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# What's New in Statistics?

## 2. Free Statistics Software

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1

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## What's New that My Employees Should Know About?

1. Permutation Tests. Never worry about a normal distribution again.
2. Free software for environmental statistics
3. Better methods for handling nondetect data
4. New and better methods for finding the best regression line.

2

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## 2. Free software for environmental statistics

R is the world standard in statistical software today

It is completely free (open-source GNU license)

Most requested package when we teach courses because

1. Its free
2. Its free
3. It has everything

3

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## What is R?

Free, open-source software

Modeled after S, a statistics language developed at Bell Laboratories in late 1980s (R is newer)

Written collaboratively by teams of volunteers

Broad suite of statistical methods

A programming language; you can develop your own routines (scripts)

Difficulty much the same as SAS; some are put off by the default command line interface

However several GUI front ends are available that make it similar in style to commercial software

4

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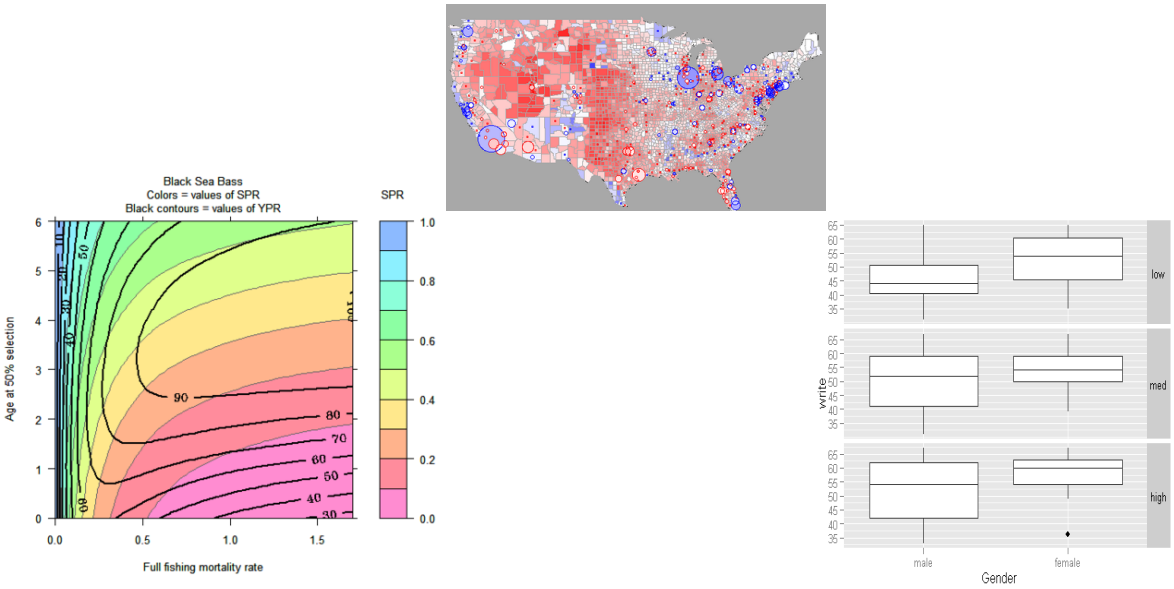
# What can R do?  Graphs




5

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# What can R do?  Statistical methods

- All basic estimators and hypothesis tests
- Kendall trend tests including the newer partial Mann-Kendall test
- Multivariate methods, including those popular in ecology
- Permutation tests
- Time series methods for data closely-spaced in time
- Methods for data with nondetects (the NADA package)
- An entire GIS package
- I can't think of something you cannot do using R!

6

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## Where can I get R software?

http://cran.r-project.org/

- For Linux, Windows and Mac OS
- Download the binary version for your OS
- Checked for viruses
- 'No one to call and yell at' but wikis and mailing lists provide much useful information and support
- Will also find free and low-cost books (pdf) onsite

7

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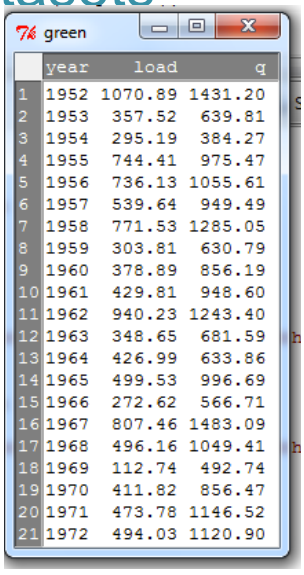
## Importing Excel Datasets

Using the GUI interface you can directly read .xls and .xlsx datasets, as well as many other formats.

