DataScience for Development and Social Change, 2015

Exploring data with R

What it is, what you can do with it

The R Programming Language

- Good at:
  - Rapid statistical analysis (4000+ R libraries)
  - Rapidly-created static graphics
- Bad at:
  - Web applications (although you can use Shiny)
  - Pretty interactive graphics (use D3)
  - Iteration (use almost anything else)

Download R from http://www.r-project.org/

Starting R

- 4 ways to run R:
  - Terminal window: type “r” (and “q()” to quit)
  - Rstudio: click on Rstudio tool
  - R script from the command line: “R <filename.r —no-save”
  - R script from inside R: source('myscript.r')
  - From Python: use the rpy2 library

Getting help

- Inside R or Rstudio:
    - help(functionname)
    - example(functionname)
    - e.g. help(sum), example(sum)
- R community:
    - R bloggers
    - R local user groups
    - R mailing lists
    - Stack overflow

Variables

- data types:
    - 2.456
    - 'This is a string'
    - TRUE, FALSE
- Variables:
    - x <- 15
    - x/4
    - y <- 'This is also a string!'
    - print(x)

Vectors

- Vector = same as Python’s list
  - a <- c(1,5,2)
  - note the ‘c’ function (‘combine’)
- NB if you try creating a mixed-variable vector, R will create a vector of strings. Try this:
  - x <- c(1,'five',2,TRUE)
- Indices:
  - x[3]
  - x[2] <- 'four'
  - x[2:4]
  - NB: R indices start at 1 (unlike Python, which start at 0)

Sequences

- 1:5
- seq(1,5)
- seq(1,5,0.3)
- x[2:4]

Functions

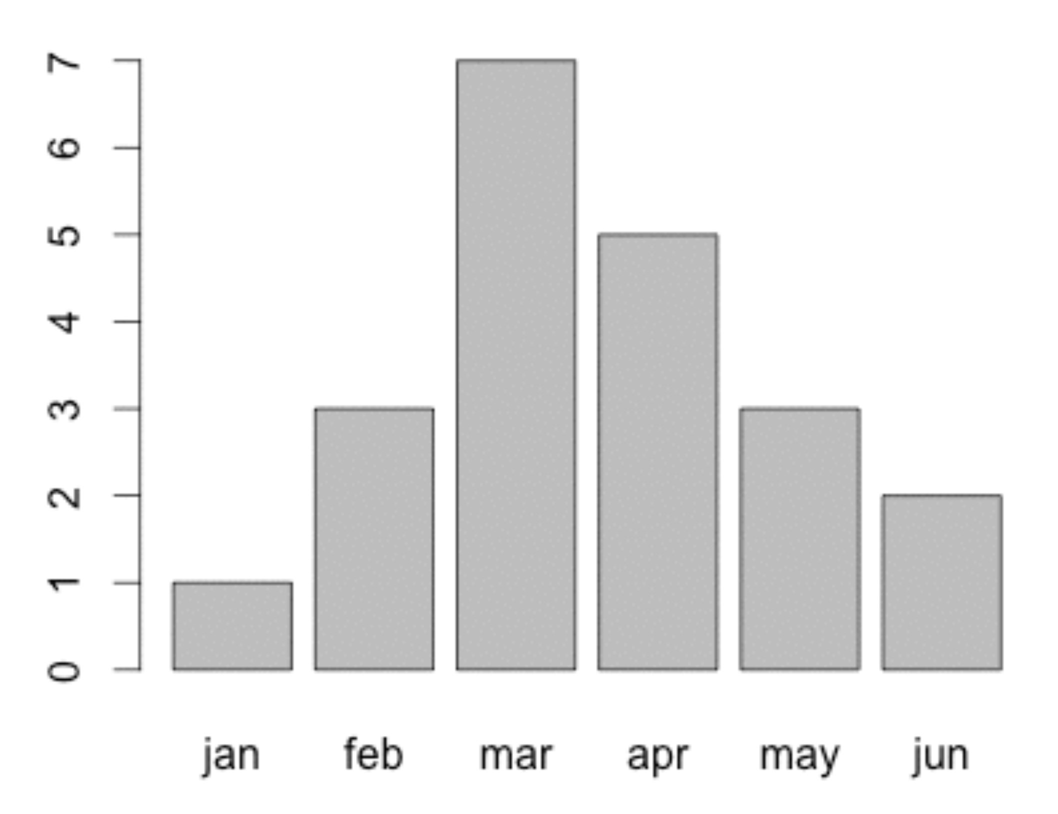
- sum(1,2,3,7,3,4)
- a <- c(1,2,3,7,3,4)
- sum(a)
- max(a)
- sqrt(a)

