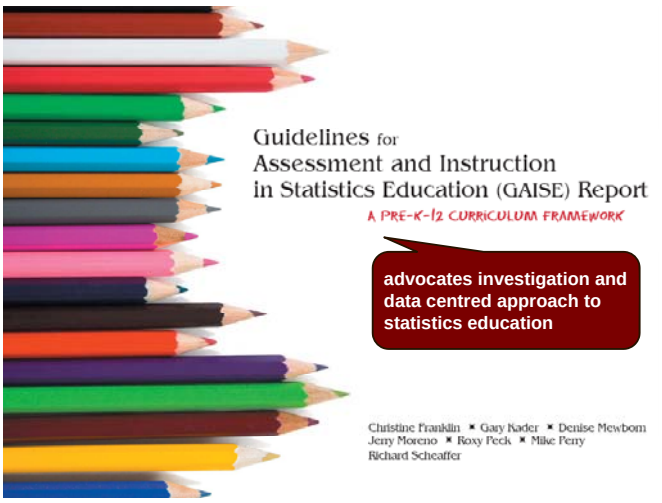

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In spirit of GAISE

New national curriculum

- **Top-level specification 2006/7 ("Tier 1")**
- **Next level of detail ("Tier 2") is underway**
- **Starts 2009 ….**

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Agenda

- **What is happening in NZ**
  - **fleeting impressions, not details**
- **Why now?**
- **Consequences of moving fast**
- **Case for cooperation with US**

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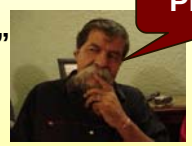
History Lesson: NZ Curriculum

What's in a name?

"Mathematics **& Statistics" !!**

Plenty !!!



"Mathematics"

18?? 1950 2009 20??

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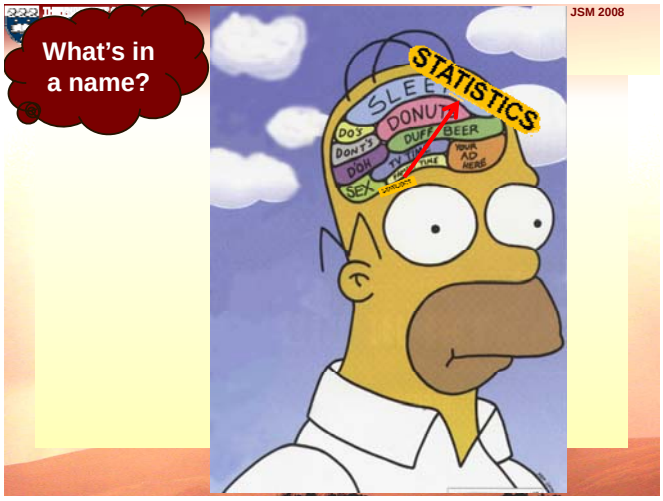
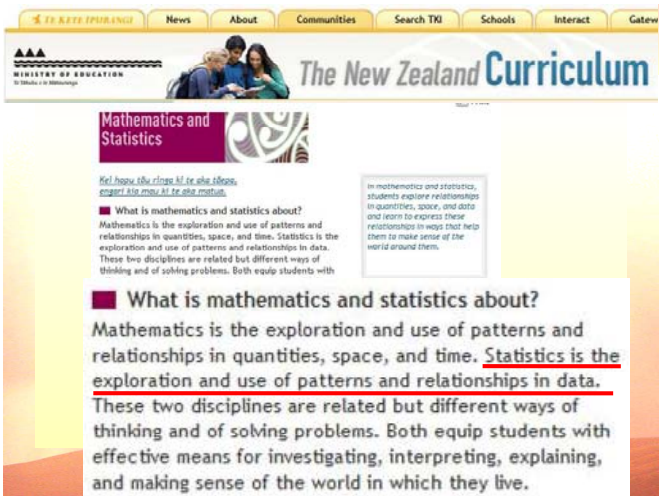
"That's not mathematics"

"No, ... but it *IS* statistics"


