RIT Department of Computer Science Colloquia Series

An Introduction to R

March 31, 2009

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What is R? (mostly from www.r-project.org)

- Integrated suite of software facilities for data manipulation, calculation and graphical display. It includes
  - Effective data handling and storage facility,
  - Suite of operators for arrays, lists, and other objects
  - Large, integrated set of intermediate tools for data analysis,
  - Graphical facilities for analysis & display (computer/hardcopy)
  - Well developed, effective programming language (‘S’) which includes conditionals, loops, recursive functions, I/O facilities. (Most of system-supplied functions are written in S.)
- Some Features
  - Object-oriented
  - Designed to be run interactively
  - Free

R is an environment

- "environment" is intended to characterize R as a fully planned and coherent system
- Not an incremental accretion of very specific and inflexible tools, frequently the case with other data analysis software.
- A vehicle for newly developing methods of interactive data analysis.
    - It has developed rapidly, and has been extended by a large collection of packages.
    - However, most programs written in R are essentially ephemeral, written for a single piece of data analysis.

Origins of R

- The design of R has been heavily influenced by two existing languages:
  - S (Becker, Chambers & Wilks)
    - S is a very high level language and an environment for data analysis and graphics.
    - In 1998, the ACM presented its Software System Award to John M. Chambers, the principal designer of S
  - Scheme (Sussman)
    - Dialect of Lisp stressing conceptual elegance and simplicity
    - Much smaller than Common Lisp
- Resulting language is very similar in appearance to S or S-Plus
- Underlying implementation and semantics derived from Scheme
- R ("GNU S")
- "R": Robert Gentleman and Ross Ihaka—University of Auckland

R is well-known

- Google
  - Minitab software: 149,000
  - JMP software: 173,000
  - SAS software: 7,220,000
  - Java software: 31,200,000
  - R software: 69,700,000

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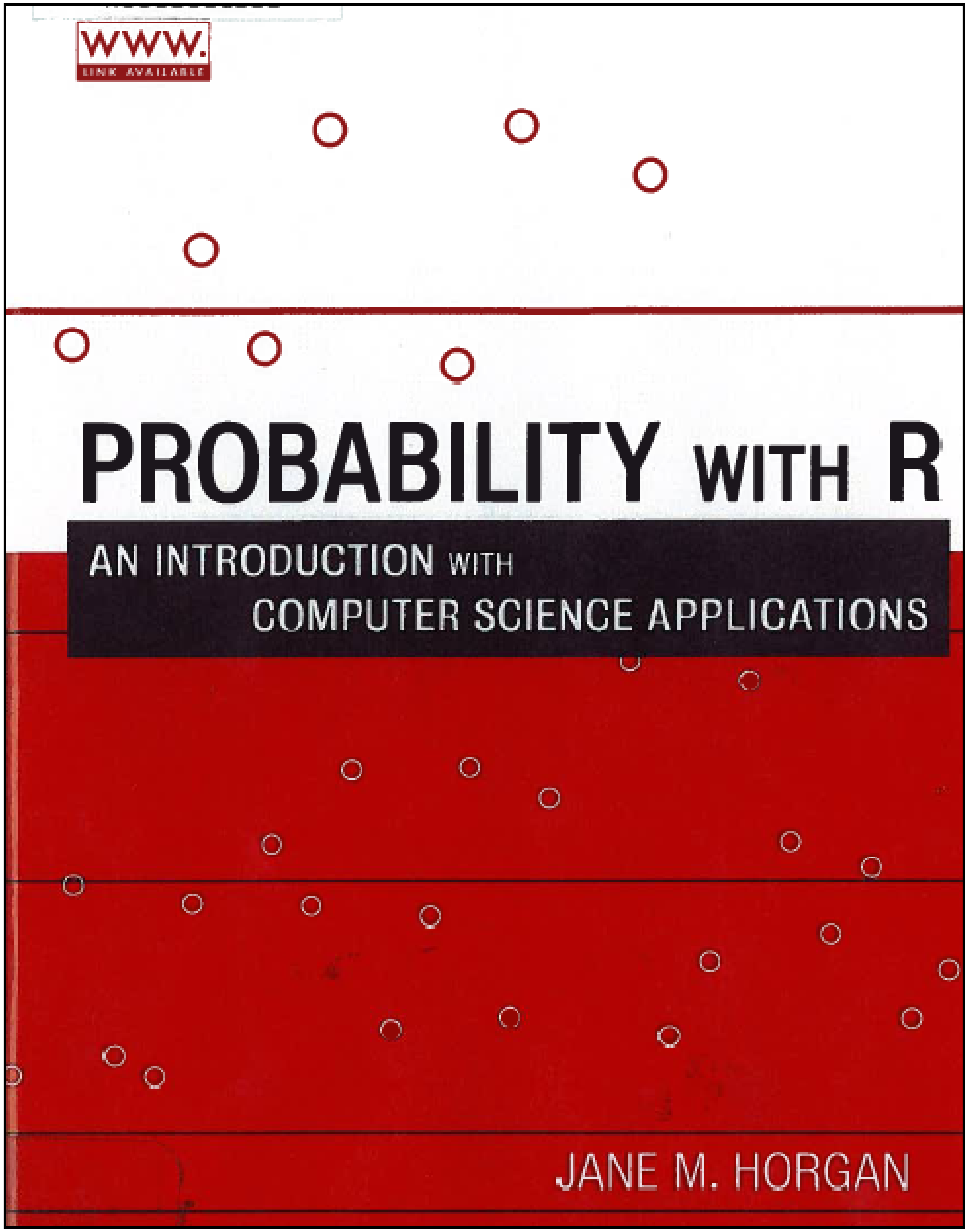
- Linux, Mac OS X, Windows

- De facto standard language for many grad statistics programs
- Many corporations (some paying for “R+”)
- You never know where it might show up ...



