R Trix for Kids?
Presentation to TVSB Math Department Heads

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W. John Braun

University of Western Ontario

Outline

Setting a Context: A Brief Pre-History of R Trix

A Sample of R

Why R?

The R Trix Site

Census at School

Setting a Context: A Brief Pre-History of R Trix

1970's: S

Goal: Statistical Methodological Research

Audience: Researchers at Bell Labs, and at other high level organizations

Setting a Context: A Brief Pre-History of R Trix

1980's: S-Plus

Goal: Scientific Research

Audience: Statistics Researchers, Faculty, Graduate Students

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1990's: R

Goal: Methodological Research

Audience: Statistics Researchers, Faculty, Graduate Students

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2000's: R

Goal: Scientific Research

Audience: Senior Undergraduate Statistics Students, Scientific Researchers, Major Corporations

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2010's: R

Audience: Undergraduate students in many fields

Future: Secondary School students

⤳ R Trix: R Teaching Resources for Interactive eXploration of data and chance

Setting a Context: A Brief Pre-History of R Trix

R is a statistical program which is available online

Home (CRAN) is in Vienna, but there are now hundreds of mirror sites worldwide

Highest concentration of R activity in Canada is at the University of W?

Wrong, not Waterloo

A Sample of R

Arithmetic:

```
> 23 + 49


[1] 72


> 359 - 198


[1] 161
```

A Sample of R

> 11111*11111

[1] 123454321

> 1234567654321/1111111

[1] 1111111

A Sample of R

> *1111^2*

[1] 1234321

> *sqrt(12345678987654321)*

[1] 111111111

A Sample of R

Modular Arithmetic:

57 mod 13

```
> 57%%13
```

```
[1]  5
```

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Absolute Value:

$$|-78|$$

```
> abs(-78)
```

```
[1] 78
```

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Functions

```
polynomials, exp(), log()

sin(), cos(), tan(), sinh(), cosh(), ...
```

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Derivatives

```
> D(expression(exp(x^3)), 'x')


exp(x^3) * (3 * x^2)
```

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Integrals

Find

$$\int_3^7 \sin(2/x)dx.$$

> *integrate(function(x) sin(2/x), 3, 7)$value*

[1] 1.634917

A Sample of R

Sequences and Series

```
> S <- seq(1,100)
> S
```

```
  [1]    1    2    3    4    5    6    7    8    9   10   11
 [19]   19   20   21   22   23   24   25   26   27   28   29
 [37]   37   38   39   40   41   42   43   44   45   46   47
 [55]   55   56   57   58   59   60   61   62   63   64   65
 [73]   73   74   75   76   77   78   79   80   81   82   83
 [91]   91   92   93   94   95   96   97   98   99  100
```

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```
> sum(S) - (100)*(101)/2



[1] 0



> sum(S^2) - (100)*(101)*(201)/6



[1] 0
```

A Sample of R

Linear Algebra

Vectors:

$$x = \begin{bmatrix} -3 \\ 8 \\ 6 \end{bmatrix}$$

```
> x <- c(-3, 8, 6)
```

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$$z = \begin{bmatrix} 15 \\ 13 \\ 32 \end{bmatrix}$$

```
> z <- c(15, 13, 32)
```

A Sample of R

$$x + z =$$

> x + z

[1] 12 21 38

A Sample of R

Inner Products:

$$x^T z =$$

```
> x%*%z
```

```
      [,1]
[1,]   251
```

A Sample of R

Matrices:

$$B = \begin{bmatrix} 2 & 4 & 3 \\ 2 & 1 & 10 \\ 1 & -2 & 1 \end{bmatrix}$$

A Sample of R

```
> B <- matrix(c(2, 2, 1,  4, 1, -2, 3, 10, 1),
+             nrow=3)
> B
```

```
     [,1] [,2] [,3]
[1,]    2    4    3
[2,]    2    1   10
[3,]    1   -2    1
```

A Sample of R

$$Bz =$$