What's in a name?
JSM 2008
STATISTICS
SLEEP
DONUT
BEER
DO'S
DON'TS
DOH
SEX


News
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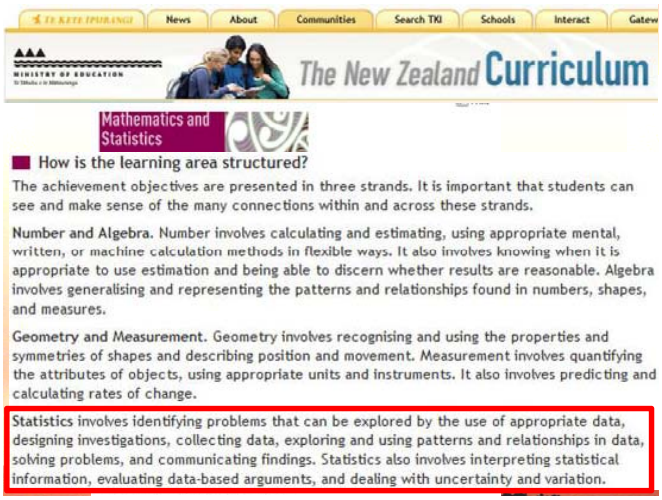
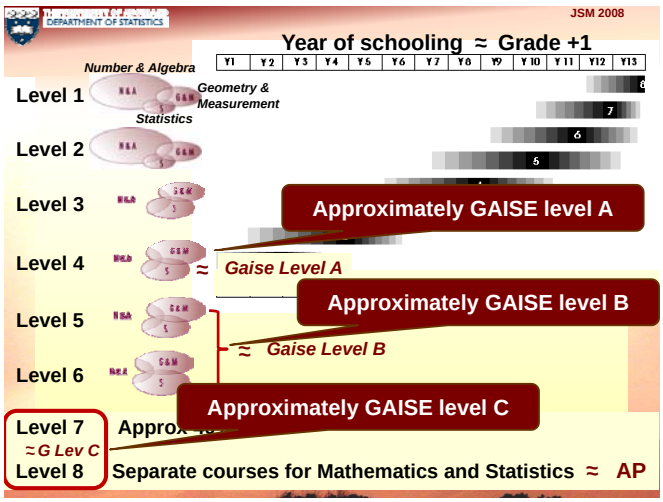
The New Zealand Curriculum
Mathematics and Statistics
What is mathematics and statistics about?
Mathematics is the exploration and use of patterns and relationships in quantities, space, and time. Statistics is the exploration and use of patterns and relationships in data. These two disciplines are related but different ways of thinking and of solving problems. Both equip students with effective means for investigating, interpreting, explaining, and making sense of the world in which they live.


The New Zealand Curriculum
Mathematics and Statistics
Why study mathematics and statistics?
By studying mathematics and statistics, students develop the ability to think creatively, critically, strategically, and logically. They learn to structure and to organise, to carry out procedures flexibly and accurately, to process and communicate information, and to enjoy intellectual challenge.
By learning mathematics and statistics, students develop other important thinking skills. They learn to create models and predict outcomes, to conjecture, to justify and verify, and to seek patterns and generalisations. They learn to estimate with reasonableness, calculate with precision, and understand when results are precise and when they must be interpreted with uncertainty. Mathematics and statistics have a broad range of practical applications in everyday life, in other learning areas, and in workplaces.


