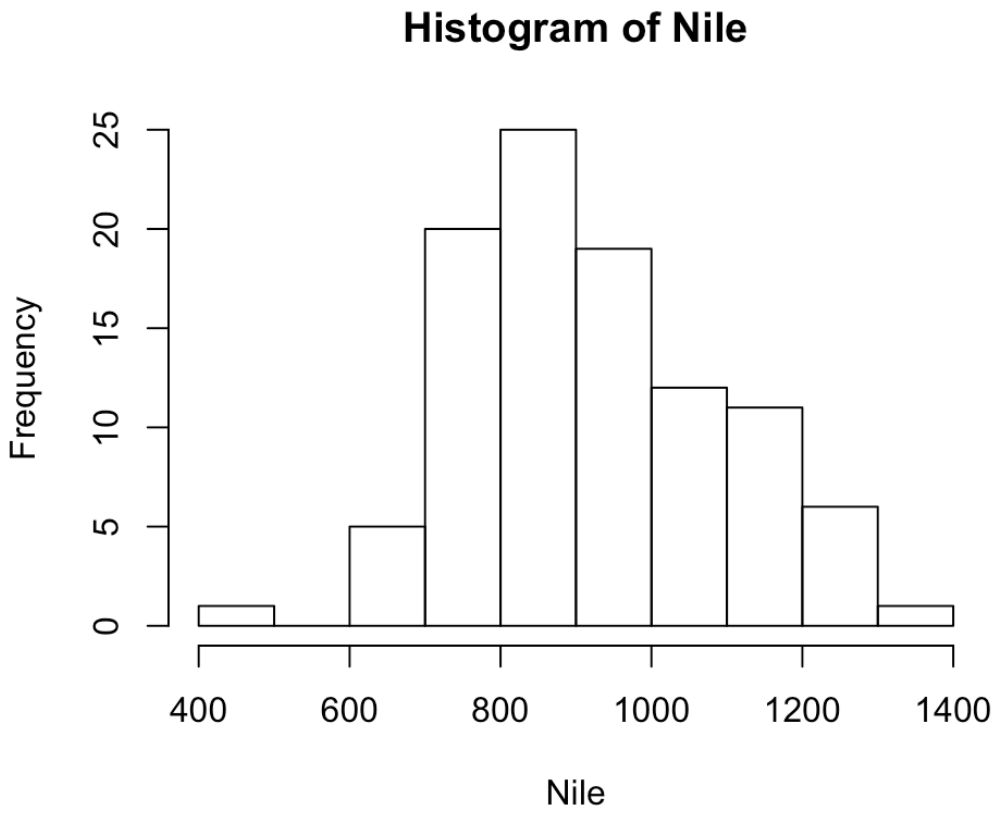
Exercise 4

See “Exercises.R” code

Solutions can be found in “Exercises_solutions.R”

