

**STATISTICAL LITERACY
and
STATISTICAL COMPETENCE
in the
NEW CENTURY**

**David S. Moore
Purdue University, USA**

● **THE ENVIRONMENT**

● **THE NEW LITERACY**

● **THE NEW COMPETENCE**

THE ENVIRONMENT

● **The intellectualizing of work**

- Need analytical, quantitative, computing skills
- Need interpretive, communication skills
- Multiple jobs, multiple careers
- **Need statistical skills?**

● **The democratization of education**

Tertiary education is now replacing secondary education as the focal point of access to rewarding careers.

OECD Education at a Glance 2000

THE ENVIRONMENT

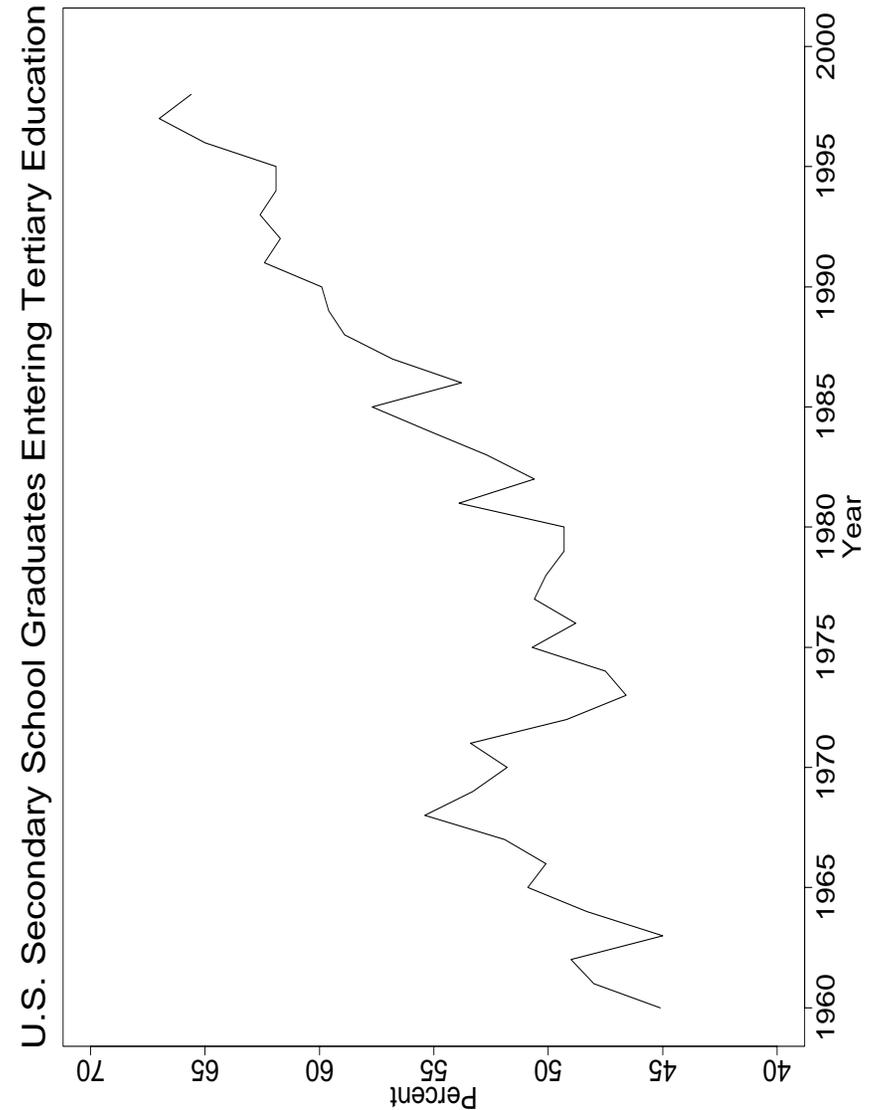
• University for the masses

	University entry rate	% Change 1990–1997
Australia	53%	+31%
Japan	36%	na
Korea	43%	+66%
New Zealand	68%	+43%
United States	44%	+8%

Source: OECD Education at a Glance 2000

• University education now

- No longer a filter, broader clientele
- No longer esoteric, link to career
- Our students are not “us, only younger”
- **Larger place for statistics.**



THE ENVIRONMENT

- **Nonstop education and training:** Employed adults in job-related continuing education, 1994–95

	All employed adults	University educated
Australia	41%	60%
New Zealand	51%	69%
United Kingdom	56%	79%
United States	47%	70%

- **Wisdom from research in math education**

- Students learn by their own activities
- Understanding and procedures are separate domains
- **We can't teach a wide audience what we used to think we covered.**

THE ENVIRONMENT

- **A changing discipline**

- Back to data, back to science
- Interdisciplinary emphasis

- **Technology**

- Drives changes in the discipline
- Drives demand for quantitative skills
- New content emphases
- New learning tools: The next big change?
- Enables competition for universities
- The information flood

This Is a Revolution

Something momentous is happening, something far more consequential than a mere technological innovation. The last time we experienced such an innovation was the invention of the printing press almost half a millennium ago.