The New Zealand Curriculum
Mathematics and Statistics
How is the learning area structured?
The achievement objectives are presented in three strands. It is important that students can see and make sense of the many connections within and across these strands.
Number and Algebra. Number involves calculating and estimating, using appropriate mental, written, or machine calculation methods in flexible ways. It also involves knowing when it is appropriate to use estimation and being able to discern whether results are reasonable. Algebra involves generalising and representing the patterns and relationships found in numbers, shapes, and measures.
Geometry and Measurement. Geometry involves recognising and using the properties and symmetries of shapes and describing position and movement. Measurement involves quantifying the attributes of objects, using appropriate units and instruments. It also involves predicting and calculating rates of change.
Statistics involves identifying problems that can be explored by the use of appropriate data, designing investigations, collecting data, exploring and using patterns and relationships in data, solving problems, and communicating findings. Statistics also involves interpreting statistical information, evaluating data-based arguments, and dealing with uncertainty and variation.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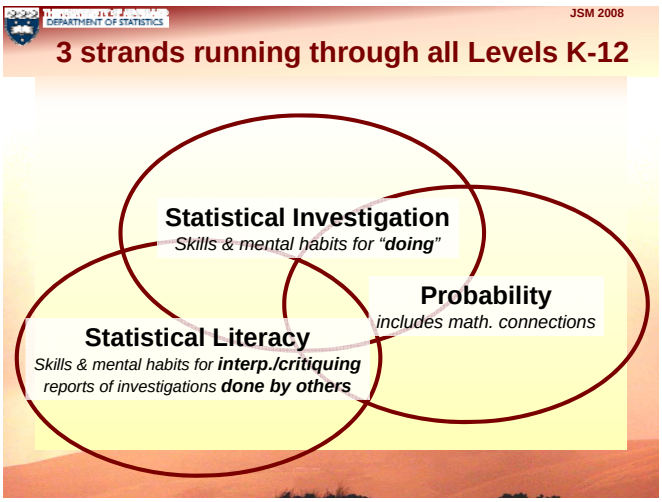
JSM 2008
Year of schooling ≃ Grade +1
Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12 Y13
Number & Algebra
Geometry & Measurement
Statistics
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
Level 7
≃G Lev C
Level 8
Approximately GAISE level A
≃ Gaise Level A
Approximately GAISE level B
≃ Gaise Level B
Approximately GAISE level C
Separate courses for Mathematics and Statistics ≃ AP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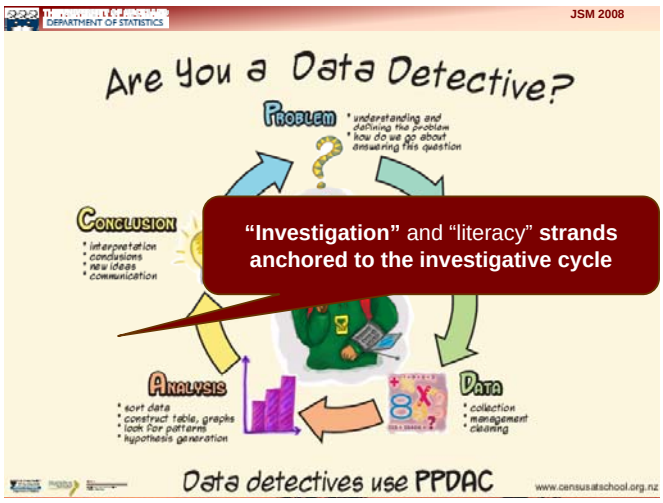
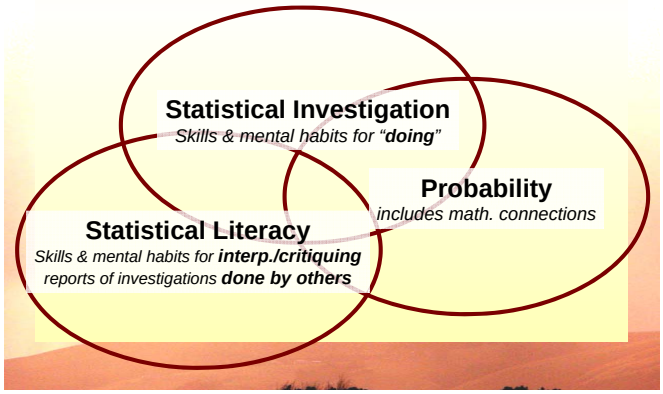
JSM 2008
3 strands running through all Levels K-12
Statistical Investigation
Skills & mental habits for "doing"
Probability
includes math. connections
Statistical Literacy
Skills & mental habits for interp./critiquing reports of investigations done by others



"Investigation" and "literacy" **strands anchored to the investigative cycle**

Download a print quality PDF version of the cycle if you would like to print one or more copies yourself:
Data Detective Poster (22MB)

3 strands running through all Levels K-12



Example: Curriculum Level 5 (≈ *Grd 8-9*)

In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:

Statistical investigation

- Plan and conduct surveys and experiments using the statistical enquiry cycle:
  - determining appropriate variables and measures
  - considering sources of variation
  - gathering and cleaning data
  - using multiple displays, and re-categorising data to find patterns, variations, relationships, and trends in multivariate data sets
  - comparing sample distributions visually, using measures of centre, spread, & prop^n
  - presenting a report of findings.

