Use of case studies and new software to motivate statistics teaching and learning at school and undergraduate university

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ABSTRACT

Interesting data provide motivational benefits when learning statistics. Videos describing study designs and contexts are presented. The studies have been selected to illustrate how statistics is used in research. Nineteen edited videos of 10 to 20 minutes duration with matching data have been produced and posted on the web for all to use. The studies involve experimental data, observational data, cohort data and data from large surveys. Tasks are suggested for classroom exercises or projects using the data. New free software developed for school and undergraduate university use is described with teacher and student opinions reported. An access key authorizing use of the statistical software at no charge is available and the software with the supporting videos and lessons is available for educational use internationally. A discussion site where new data sets and lessons can be posted is being established on the website.

Powerpoint slides for the verbal presentation follow

Reaching out to society using case study videos, new software and class lessons

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OUTLINE

- A Website described
- Case study videos discussed
- GenStat for Teaching and Learning (GTL)
- Experiences in New Zealand reported
- Recent developments announced
- Conclusions and controversy outlined

Website (1)

http://www.maths.otago.ac.nz/videos/statistics

Motivational case study videos (19)

Data sets (19)

Lessons using GTL (13)

Training videos for GTL (5)

A site for new classroom lessons accessible

Access to VSNi (ViSioN International)

Statistics Video Presentations

The videos and lessons below use graphical procedures and data summary statistics. Any further statistical procedures used are listed below individually.
Most methods are in the New Zealand high school curriculum but others (for example multiple linear regression and multivariate procedures) are more appropriate at university undergraduate level.
Videos 1 through 13 include exercises that can be carried out with the program GenStat.

1. **O cockle, where art thou?**
   Austina Clark, Mathematics and Statistics, University of Otago
   A designed experiment, stratified sampling; confidence intervals and tests on means; simple linear regression; two factor factorial experiment; multiple linear regression. (Video runtime: 9:00)

2. **Use of infrared thermography for non-invasive assessment of animal welfare**
   Mairi Stewart, AgResearch, Ruakura
   A designed experiment with sequential data; confidence intervals and tests on means; bootstrap confidence intervals; analysis of variance; repeated measures. (Video runtime: 15:09)

3. **Maui's Dolphin: Uncovering a new subspecies**
   Adam N. H. Smith, NIWA
   Observational data with 59 cases; confidence intervals and tests on means; simple linear regression and correlation; principal component analysis. (Video runtime: 16:31)

4. **Ten minute course in epidemiology**
   Nigel Dickson, Preventative and Social Medicine, University of Otago
   Observational cohort data with 1890 cases; cross tabulations and confidence intervals for proportions; confounder control by stratification; relative risk; logistic regression. (Video runtime: 12:30)

5. **Is iron deficiency common among NZ infants and toddlers?**
   Elaine Ferguson, Human Nutrition, University of Otago
   Cross sectional survey with 323 cases; chi square tests; confidence intervals and tests for means, proportions and differences; log transformations; multiple linear regression. (Video runtime: 22:11)

Statistical analysis of trace metals in New Zealand Dredge Oysters

Barry Peake

Video

Hosted by UniTube

This video requires a Flash-compatible browser plugin. If the video does not play, you can download it here (right-click and choose Save Link As).
The saved movie will play in MPEG-4 compatible players such as VLC.

Tasks

The data for this study is in the file OystersData.xls

If you have access to GenStat, you can go through the lesson Oysters-GenStat.pdf

<< Back to all videos

Trace Metal Levels in New Zealand Dredge Oysters

Over a number of years, environmental chemists at the University of Otago have measured the trace metal content of New Zealand organisms. One such organism is the dredge (Bluff) oyster, which grows on the seabed and is found at a variety of sites around the country. Phytoplankton, a food source for the oysters, are able to absorb small amounts of trace metals, which leads to bioconcentration of the metals in the oysters.

As the concentration of the trace metals depends on the location of the oyster, it provides scientists the ability to characterise the area that the oysters were collected, and also allows them to determine the origin of 'mystery' oysters (such as those bought at a supermarket). This lesson will explore the use of such data to characterise the locations, and will show how to determine the origin of an oyster based solely on the trace metals it contains.

