The R Project

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What is R?

- A statistical software system created at the University of Auckland in the early to mid 1990s.
  - Originally, created as a testbed for ideas.
  - Later, developed as a teaching tool.
  - Finally, adopted by a wider community of developers and users.
- A free software system created and maintained by an international collaboration of statisticians (from academia and industry).
  - A core "language" and set of libraries.
  - A very large collection of user-contributed libraries (currently more than 1800).

Getting Started

- R was created by Robert Gentleman and Ross Ihaka to explore some statistical computing ideas.
- It combines ideas from the "Scheme" and "S" programming languages.
- The name "R" is a play on the name "S" and the first initials of the authors.
- Success of the initial ideas lead to a goal of using R to teach elementary statistics courses.
- The system was introduced to a wider audience in a 1996 paper in *The Journal of Computational Statistics and Graphics*.

The original R developers plotting world domination at the *Black Crow Cafe* on Kitchener Street.

Wider Distribution

- Word about R began to spread to colleagues overseas.
- Requests for copies soon followed.
- Versions were distributed under the Free Software Foundation's GNU Public License (Version 2).
- A "Core Development Team" of volunteers formed to support the further development of R.
- A network of "CRAN" websites was formed to distribute the software.
- It is now estimated that there are over a million R users worldwide (estimate by Intel Capital).

International collaboration in full swing at the *Wieden Bräu* pub/brewery near the Technical University of Vienna.

Simple Dot Charts

The R philosophy is "make standard things easy."

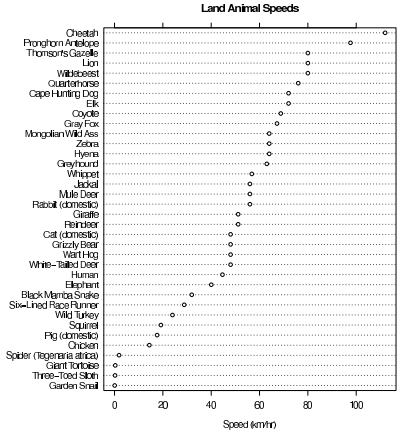
The data set "`animalSpeed`" contains observations of land animal speeds in mph.

The following statement converts mph to kph and sorts the values into ascending order.

```
> speed = sort(1.6 * animalSpeed)
```

With the units converted we can display the data in a Cleveland "dot chart."

```
> dotchart(speed,
           main = "Land Animal Speeds",
           xlab = "Speed (km/hr)")
```

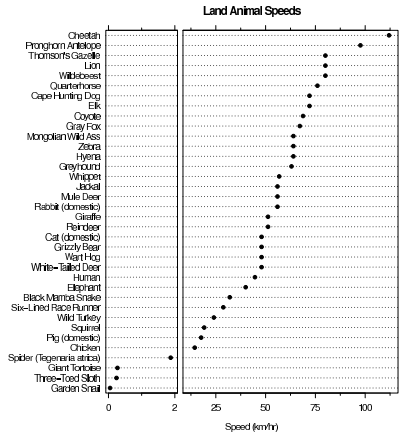


Customised Dot Charts

A second part of the R philosophy is that the software should not unduly restrict what you can do.

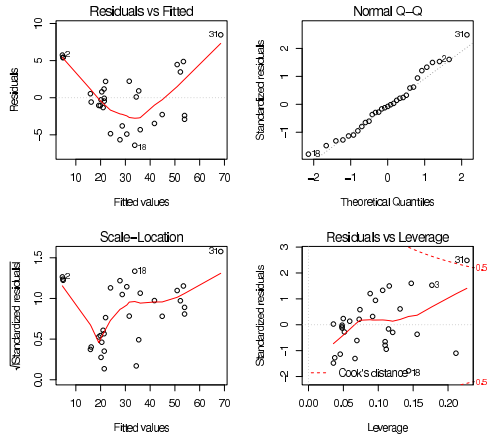
Here is a highly customised dotchart.

```
> dotchart(speed, pch = 19,
           limits = list(c(0, 2), c(12.5, 112.5)),
           widths = c(1, 3),
           shortticks = c(1, seq(12.5, 112.5,
                                 by = 25)),
           labelticks = c(0, 2, seq(25, 100,
                                    by = 25)),
           main = "Land Animal Speeds",
           xlab = "Speed (km/hr)")
```



Statistics with R

```
> res = lm(Volume ~ Height + Girth, data = trees)
> summary(res)

Call:
lm(formula = Volume ~ Height + Girth, data = trees)

Residuals:
    Min      1Q  Median      3Q     Max
-6.4065 -2.6493 -0.2876  2.2003  8.4847

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -57.9877     8.6382  -6.713 2.75e-07 ***
Height        0.3393     0.1302   2.607   0.0145 *
Girth         4.7082     0.2643  17.816  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.882 on 28 degrees of freedom
Multiple R-squared: 0.948,      Adjusted R-squared: 0.9442
F-statistic:   255 on 2 and 28 DF,  p-value: < 2.2e-16

> plot(res)
```



Capabilities

- R is the most fully-featured statistical software system available.
- In addition to the base-level functionality there are over 1800 extension packages available, including many "hot off the press" statistical techniques.
- It comes with the ability to communicate with other systems like *Minitab*, *S*, *SAS*, *SPSS*, *Stata*, *Systat*, etc., as well as machine learning systems such as *KEA*.
- The graphics system is considered one of the best available.
- Support is available from some of the world's best statisticians on the *R-help* mailing list.
- Best of all — it's all free!

Resources

`www.r-project.org` — The main R Project website.

`cran.r-project.org` — The Comprehensive R Archive Network.

`cran.stat.auckland.ac.nz` — A local CRAN mirror.

`journal.r-project.org` — *The R Journal*.

Critique

- R was designed for working with quite small data sets.
- It works well for data sets with tens of variables and thousands of observations.
- It does not handle large data sets well.
- Offloading data processing to a specialist database system can help a little.
- Database support can be found in the packages: Packages: *DBI*, *RJDBC*, *RODBC*, *RMySQL*, *ROracle*, *RPostgreSQL* etc.

The Future

- R is a stable, widely-used software system which is still undergoing incremental improvement.
- Because it is widely used and depended on by a large user base, it is no longer a suitable platform for experimentation.
- The need to deal with much larger datasets indicates that a "new" system is needed.
- Initial work on this is being conducted by Duncan Temple Lang, Brendan McArdle and Ross Ihaka.
- Initial indications are that it will be possible to build a system which is hundreds of times faster and which can handle much larger data sets.