The State of Statistics
Education in the Schools

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What is statistics (data handling, data analysis) at the school level?

NZ Achievement Objectives

• Statistical Investigation
  – Statistical inquiry cycle
• Statistical Literacy
• Probability

A few noteworthy points:

• Oriented to grade level, with a logical progression
• Stat literacy and probability separated from Stat investigations
• Informal inference leading to formal inference
• Risk considered as a separate topic
IASE Emphases (college level)

- Immersion in data:
  - What question might be answered with data?
  - What data is needed?
  - How is the data screened and explored?
  - How can we justify our chosen methods of analysis?
  - How can the whole process, including the conclusions, be described in words and graphs?

GSA Emphases (outside of the United States)

- Australian Bureau of Statistics
  - Data awareness
  - Ability to understand statistical concepts
  - Ability to analyse, interpret and evaluate statistical information
  - Communicate statistical information and understanding

- Verbal question to verbal answers
- Uncover information from data

- “The examples and programs presented here could complement from the first to the last chapter of any Introductory Statistics book and other Introductory books.”
- Largely about literacy rather than investigation
- Emphasis on graphics and summary statistics (index numbers, weighting, etc.); less on design, data collection and inference, even informal
“...summary statistics entail only information, but information is not knowledge.”

Where is the knowledge we have lost in information?
Where is the wisdom we have lost in knowledge?

T. S. Eliot - Choruses from *The Rock*

**GAISE Model**

Statistical problem-solving process:
- Formulate Questions
- Collect Data
- Analyze Data
- Interpret Results

**Guiding principles for teaching statistics:**
- Conceptual understanding takes precedence over procedural skill.
- Active learning is key to the development of conceptual understanding.
- Real-world data must be used wherever possible.
- Appropriate technology is essential in order to emphasize concepts over calculations.
- All four steps of the investigative process should be encountered at each grade level.

**Why statistics in the mathematics curriculum?**

**NZ**
- The curriculum is called *Mathematics and Statistics*; Wonderful!
- The UK and Commonwealth countries have a long history of statistics in the schools.
- Influenced the U.S. from the days of the Schools Project of the 1970s.
IASE
• Statistics not a natural part of math; statistical thinking (ideas) are different from calculation.
• Should we look outside of the math curriculum?
• “At the schools, it may be necessary to integrate statistics instruction with science instruction or even social science instruction.”

GAISE (implicit)
• Mathematics is the only field willing to teach statistics as a body of interconnected knowledge.
• Statistics is mathematically demanding.
• Statistics can motivate and enhance the learning of mathematics.
• Mathematics should include notions of plausible reasoning (George Poly).

GSA
• Mathematics is not the whole show …
  – Agencies do appeal to the social sciences, business and economics, even librarians
• But, mathematics is essential …
  – South Africa: “… encourage the development of mathematics education as an important bedrock for statistics.”

What about the teachers?
NZ
Teachers need detailed help
  – comprehensive prescriptions
  – exemplars
  – assessments
  – teacher development for a mathematics teacher workforce that has very little experience that is relevant to an investigation/real problems, real data/experiential/graphics driven/discussion based teaching of statistics.
IASE
- Teachers have qualifications in mathematics (but not statistics).
- Math topics (calculation, probability) tend to get the emphasis.
- “… obtain enhanced recognition at the secondary school level for those mathematics teachers that have a genuine interest in statistics.”
- Textbooks not aligned with the process of teaching by immersion in data
- (Large classes are not an issue.)

GSA
- Programs represented herein provide:
  - Statistics lessons with examples
  - Curricular activities for teachers
  - Workshops and other types of training for teachers
- (Training in Official Statistics largely absent for the educational scene – even in statistics education.)

GAISE
- Teacher education is key
  - College Board Standards
  - Achieve Benchmarks
  - National Mathematics Panel recommendations
    - Geared toward algebra
    - Teacher education
    - Research
- National Council of Teachers of Mathematics
  - Curriculum Focal Points:PK-8
  - Focus on High School Mathematics
- U.S. statistics departments do little

GAISE Activities Project (GAP)
- Working group of statisticians and teachers
  - (share ideas?)
- Activities written with teachers in mind
- Materials cover three grade bands
Who is responsible for statistics in the schools?

- The community of professional statisticians must play a more prominent role!
- “Statisticians should be responsible for making the public statistically literate with respect to the numbers they produce …”

The statistician keeps his finger on the pulse of Humanity, and gives the necessary warning when things are not as they should be.

Adolphe Quetelet

College Statistics Enrollments (1000s)

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<th>Statistics Departments</th>
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2000 to 2005

Statistics enrollment increases: 6.4% in mathematics
2.7% in statistics
58% in two-year colleges

Four-year college enrollments up 14%
Two-year college enrollments up 12%

BIG question (in U.S.):

How to sell statistics to the decision makers at the top levels?

IASE at JSM 2008: Scheaffer
In summary -

- DATA IS THE SUBSTANCE
- STATISTICS AS IN INVESTIGATIVE PROCESSS, A WAY OF THINKING, IS THE GOAL
- TEACHERS ARE THE ESSENTIAL LINK – AND NEED HELP
- STATISTICIANS HAVE AN OBLIGATION TO HELP!!!