Skim for flavour, not details

Statistical literacy

- Evaluate statistical investigations or probability activities undertaken by others, including data collection methods, choice of measures, and validity of findings.

Probability

- Compare and describe the variation between theoretical and experimental distributions in situations that involve elements of chance.
- Calculate probabilities, using fractions, percentages, and ratios.

Example: Curriculum Level 8 (*Grd 12*)

In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:

Statistical investigation

- Carry out investigations of phenomena, using the statistical enquiry cycle:
  - conducting experiments using experimental design principles, conducting surveys, and using existing data sets
  - finding, using, and assessing appropriate models (including linear regression for bivariate data and additive models for time-series data), seeking explanations, and making predictions
  - using informed contextual knowledge, exploratory data analysis, and statistical inference
  - communicating findings and evaluating all stages of the cycle
- Make inferences from surveys and experiments:
  - determining estimates and confidence intervals for means, proportions, and differences, recognising the relevance of the central limit theorem
  - using methods such as resampling or randomisation to assess the strength of evidence

Example: Curriculum Level 8 cont. (*Grd 12*)

Statistical literacy

- Evaluate a wide range of statistically based reports, including surveys and polls, experiments, and observational studies:
  - critiquing causal-relationship claims
  - interpreting margins of error

Probability

- Investigate situations that involve elements of chance:
  - calculating probabilities of independent, combined, and conditional events
  - calculating and interpreting expected values and standard deviations of discrete random variables
  - applying distributions such as the Poisson, binomial, and normal

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Why the big changes now?

Constellations/Planets lined up

Timing
- New curriculum

Relationships with
- Ministry of Education
- Government Agencies
- Lead Teachers
- Teacher Trainers
- Mathematicians

Dawning of the age of Aquarius

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Some consequences of moving Fast

-- very ambitious but must deliver

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Informal Inference

The following is a talk on the subject of informal statistical inference given by **Chris Wild** to the **Auckland Mathematical Association** on 14 June 2008.

- **Chris Wild's talk** (50 mins, streams through browser, requires **Flash plugin**)
- Demonstrations of sampling variability used inside the talk:
  - **barchart of travel mode** (as Flash or **Windows Media**)
  - **boxplot of heights** (as Flash or **Windows Media**)
- Slides (1 Mb pdf file)
- Handout 1: **Informal Inference Diagrams** (700 Kb pdf file)
- Handout 2: **A teacher's guide to informal comparative reasoning** by Pfannkuch, Wild, Norton and Regan (240 Kb pdf file)


Maxine Pfannkuch


Nick Horton


Matt Regan

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"Informal statistical inference"

Objectives

- Convey "the big ideas" of statistical inference
- Simple methods for students to apply ***when looking*** *at their own data*
  - Minimise steps that lead students to take their eyes off the data
  - "***Exploit the power of the visual sense***"

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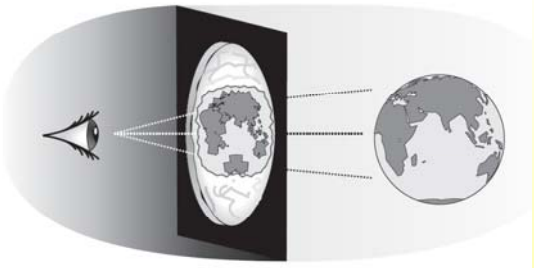
"What I see is not quite the way it really is"