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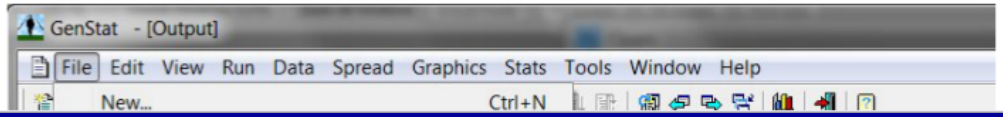

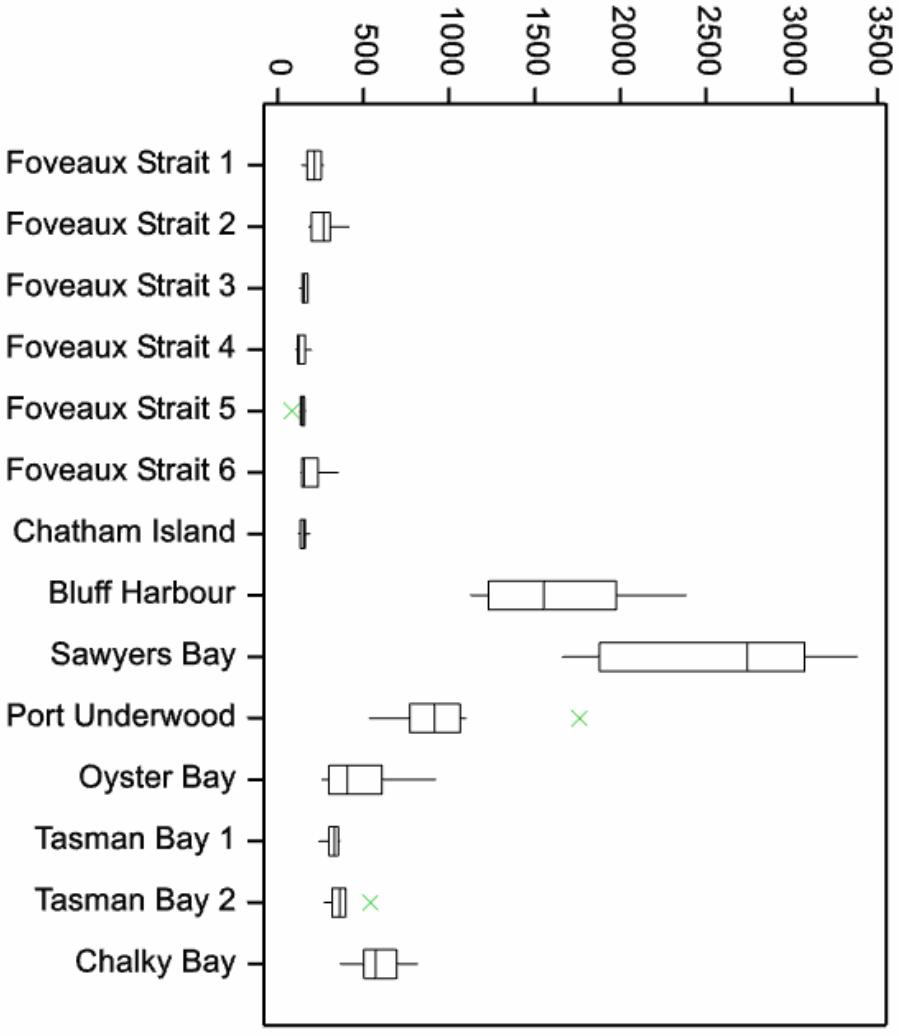
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Foveaux Strait 6
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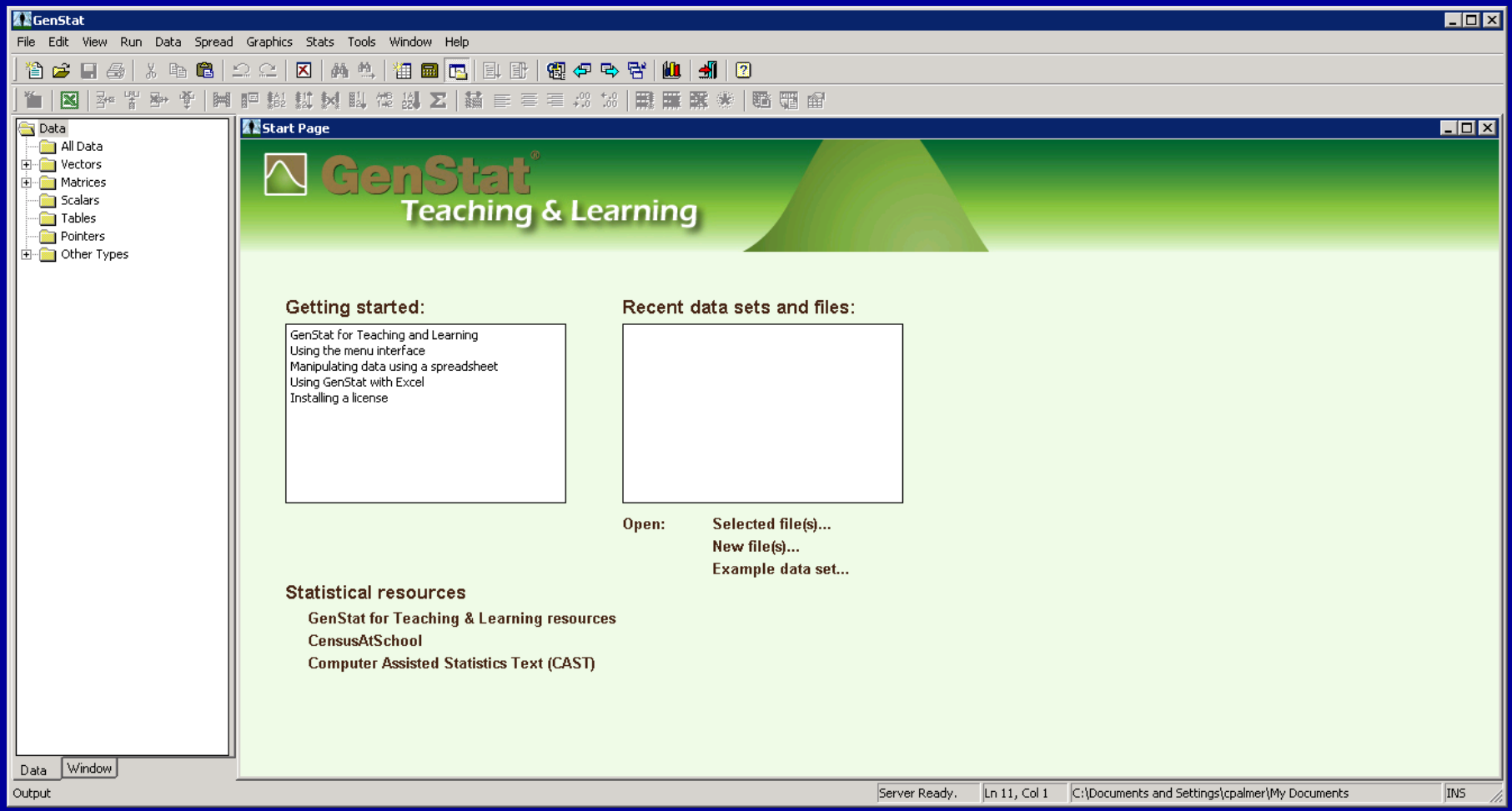
Bluff Harbour
Sawyers Bay
Port Underwood
Oyster Bay
Tasman Bay 1
Tasman Bay 2
Chalky Bay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Other Types
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GenStat®
Teaching & Learning
Getting started:
GenStat for Teaching and Learning
