

## The State of Statistics Education in the Schools

Comments by:  
Richard Scheaffer  
rls907@bellsouth.net

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?

- Verbal question to verbal answers
- Uncover information from data

## 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

- “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.
- Jowett, G. H., and Davies, H. M. (1960), "Practical Experimentation as a Teaching Method in Statistics", *Journal of the Royal Statistical Society, Ser. A*, 123, 10-35.

## 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.”

## 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.”

## 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).

## 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 ...”

## College Statistics Enrollments (1000s)

	Mathematics Departments				Statistics Departments				Two-year College Mat			
	1990	1995	2000	2005	1990	1995	2000	2005	1990	1995	2000	2005
Elem	87	115	136	148	30	49	54	54	54	72	74	117
Upper	38	28	35	34	14	16	20	24	0	0	0	0
Total	125	143	171	182	44	65	74	78	54	72	74	117

### 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%

*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

## BIG question (in U.S.):

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

## In summary -

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