Vector names

- You can name each entry in your vector:
  - x <- c(1,'five',2,TRUE)
  - names(x) = c('1st', '2nd', 'third', 'rainbow')
  - x['2nd']
  - x['rainbow'] <- FALSE

Visualisations

- b <- c(1,3,7,5,3,2)
- names(b) <- c('jan','feb','mar','apr','may','jun')
- barplot(b)

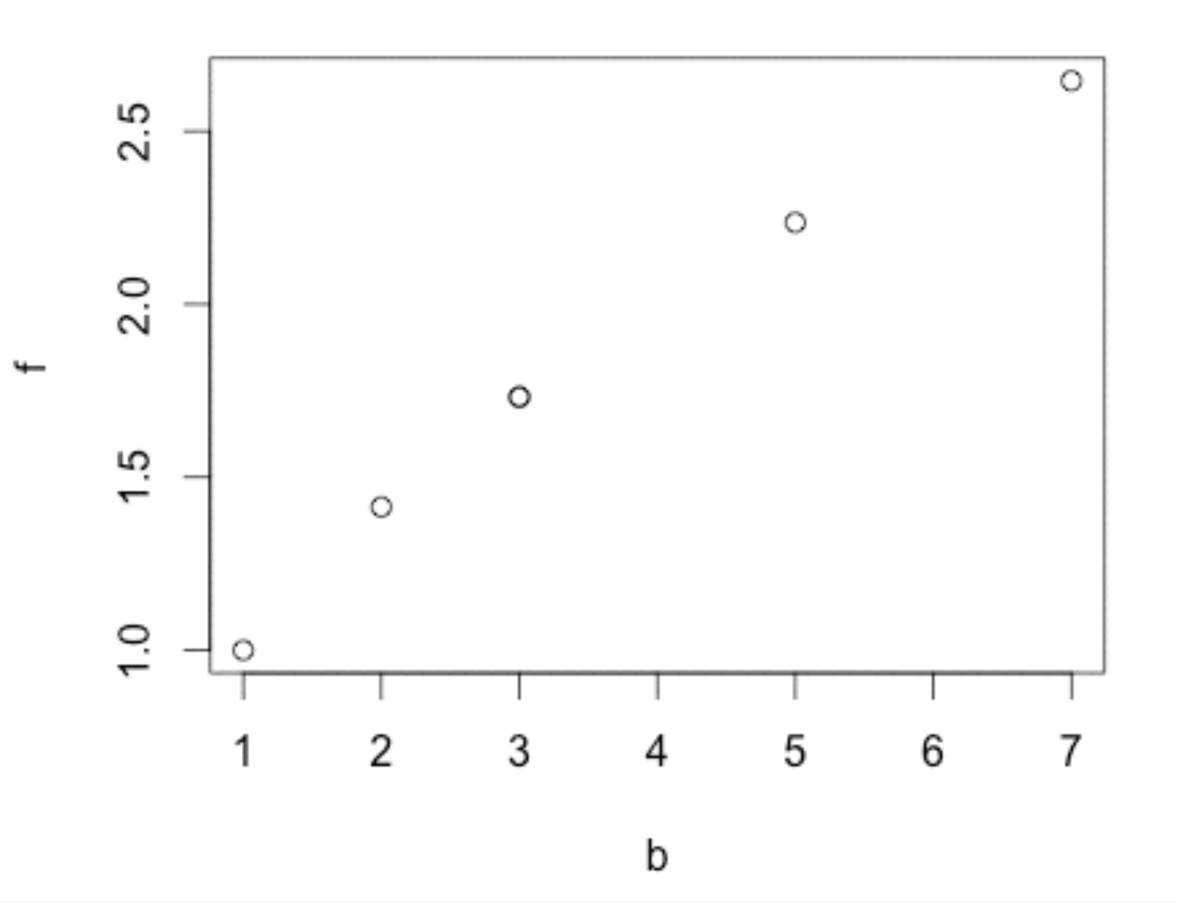