Using the menu interface
Manipulating data using a spreadsheet
Using GenStat with Excel
Installing a license
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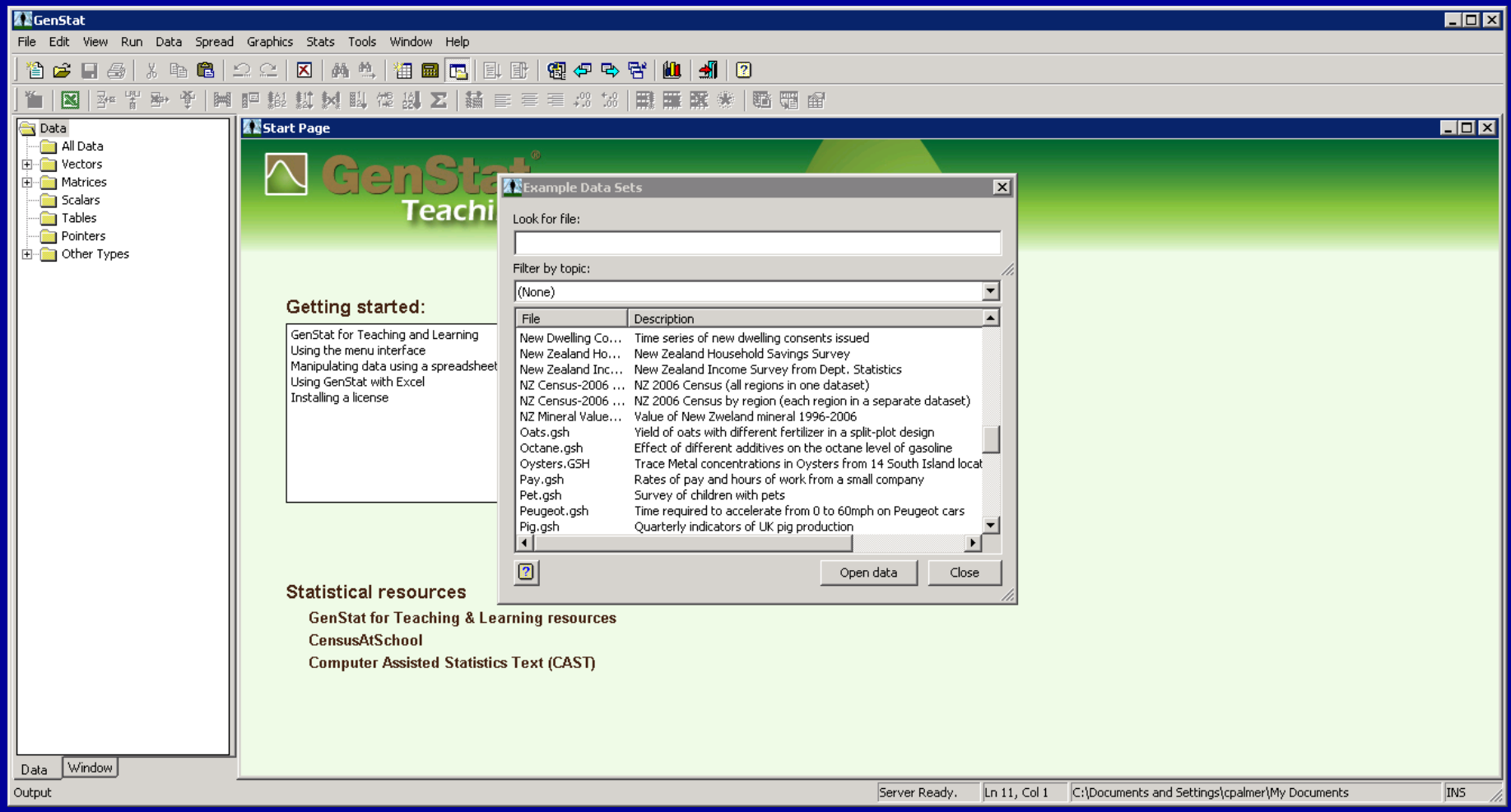
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New Zealand Ho...
New Zealand Household Savings Survey
New Zealand Inc...
New Zealand Income Survey from Dept. Statistics
NZ Census-2006 ...
NZ 2006 Census (all regions in one dataset)
NZ Census-2006 ...
NZ 2006 Census by region (each region in a separate dataset)
NZ Mineral Value...