Gertrude Himmelfarb

THE NEW STATISTICAL LITERACY

- **Data beat anecdotes**

- Power lines and childhood leukemia

- **...and intuition**

- General Electric appliance delivery

- **...and even “experts”**

- For every Ph.D., there is an equal and opposite Ph.D.

THE NEW STATISTICAL LITERACY

- **Think broadly: Is this the right question?**
 - Who is unemployed?
- **Think broadly: Does the answer make sense?**
 - “Only 15% of new entrants into the work force will be native white males.”
- **Communication: Can you read a graph?**
 - France in a population pyramid

THE NEW STATISTICAL LITERACY

- **Only big ideas need apply (details automated). One cluster:**
 - The omnipresence of variation
 - **Conclusions are uncertain**
 - Avoid inference from short-run irregularity
 - Avoid inference from coincidence

The rule for staying alive as a forecaster is to give a number or give a date, but never give both at once.

Jane Bryant Quinn

THE NEW STATISTICAL LITERACY

- **Big ideas: Another cluster:**

- Beware the lurking variable
- Association is not causation
- Where did the data come from?
- Observation versus experiment

- **Filters for nonsense: Triage on the information flood**

- The Bible Code predicts the future.

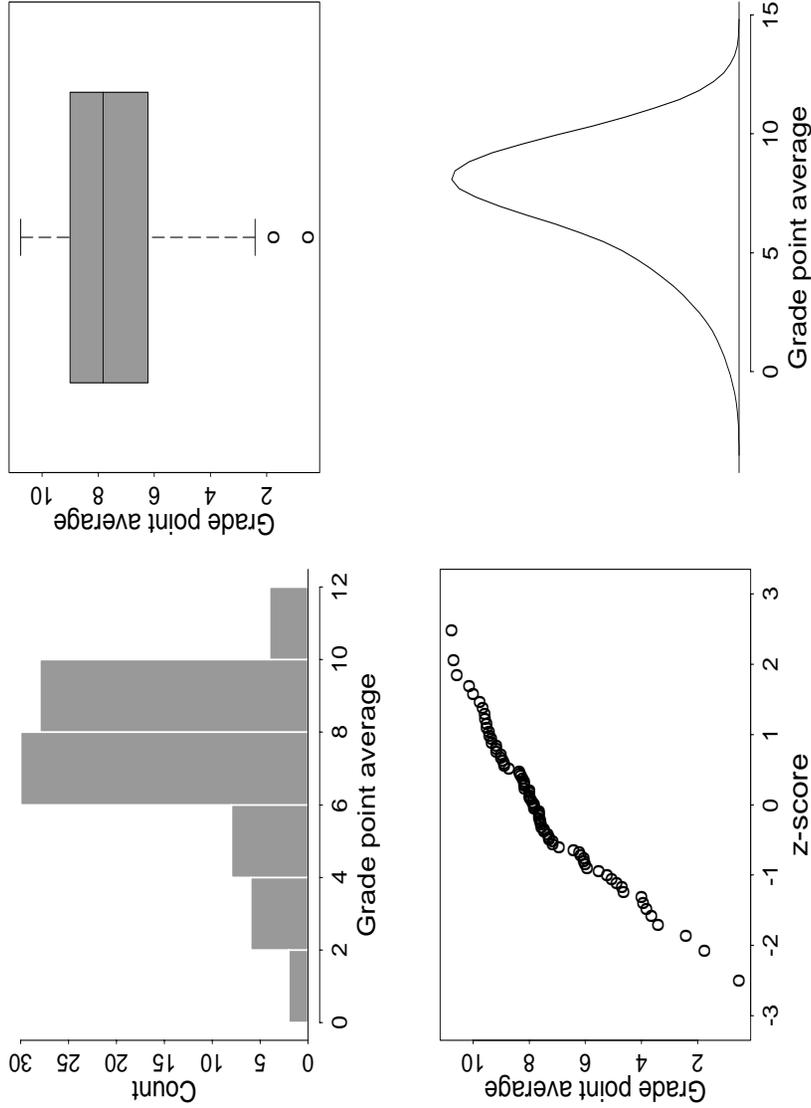
It's easy to lie with statistics. But it is easier to lie without them.

Frederick Mosteller

THE NEW STATISTICAL COMPETENCE

- **Use automated tools gracefully**
 - **What can't be automated?**
 - **Keep thinking broadly**
 - **Statistical thinking (ASA/MAA)**
 - The need for data
 - The importance of data production
 - The omnipresence of variability
- and . . .**

Use Automated Tools Gracefully: An Example



THE NEW STATISTICAL COMPETENCE

- **The quantification and explanation of variability**
 - Randomness and distributions
 - Patterns and deviations (fit and residual)
 - Mathematical models for patterns
 - Model-data dialog (diagnostics)
- **This is serious stuff**
 - Understanding chance variation
 - One pass through software isn't enough
 - Models as interpretive tools
 - Strategies, not just methods

THE NEW STATISTICAL COMPETENCE

- Data strategies: an example

PLOT
YOUR DATA



INTERPRET
WHAT YOU SEE



NUMERICAL
SUMMARY?



MATHEMATICAL
MODEL?

- But you can choose the details to fit your context

CHALLENGES

- The need to communicate.
- Our teaching is too narrow.
- Is quantitative literacy our turf?
- Does statistics retain a core?
- If the rocket goes up, I don't care where it comes down.