```
> B%*%z
```

```
        [,1]
[1,]   178
[2,]   363
[3,]    21
```

A Sample of R
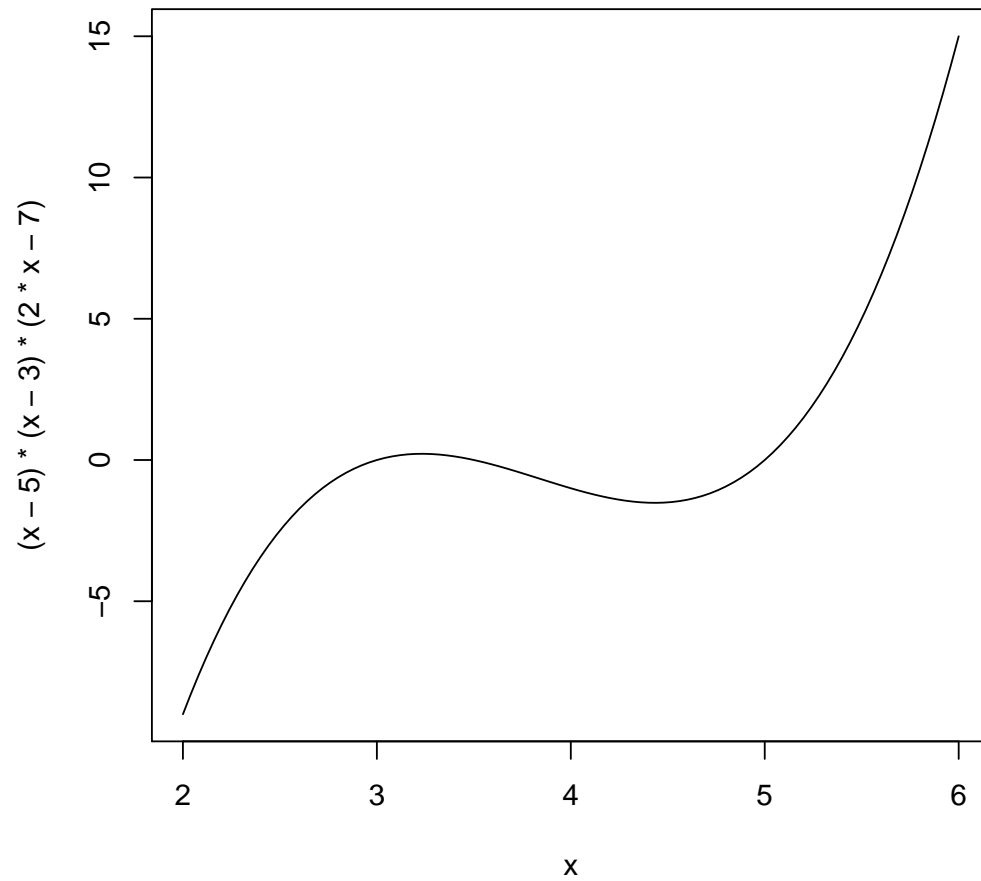
Solving Linear Systems:

$$By = z, \quad y =$$