Value of New Zweland mineral 1996-2006
Oats.gsh
Yield of oats with different fertilizer in a split-plot design
Octane.gsh
Effect of different additives on the octane level of gasoline
Oysters.GSH
Trace Metal concentrations in Oysters from 14 South Island locat
Pay.gsh
Rates of pay and hours of work from a small company
Pet.gsh
Survey of children with pets
Peugeot.gsh
Time required to accelerate from 0 to 60mph on Peugeot cars
Pig.gsh
Quarterly indicators of UK pig production
Open data
Close
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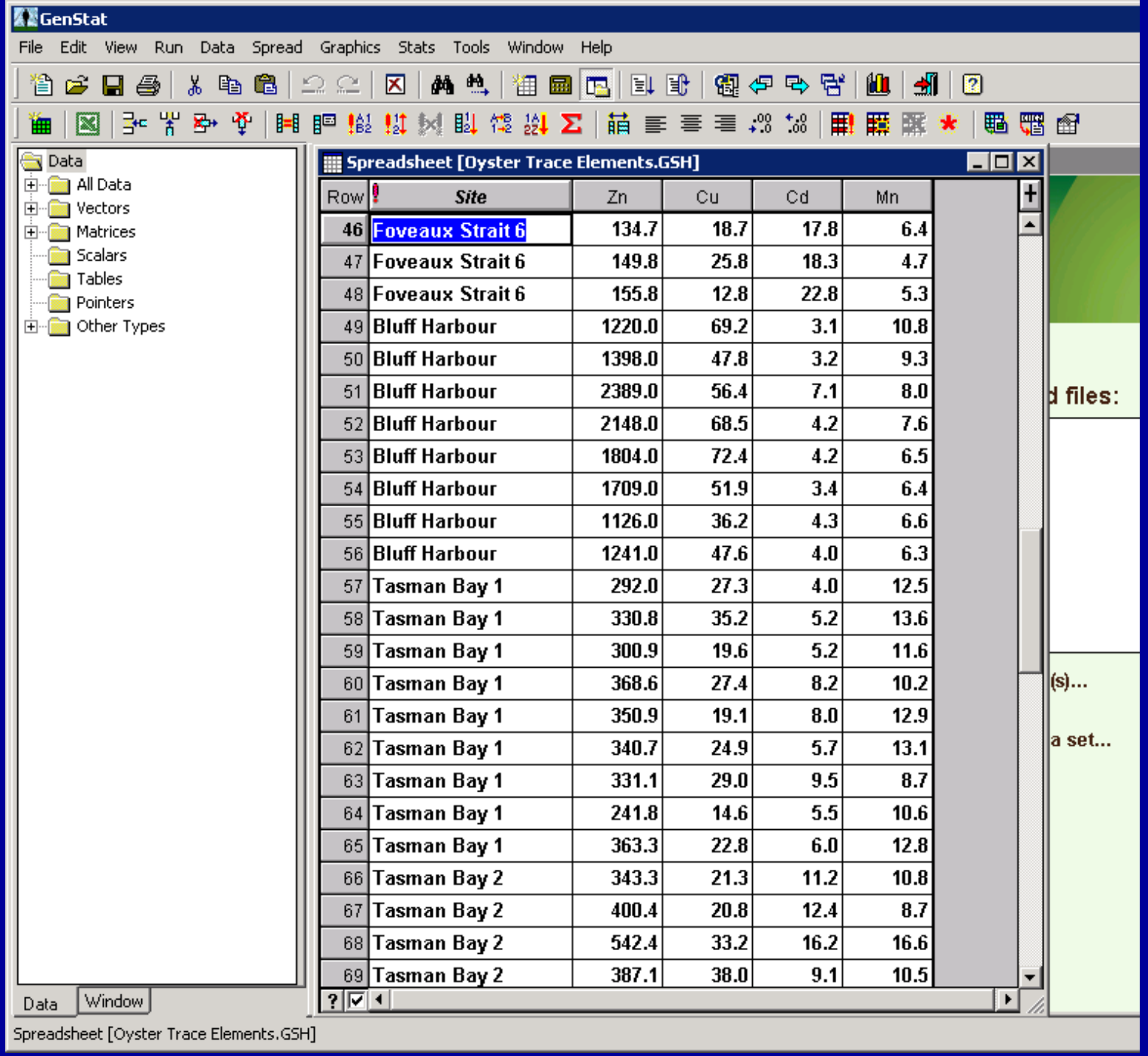