Data > Import Data > Excel

Read in the Green.xls file




| | year | load | q |
|---|---|---|---|
| 1 | 1952 | 1070.89 | 1431.20 |
| 2 | 1953 | 357.52 | 639.81 |
| 3 | 1954 | 295.19 | 384.27 |
| 4 | 1955 | 744.41 | 975.47 |
| 5 | 1956 | 736.13 | 1055.61 |
| 6 | 1957 | 539.64 | 949.49 |
| 7 | 1958 | 771.53 | 1285.05 |
| 8 | 1959 | 303.81 | 630.79 |
| 9 | 1960 | 378.89 | 856.19 |
| 10 | 1961 | 429.81 | 948.60 |
| 11 | 1962 | 940.23 | 1243.40 |
| 12 | 1963 | 348.65 | 681.59 |
| 13 | 1964 | 426.99 | 633.86 |
| 14 | 1965 | 499.53 | 996.69 |
| 15 | 1966 | 272.62 | 566.71 |
| 16 | 1967 | 807.46 | 1483.09 |
| 17 | 1968 | 496.16 | 1049.41 |
| 18 | 1969 | 112.74 | 492.74 |
| 19 | 1970 | 411.82 | 856.47 |
| 20 | 1971 | 473.78 | 1146.52 |
| 21 | 1972 | 494.03 | 1120.90 |

8

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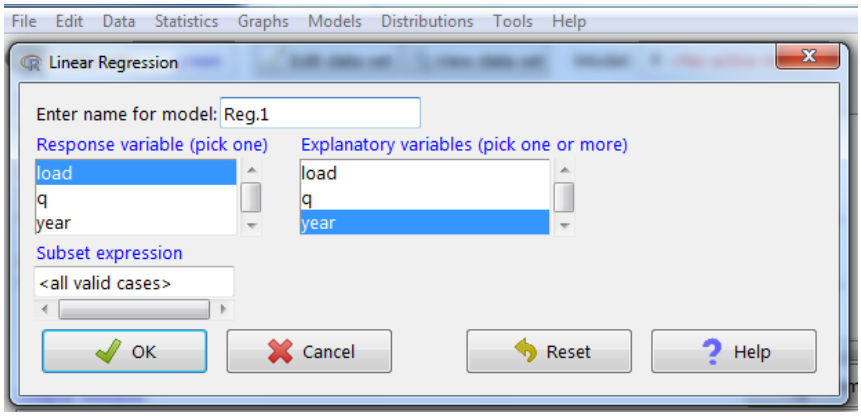
# Stats with R: Regression

## Statistics > Models > Linear Regression




9

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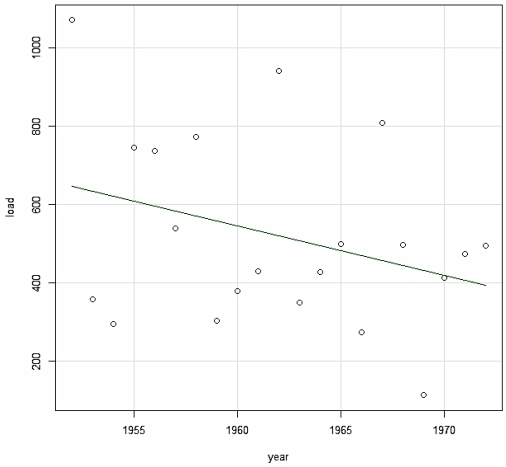
# Regression using Rcmdr

Graphs > Scatterplot




10

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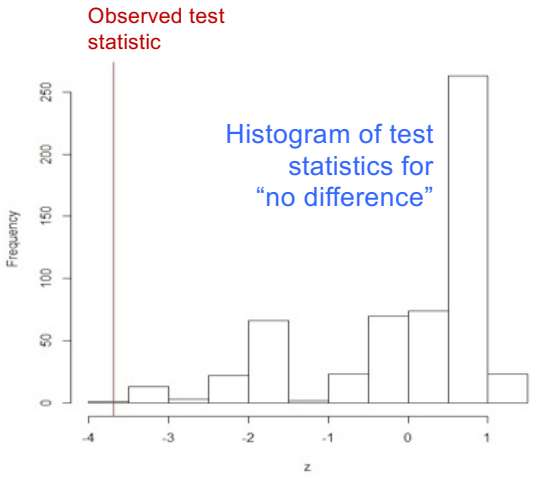
# Permutation Tests using R