Vector Maths

- b <- c(1,3,7,5,3,2)
- b+1
- b/4
- sqrt(b)
- d <- c(3,6,5,4,3,7)
- b*d
- b == d

More visualizations

- b <- c(1,3,7,5,3,2)
- f <- sqrt(b)
- plot(b,f)



Handling missing values

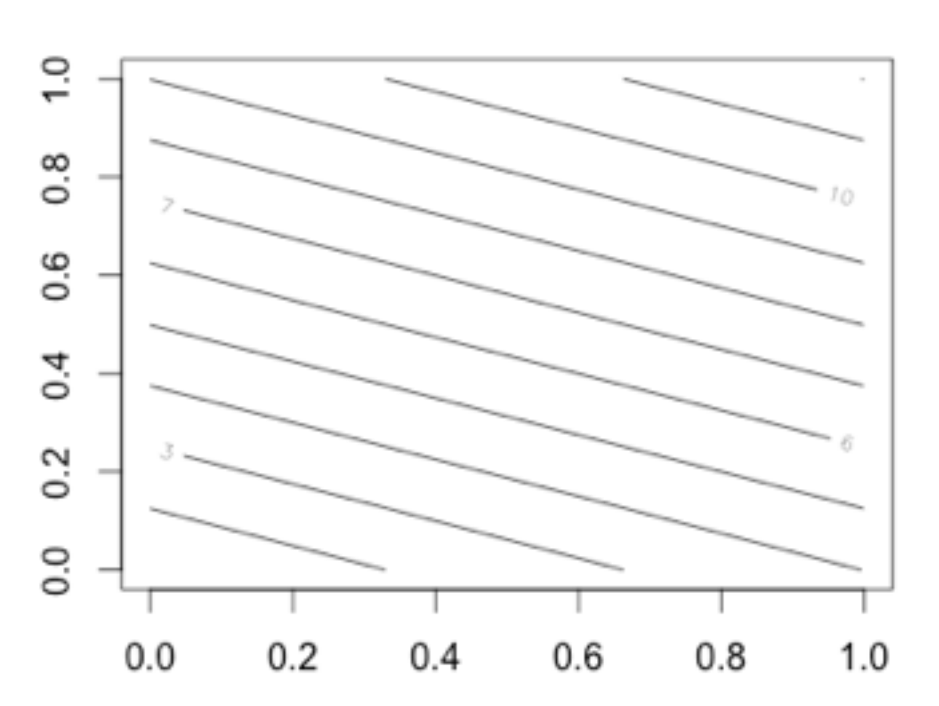
- b <- c(1,3,7,NA,3,2)
- sum(b)
- sum(b, na.rm=TRUE)

Matrices (two-dimensional arrays)