```
> y <- solve(B, z)
> y
```

```
[1] 23.203390 -5.779661 -2.762712
```

A Sample of R

```
>  curve((x-5)*(x-3)*(2*x-7), from=2, to=6)
```
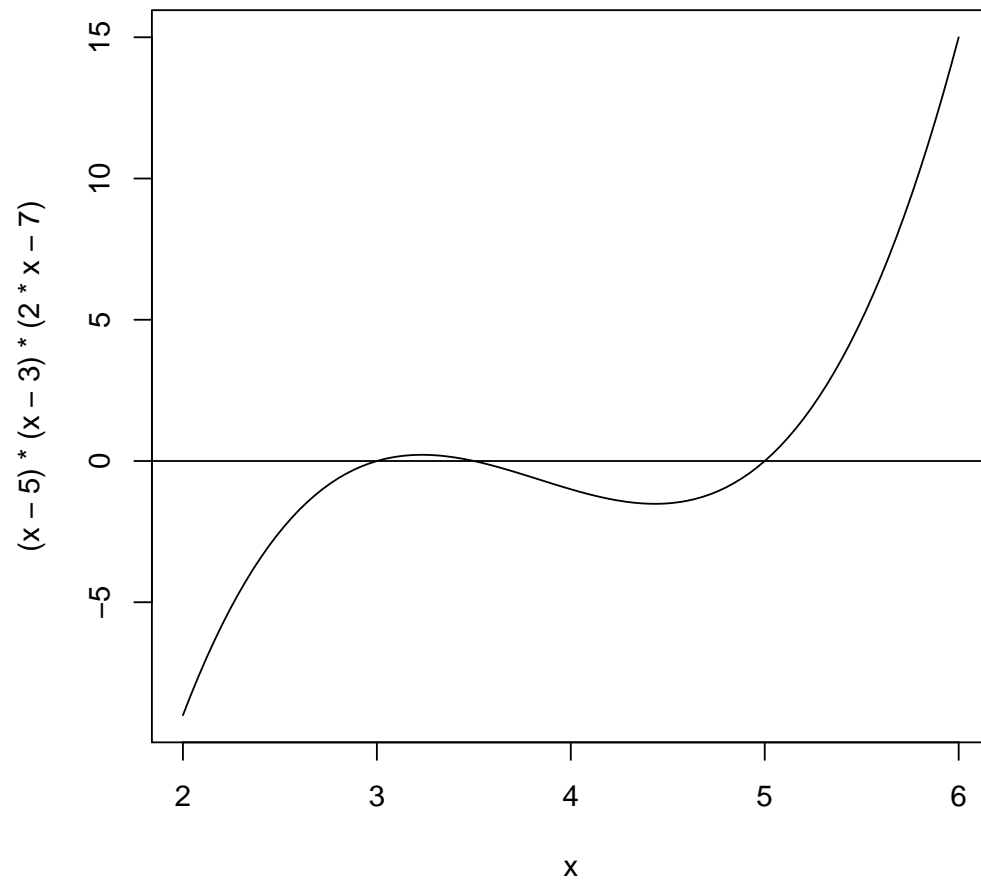
A Sample of R

Graphics

A Sample of R

```
> curve((x-5)*(x-3)*(2*x-7), from=2, to=6)
> abline(h=0)
```

A Sample of R

Graphics

A Sample of R

Statistics

```
> weights <- c(35, 45, 44, 36, 38)
> mean(weights)



[1] 39.6



> sd(weights)



[1] 4.615192
```

A Sample of R

```
> median(weights)



[1] 38



> var(weights)