Molybdenum concentrations before and after treatment in groundwater

t-test cannot see difference in the two means due to skewness (3.94 before, 0.25 after)

Perm test p= 0.0017. Strong evidence of a difference between means




11

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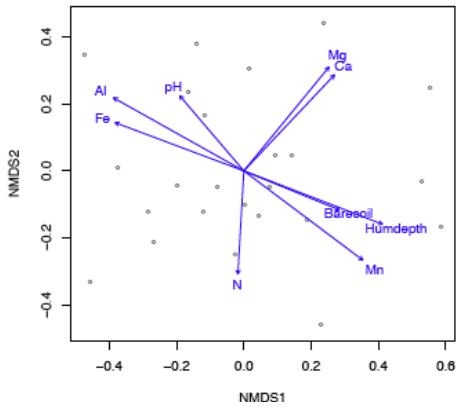
# R packages: Vegan

http://cc.oulu.fi/~jarioksa/softhelp/vegan.html

biplots, NMDS, correspondence analysis, PCA, factor rotation, permutation tests for correlation between groups of data…..




12

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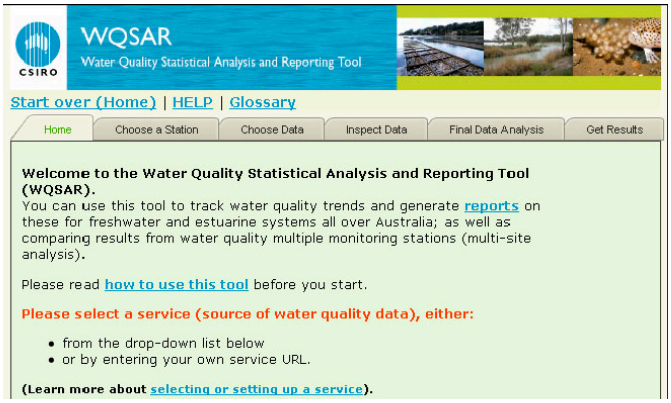
# R online: integration of processes

CSIRO, Australia.  Auto generate reports




13

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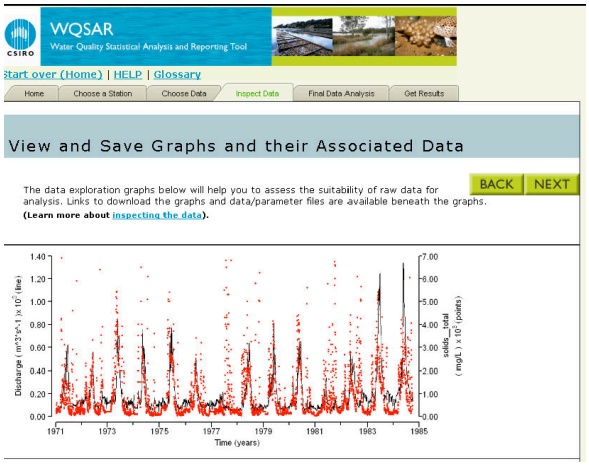
# R online: integration of processes

Choose parameters for on-demand reports




14

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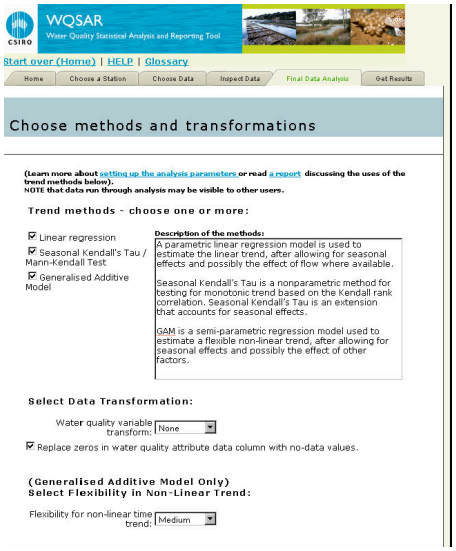
# R online: integration of processes