Row	Site	Zn	Cu	Cd	Mn
46	Foveaux Strait 6	134.7	18.7	17.8	6.4
47	Foveaux Strait 6	149.8	25.8	18.3	4.7
48	Foveaux Strait 6	155.8	12.8	22.8	5.3
49	Bluff Harbour	1220.0	69.2	3.1	10.8
50	Bluff Harbour	1398.0	47.8	3.2	9.3
51	Bluff Harbour	2389.0	56.4	7.1	8.0
52	Bluff Harbour	2148.0	68.5	4.2	7.6
53	Bluff Harbour	1804.0	72.4	4.2	6.5
54	Bluff Harbour	1709.0	51.9	3.4	6.4
55	Bluff Harbour	1126.0	36.2	4.3	6.6
56	Bluff Harbour	1241.0	47.6	4.0	6.3
57	Tasman Bay 1	292.0	27.3	4.0	12.5
58	Tasman Bay 1	330.8	35.2	5.2	13.6
59	Tasman Bay 1	300.9	19.6	5.2	11.6
60	Tasman Bay 1	368.6	27.4	8.2	10.2
61	Tasman Bay 1	350.9	19.1	8.0	12.9
62	Tasman Bay 1	340.7	24.9	5.7	13.1
63	Tasman Bay 1	331.1	29.0	9.5	8.7
64	Tasman Bay 1	241.8	14.6	5.5	10.6
65	Tasman Bay 1	363.3	22.8	6.0	12.8
66	Tasman Bay 2	343.3	21.3	11.2	10.8
67	Tasman Bay 2	400.4	20.8	12.4	8.7
68	Tasman Bay 2	542.4	33.2	16.2	16.6
69	Tasman Bay 2	387.1	38.0	9.1	10.5