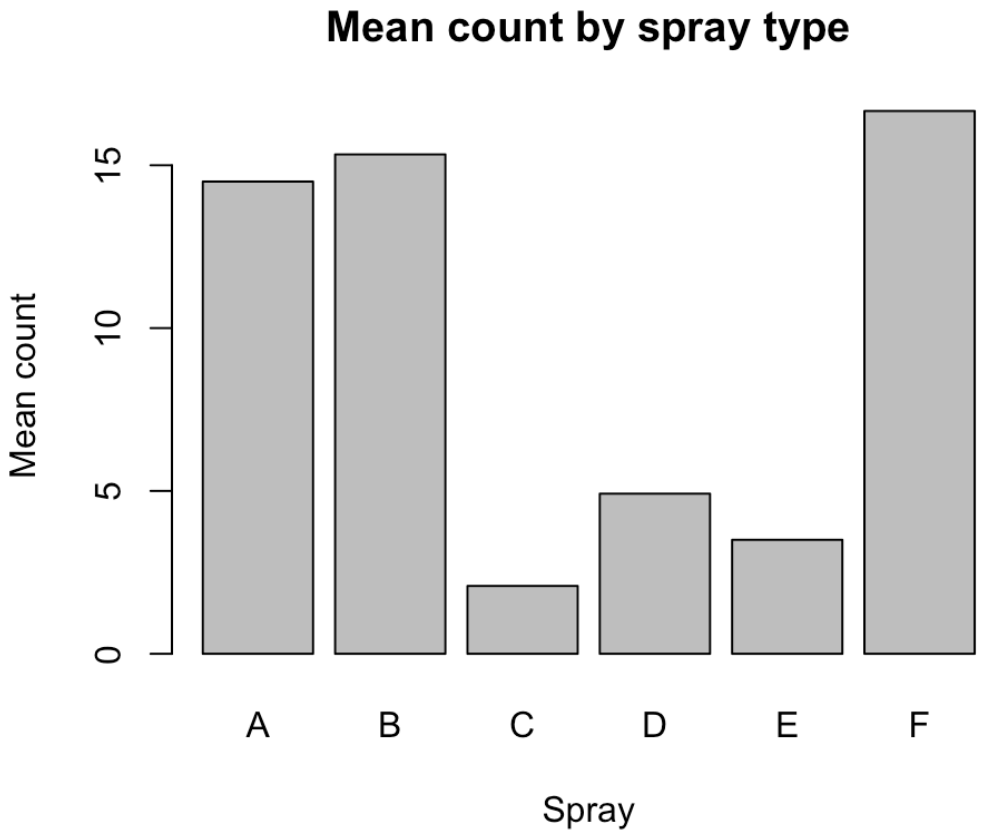
Plotting: histograms

histogram(data, [other parameters])



Plotting: barplots

barplot(data, [other parameters])



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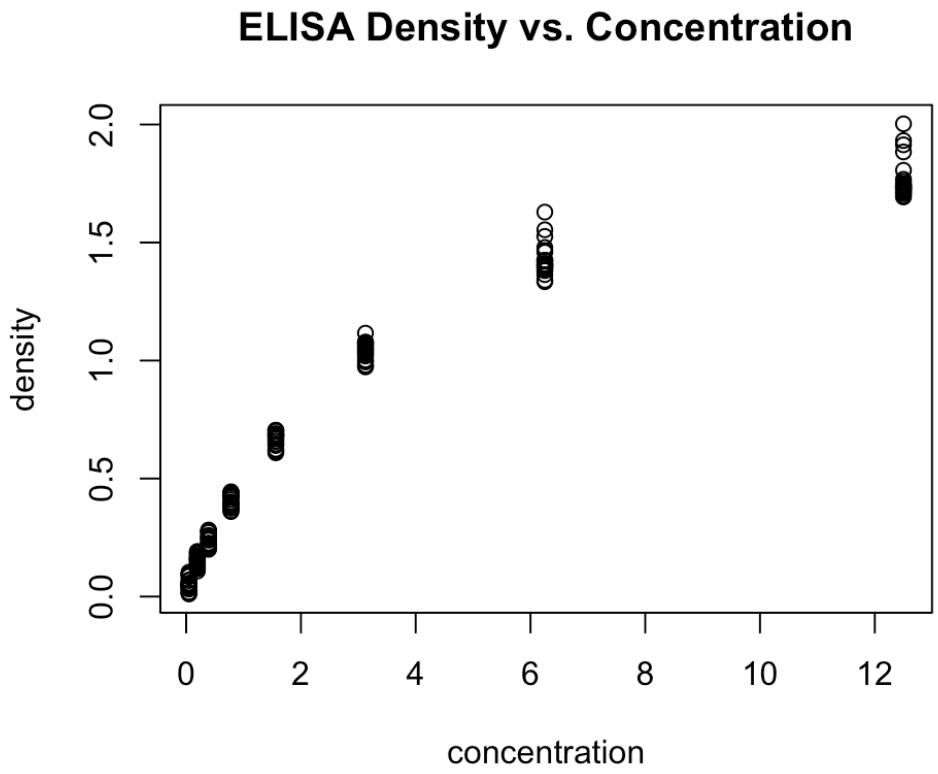
Plotting: scatterplots

plot(x, y, [other parameters])



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Exercise 5

See “Exercises.R” code

Solutions can be found in “Exercises_solutions.R”

Analyzing Potato Variety Trial Data

See “PotatoVarietyTrialAnalysis.R” code

This code provides some example analysis for potato variety trial data. It can be modified for your own data sets.