15

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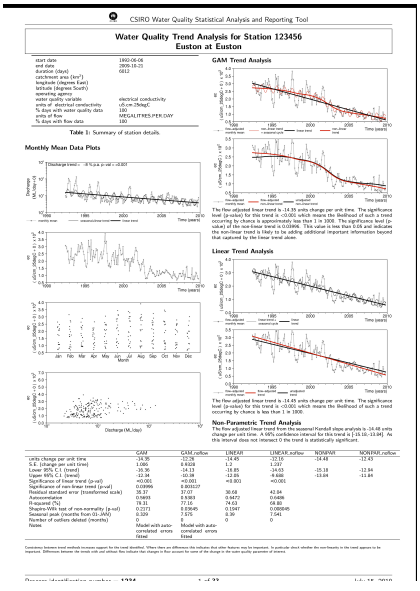
# R online: integration of processes

Get completed on-demand report




16

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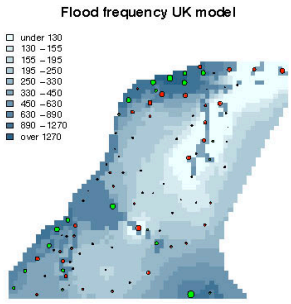
# R spatial analysis

## Universal kriging predictions




Of course, the resolution of the grid of prediction locations means that the shift from flood frequency class 1 to the others is too "chunky", but the effect of flood water "backin up" creeks seems to be captured:

```
> image(BMcD_grid, "UK_pred",
+       breaks = brks, col = cols)
```

Universal kriging adds a regression type of prediction relationship to the kriging process

17

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## Summary

- R is a powerful and comprehensive package for statistics, for visualization, and for linking computer processes together to create information online
- Its free!
- Statisticians around the world use it. Recommended by USEPA's Research Division.
- With new interfaces, R is no more difficult to use than other stat software

18

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## Summary: R Software

R can save corporations and agencies a great deal in software costs

Commonly used in universities. Employees with recent college experience in statistics and computer science are likely to know R

Scripts can be shared among offices, standardizing operations

19

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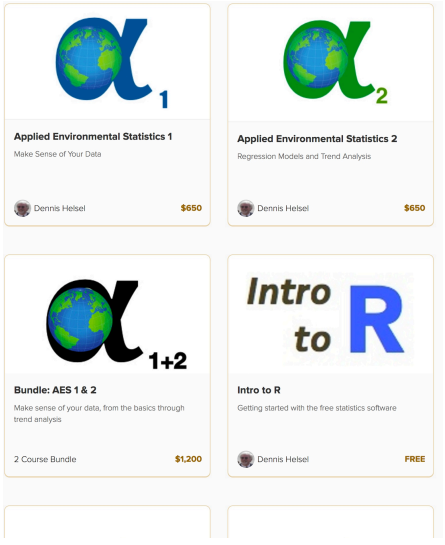
## Resources – more info on these topics

Free Newsletters
http://www.PracticalStats.com/news/

Webinars and Training Courses
https://PracticalStats.teachable.com

our Applied Environmental Statistics course(s) are also an introduction to using R software.




20

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# Questions?

For answers to questions from the live broadcast --
see the Q&A pdf file underneath this video

21

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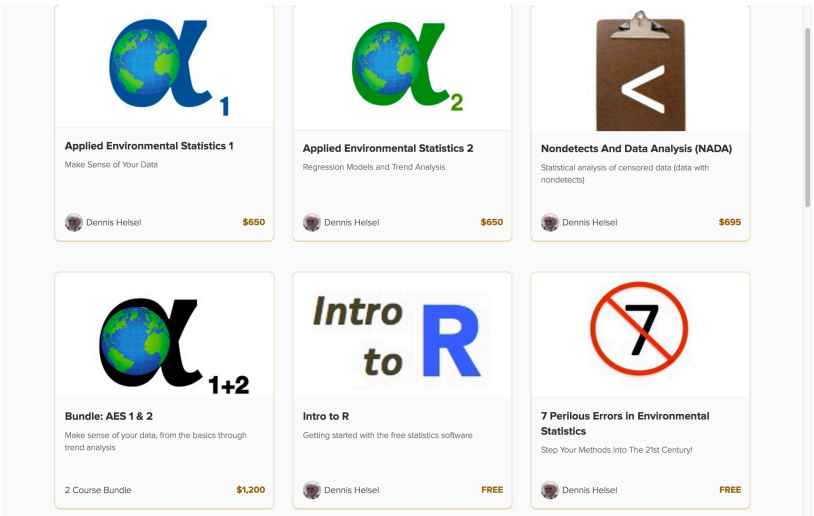
# More Details Are On Our Online Training Site

https://practicalstats.teachable.com
where you'll fine more videos and courses.




22