Looking at the world using data



is like looking through a window with ripples in the glass

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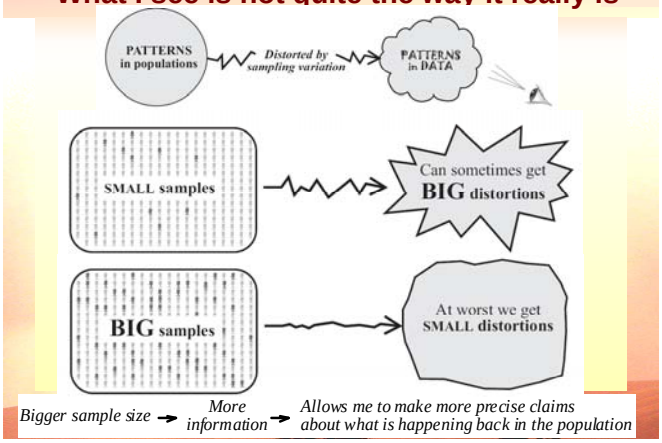
"What I see is not quite the way it really is"



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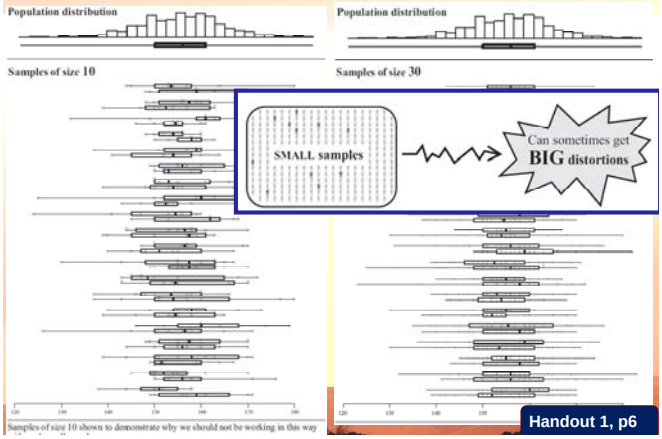
Heights of 12 year-olds JSM 2008

Examples of shifts called purely by sampling



Handout 1, p6

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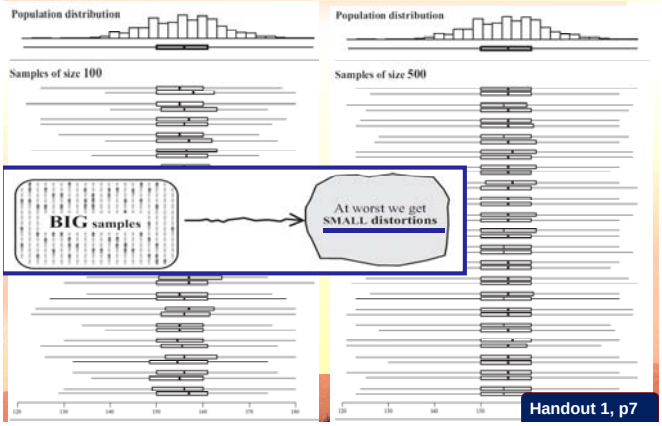
Heights of 12 year-olds JSM 2008

Examples of shifts called purely by sampling



Handout 1, p7

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Making the Call – the basic idea

Observed data:	Back in the populations: "Do *B* values tend to be bigger than *A* values?"	
	My call is	
A / B	**B is bigger**	*all sample sizes*
A / B	*B* is bigger	
A / B	*Claim "B is bigger" if both sample sizes > 20*	*Larger random samples have more information about the populations they came from.*
A / B	*What's my call here?*	*Thus, with larger random samples, we can make the "B is bigger" call from smaller shifts*
A / B	*What's my call here?*	***But how do we decide?*** - *depends on educational level of students* - *see next page ...*
A / B	*Call "Cannot tell" unless both samples are huge*	
A / B	**Cannot tell**	*all sample sizes*

Warning to teachers: avoid doing this sample with sizes smaller than about 20 in each group. Small samples quite often give rise to unstrable and often very strange boxplots
To echo the previous diagram, we get very large distortions -- see plots for samples of size 10 on page 6

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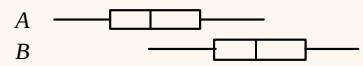
"How to make the call" by Curriculum level

At all levels:



If there is no overlap of the boxes, or only a very small overlap make the claim "***B tends to be bigger than A***" back in the populations

Apply the following when the boxes do overlap ...