Case study videos

View a video in sections with discussions

Discuss study design, data collection, data analysis and report conclusions

Videos are recordings of researchers

Data accessible for analysis

Tasks are proposed as exercises

Lessons outlined using GTL

GTL Software (1)

Powerful, free and menu-driven

Schools register; then available for free home use

Load data from other packages, or type in, or select from list directly from GTL

Spreadsheet manipulation easy

File size is generous (2500 cases by 100 variables)

Easy to cut and paste results to Word

Submit results either from home or in the classroom

Family can see work on interesting data at home

GTL Software (2)

Options requested in GTL Schools:

- Graphical procedures (same as commercial version)
- Data summary procedures
- Estimation for means, proportions and differences
- Testing hypotheses and p-values
- Regression and curve fitting
- Count data
- Time series
- Bootstrapping

All are in the New Zealand School curriculum

There is a more extensive free undergraduate version of GTL Undergraduate

Experiences in New Zealand

GTL tested in high schools. Comments:

"The use of GenStat for bivariate data in the middle school was a huge success in terms of student learning about bivariate data theory".

"I was reluctant to change with my final year class as I was familiar with Excel. However I picked up GTL quickly".

"GenStat has enlivened and enriched the teaching in my classes".

"It does force students to think more about the statistical processes and I am looking forward to doing it again next year".

Recent developments

Replacing Excel in some junior high school classes

Used by biology in data analysis project work

Used in the school final year subject, *Statistics and Modelling*

Professional development / conference sessions

GTL Manuals developed for statistics texts

New method of registering soon; GTL schools to be run without registration

Development of a site for new lessons using GTL

CONCLUSIONS

Authentic data sets engage students and the community

Ability to explore large data sets essential

GTL Schools is a “sleeping giant”

Potential to raise profile of statistics in society

Need for professional development sessions for teachers

CONTROVERSIES

Is open source R a better approach?

Some may think use of GTL results in a “black box” approach to teaching statistics

Simulation software animations are elegant and teach concepts. But will GTL complement these methods?

Some people incorrectly think GenStat is about agriculture

Discussion and questions ?