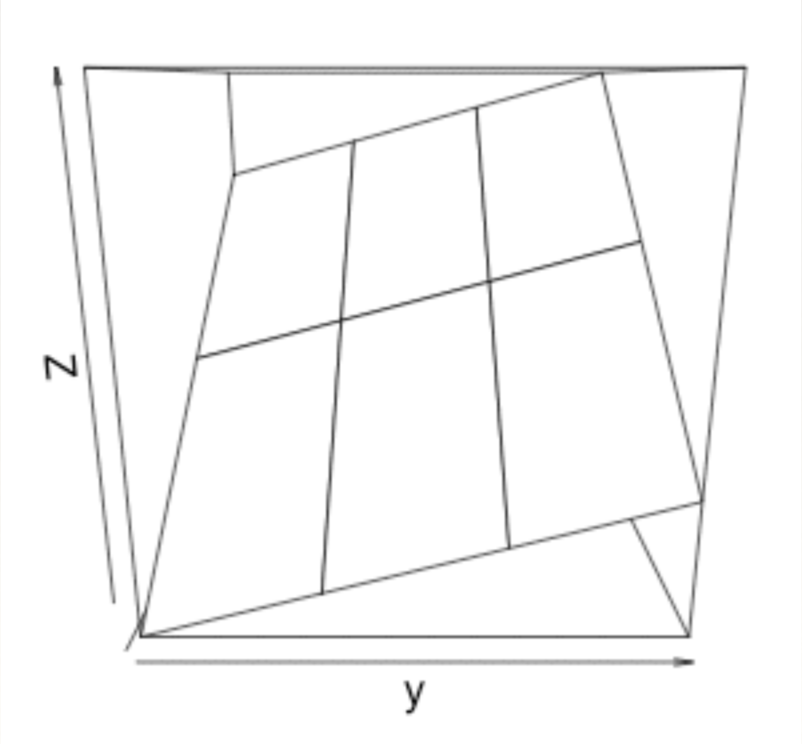
- x <- matrix(0, 4, 3)
- y <- matrix(1:12, 4, 3)
- y[2,3] <- 15
- y[,3]
- y[2,2:3]
- print(y[1,3])
- z <- 1:15
- dim(z) <- c(3,5)
- print(z)

More visualisation

- y <- matrix(1:12, 4, 3)
  - contour(y)
  - persp(y)



- R comes with example datasets:
  - contour(volcano)
  - persp(volcano)