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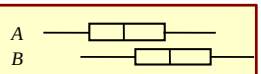
"How to make the call" by Curriculum level

Curriculum Level 5: *the 3/4-1/2 rule*



If the median for one of the samples lies outside the box for the other sample
("*more than half of the B group are above three quarters of the A group*")
make the claim "***B tends to be bigger than A***" back in the populations

[Restrict to samples sizes of between 20 and 40 in each group]

Majority of one to the right of "the great whack" of the other

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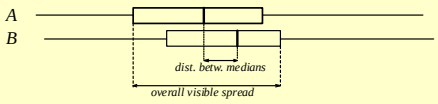
"How to make the call" by Curriculum level

Handout 1, p. 4

Curriculum Level 6: *distance between medians as proportion of "overall visible spread"*



Make the claim ***B tends to be bigger than A*** back in the populations
if distance between medians is greater than about ...

1/3 of overall visible spread for sample sizes of around **30**

1/5 of overall visible spread for sample sizes of around **100**

[***Could also use*** 1/10 of overall visible spread for sample sizes of around 1000]

Stress "eye-ball judgements"

See Tech notes on p. 5

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"How to make the call" by Curriculum level

Curriculum Level 7: *based on informal confidence intervals for the population median*

Draw horizontal line

Med – 1.5 $\frac{IQR}{\sqrt{n}}$ Med + 1.5 $\frac{IQR}{\sqrt{n}}$

IQR = interquartile range = width of box
n = sample size

Make the claim ***B tends to be bigger than A*** back in the populations

A
B

if these horizontal lines (intervals) do not overlap

Stress to teachers that this is only one tiny part Of what the statistics module is all about

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"How to make the call" by Curriculum level

Curriculum Level 7: *based on informal confidence intervals for the population median*

Draw horizontal line

Med – 1.5 $\frac{IQR}{\sqrt{n}}$ Med + 1.5 $\frac{IQR}{\sqrt{n}}$

IQR = interquartile range = width of box
n = sample size

Make the claim ***B tends to be bigger than A*** back in the populations

A
B

A
B

dist. = lower confidence limit for difference in population medians

dist. = upper confidence limit for difference in population medians

Getting all our ducks in a row

- CensusAtSchool NZ
- **Curriculum change**
- ***National assessment change***
- Teacher education and development
- Schools outreach

Getting all our ducks in a row

Getting all our ducks in a row

- CensusAtSchool NZ
- **Curriculum change**
- ***National assessment change***
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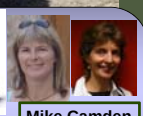
- Schools outreach



Mike Camden (Stats NZ)