[1] 21.3
```
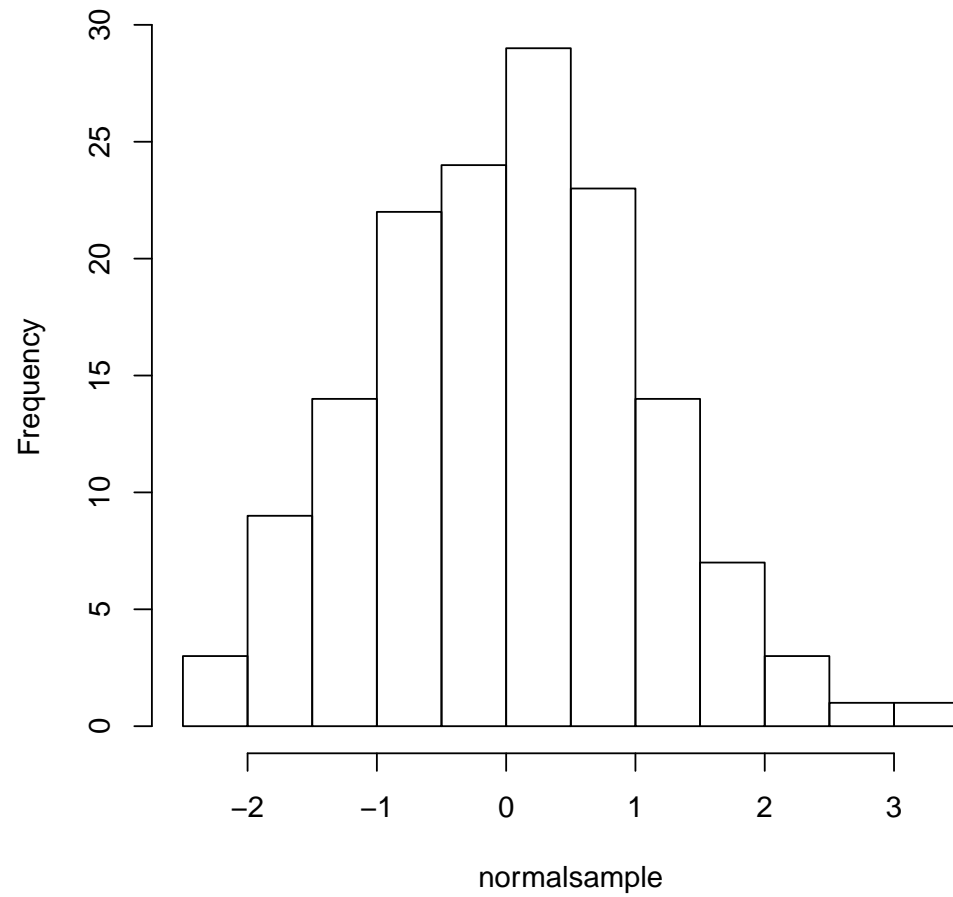
A Sample of R

```
> normalsample <- rnorm(150)
> hist(normalsample)
```
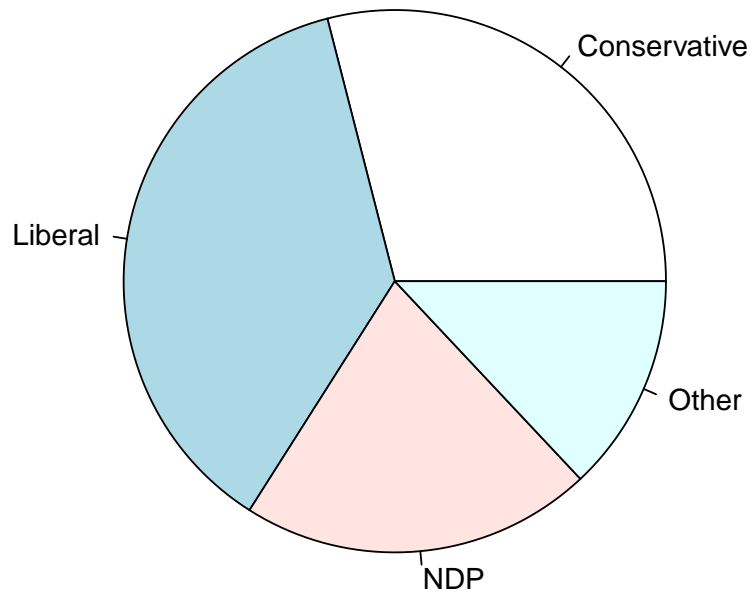
A Sample of R

Histogram of normalsample

A Sample of R

```
> pie(c("Conservative"=29, "Liberal"=37,
+          "NDP"=21, "Other"=13))
```

A Sample of R

Why R?

Open Source, so it is freely available

Powerful, using the best known statistical and numerical software, contributed to by 1000's of researchers worldwide

Flexible, but easy to learn*

Used by industry

*R syntax is trivial compared with Java and other programming languages typically taught in secondary school computing courses. Many R applications do not require any programming ability at all.

The R Trix Site

Under development by researchers at Western

A growing collection of resources and tools which can be used in introductory statistics classes

Introductory R materials

R Apps for math and statistics which do not require knowledge of R, accessible by many mobile devices

Materials can currently be accessed from

`www.stats.uwo.ca/faculty/braun`

Census at School

Access to census-type data at local, national and international levels

Provides real data experience for students

Can be interfaced to R Trix

No longer supported by Statistics Canada, but adopted by the Statistical Society of Canada*

*Coordinator: Alison Gibbs, University of Toronto

Concluding Remarks

R is a powerful tool which can be placed in the hands of secondary school students to aid in mathematics and statistics calculations and graphing

R Trix is under development to

- **ease the transition to full-blown R**
- **provide students with online tools to possibly remove the need for special graphics calculators**
- **defer system administration issues related to site-wide installation of R**