WWW.
LINK AVAILABLE

PROBABILITY WITH R

AN INTRODUCTION WITH
COMPUTER SCIENCE APPLICATIONS

JANE M. HORGAN

Yeah, but What is R??

- Some Examples

Example 1. Some Basic Ideas

CPU dataset

Asuncion, A., Newman, D.J. (2007). *UCI Machine Learning Repository*. Irvine, CA: University of California, School of Information and Computer Science. [http://www.ics.uci.edu/~mlearn/MLRepository.html.].

- Objects
- Data Frames
- Classes
- Search Path
- Graphs
- Linear Regression
- Matrices

Example 2. Some Data Structures

- Vectors
- Matrices
- Arrays
- Lists
- Data Frames
- Combinations of structures
- Your own structures

Example 3. Vectorized Arithmetic

- Vectorized arithmetic
- Some (naïve) alternatives

Simulate 100,000 uniform numbers in [0,1]

nsim<-100000

1. Working on the entire object—good!

   ```
   system.time(x<-runif(nsim))
   ```

2. Using a ***for*** loop—bad!

   ```
   x<-rep(NA,nsim)
   system.time(
      for(i in 1:nsim) x[i]<-runif(1) )
   ```

3. Using a ***for*** loop and building up an object—very bad!

   ```
   x<-c()
   system.time(
     for(i in 1:nsim) x<-c(x,runif(1)) )
   ```

Example 4. A Many-Files Problem

- Reading in a more complex file
- Cleaning up the file
- Rearranging data
- Reading in many files

See next page, TestMe.txt, and .R file

1. Scientist wants to work with data: o/p from profilometer.
2. Output: text file with header; x, then y values; trailer
3. What needs to be done
    a. Delete all records up to, including, 2nd row of “EOR”
    b. Delete last two rows: “EOR” and “EOF”
    c. The remaining data should all be numeric, with one number per record. (Say numR records.)
    d. Split single column into two columns of length numR/2 (x=1st numR/2 numbers and y=2nd numR/2 numbers).
    e. Create third column, g(x, y)=x+y.
    f. Write result to file, same as i/p but with “_op” on end.
4. An example file, TestMe.txt, can be used to test the code.
5. Also, investigate relationship of x and y, and look for any unusual values.
6. Then run the i/p→o/p routine on all .txt files in a directory.

Example 5. Windows Files, Regular Expressions

- Accessing Windows file names
- Creating new file names
- Creating a new directory
- Copying files

See pings directory and PingFiles_Example.R

Example 6.
Function Writing—Sieve of Erasthones'

R naturally lends itself to writing functions

- The 'sieve of Erasthones' determines whether a positive integer x is prime.
- Method: Check each integer y between 2 and $\sqrt{x}$ to determine whether y evenly divides x.
- Requirements
  1. Return TRUE if x is prime, FALSE otherwise
  2. Return the divisors of x.

- Function writing
- sapply function (one of several *apply functions)

Example 7. More graphs

R has a wide variety of powerful graphic functions. You may also build a graph from more basic graphic calls.

Example 8. Packages

- 1752 at last count
- A wide variety of uses
  - Newest statistical techniques
  - Additions to base R
  - I/O, e.g. html, LaTex, Excel
  - Data sets from books
  - Interfaces to other libraries
  - Graphics
  - Utilities
  - Connections to editors

ADaCGH	Analysis of data from aCGH experiments
AER	Applied Econometrics with R
AIGIS	Areal Interpolation for GIS data
AIS	Tools to look at the data ("Ad Inidicia Spectata")
ALS	multivariate curve resolution alternating least squares (MCR-ALS)
AMORE	A MORE flexible neural network package
ARES	Allelic richness estimation, with extrapolation beyond the sample size
AcceptanceSampling	Creation and evaluation of Acceptance Sampling Plans
AdMit	Adaptive Mixture of Student-t distributions
AdaptFit	Adaptive Semiparametic Regression

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yest	Gaussian Independence Models
ZIGP	Zero Inflated Generalized Poisson (ZIGP) regression models
Zelig	Everyone's Statistical Software
zipfR	Statistical models for word frequency distributions
zoeppritz	Zoeppritz Equations
zoo	Z's ordered observations
zyp	Zhang + Yue-Pilon trends package

More Information on R?

www.r-project.org/

www.rit.edu/kgcoe/cqas/about/technicalreports.htm

(My Intro to R for Windows)

Thank you

Questions?