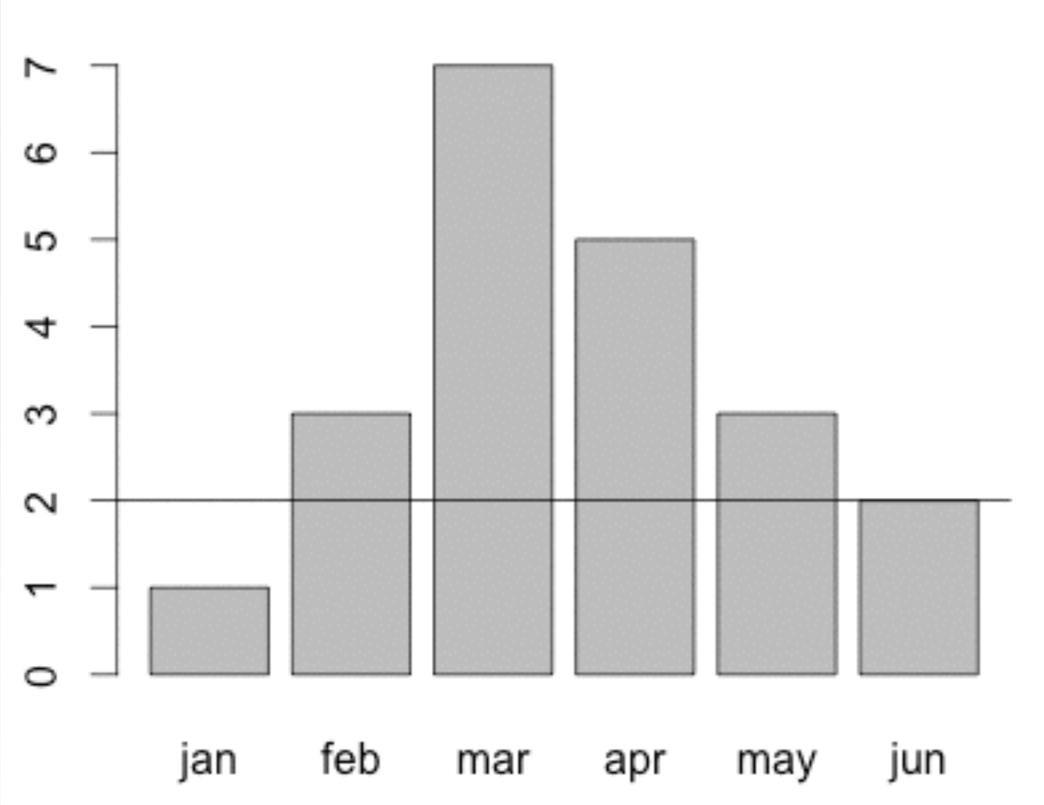


Getting Statistics

- b <- c(1,3,7,5,3,2)
- mean(b)
- median(b)
- sd(b)

Adding to visualizations

- b <- c(1,3,7,5,3,2)
- names(b) <- c('jan','feb','mar','apr','may','jun')
- barplot(b)
- abline(h=2)



Factors

- a <- c('developed', 'transitioning', 'developed', 'developing', 'developed', 'developing', 'developed')
- classes <- factor(a)
- print(classes)
- print(levels(classes))

DataFrames (tables)

- refugees = c(23,175,15543,11,338796,1244,63,53)
- asylumseekers = c(140,77,2872,6,255,91,6,7)
- origins = c('Burundi','Dem. Rep. of the Congo', 'Eritrea', 'Rwanda', 'Somalia','South Sudan','Sudan','Uganda')
- countries <- factor(origins)
- popstats <- data.frame(refugees, asylumseekers, countries)
- print(popstats)
- print(popstats$asylumseekers)

Reading CSV files into Dataframes

- List all files:
  - list.files()
- Read a CSV into a data frame:
  - refugees <- read.csv('popstats_clean.csv')
- Read a tab-separated file into a data frame:
  - population <- read.table('sp_pop.tsv', sep='\t', header=TRUE)

Exploring a Dataframe

- refugees <- read.csv(‘popstats_clean.csv')
- dim(refugees)
- **str(refugees)**
- head(refugees)
- tail(refugees)

Merging dataframes

- merge(x = refugees, y = population, by.x='Country.of.origin', by.y='Country.Name')

- Spaces in headings got converted to dots
- Use by.x, by.y *unless* you have at least one column with the same name in both files

Science: correlation

- plot(column1, column2)
- cor.test(column1, column2)
- Is the p-value smaller than 0.05? Yes = strong evidence for correlation.

P-Values

- Data scientists often mention “p-values”
  - Part of hypothesis testing:
    - Null hypothesis = no relationship between two items
    - significance level = lowest value we can reject null hypothesis at, e.g. 1%, 5% etc. (below this = sampling error)
    - p-value: calculated strength of relationship. If p-value < significance level, assume no relationship

Science: linear models

- plot(column1, column2)
- line <- lm(column2 ~ column1)
- abline(line)