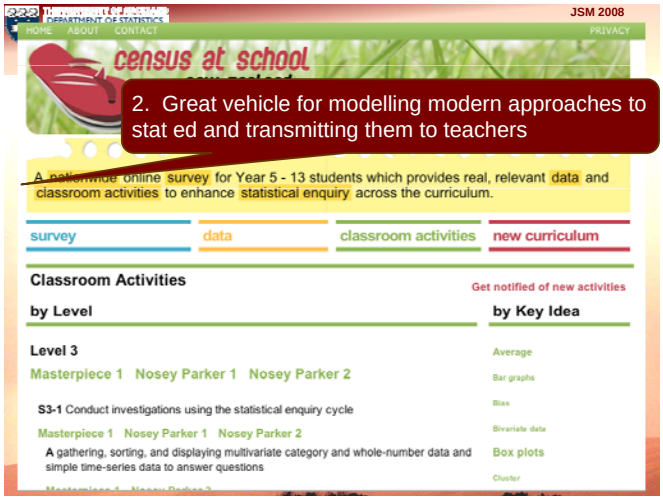
JSM 2008

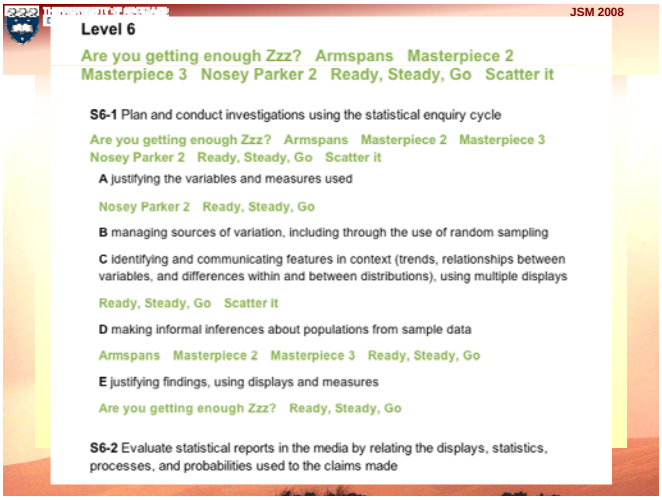
CensusAtSchool
2nd International Workshop
UCLA, Los Angeles, California
July 28-29, 2008

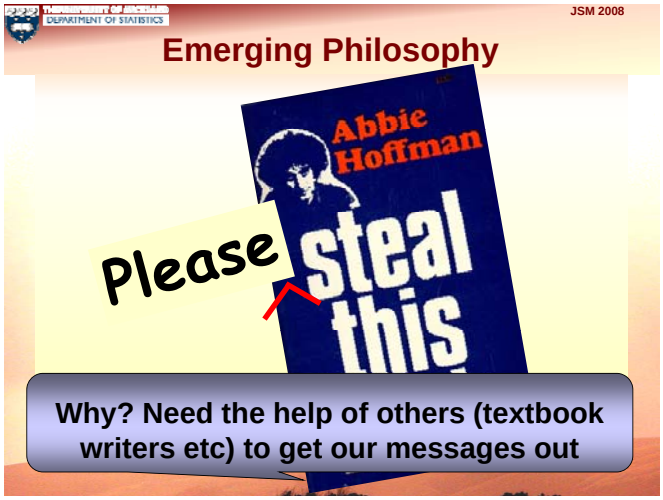
http://censusatschool-california.stat.ucla.edu/index.html
Hosted by the Department of Statistics at UCLA
Workshop Organizer: Juana Sanchez, UCLA Statistics

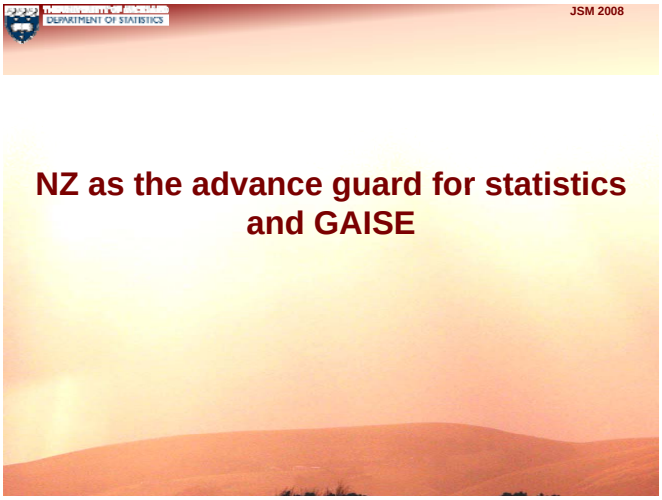
Coming soon to Japan

1. **C@S project is a great vehicle for generating interesting multivariate data for kids about kids**









- NZ set ourselves a huge task
- In interests of GAISE-attuned educators everywhere that it works well

- But NZ has a very small number of people capable of producing the teaching materials
- Great if US efforts to advance GAISE could also help to ensure the NZ curriculum delivers

- Then maybe the US can start to use NZ …


Thank you
Slides at http://www.stat.auckland.ac.nz/~wild/08-talks/JSM.wild.horton.pdf