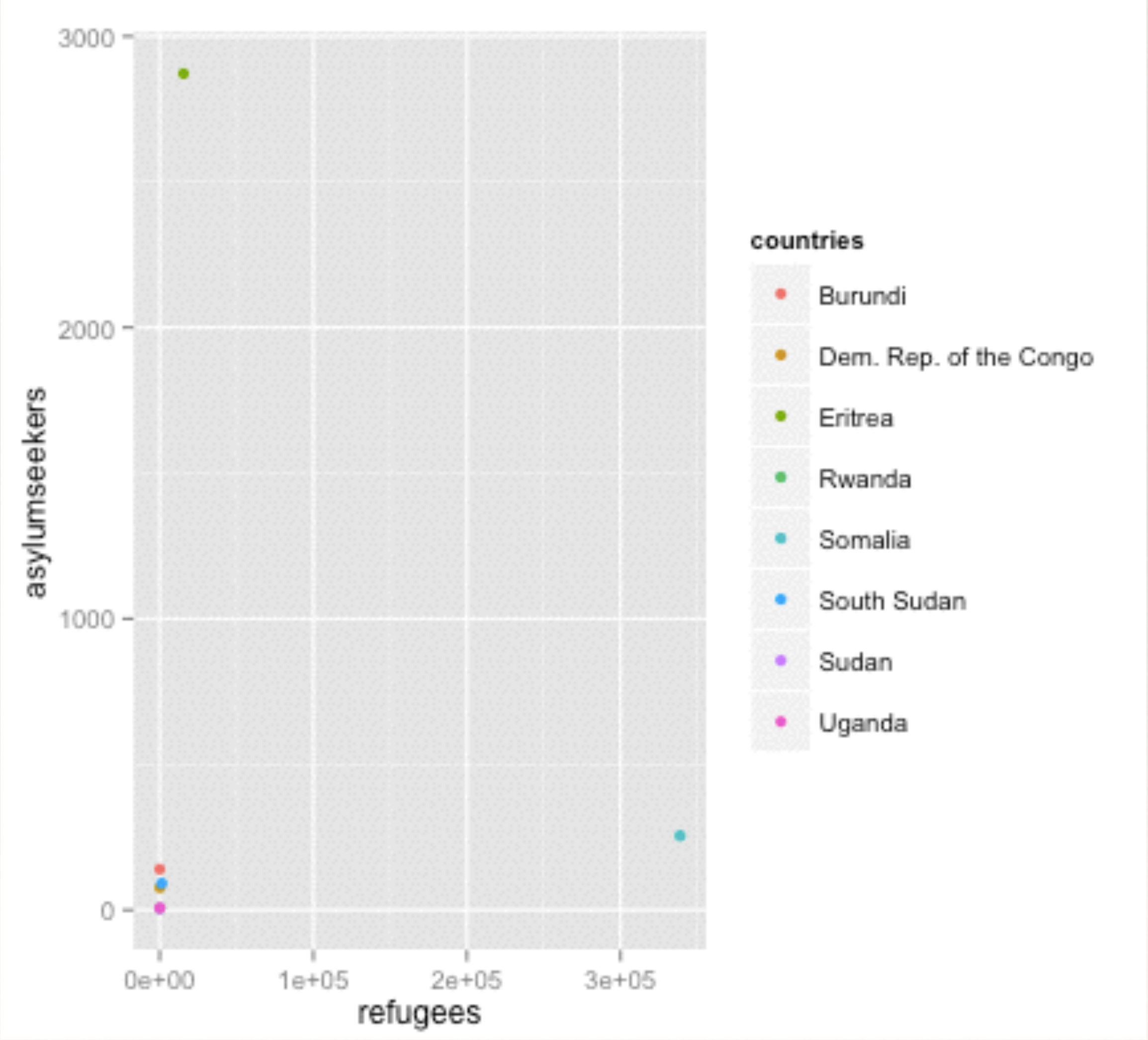
R libraries

- R libraries are called “packages”. They live here: http://cran.r-project.org/
- To install package x, start R and type:
  - install.packages('x')
- To get information about a package, type:
  - help(package = 'x')
- You’ll probably want these packages:
  - ggplot2
  - plyr
  - xlsx

Using ggplot2

- refugees = c(23,175,15543,11,338796,1244,63,53)
- asylumseekers = c(140,77,2872,6,255,91,6,7)
- origins = c('Burundi','Dem. Rep. of the Congo', 'Eritrea', 'Rwanda', 'Somalia','South Sudan','Sudan','Uganda')
- countries <- factor(origins)

- library(ggplot2)
- qplot(refugees, asylumseekers, color = countries)



Continuing your R Journey

- Websites:
  - http://www.cookbook-r.com/
  - http://www.statmethods.net/
  - The community sites from slide 3
- Books:
  - Paul Teetor, "The R cookbook"
  - Examples in O'Neil's "Doing data science"