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Quantitative Literacy Today

MILO SCHIELD,
Augsburg College

Webmaster www. StatLit.org
VP National Numeracy Network
US Rep: International Statistical Literacy Project
October 8, 2010
Sponsored by PKAL and Quirk at Carleton College
www.StatLit.org/2010SchieldCarleton6up.pdf

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Quantitative Literacy (QL): 2010

Agenda:

- **QL in the News; QL at Colleges.**
- **2009 MAA QL survey**
- **QL: Two Big Ideas**
- **News-Based QL Courses**
- **Statistical Literacy**

"accused the paper [LA Times] of **unfair reporting** in using a **statistical analysis to rank the performance** of … instructors. (9/14/2010)

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Univ. of Texas: San Antonio $4M: Quantitative Scholarship

Quantitative tools will be embedded in core courses such as biology, economics, sociology and **political science.**

UTSA graduates will **interpret** mathematical and statistical models, **analyze** data and **make judgments** concerning the **validity and accuracy** of the data.

Nandini Kannan is the project director.
Source: www.utsa.edu/sacs/qep/qepTopic.html and www.utsa.edu/qep/

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U. Mass, Boston NSF Grant: $191K QR Course

PI: Maura Mast, Ethan Bolker. March, 2010, 3 yr.
General education QR course:
driven by complex stories such as inflation, fuel economy, and paying off debt.

Students **develop** quantitative approaches.
Instructors review mathematics as needed.
Spreadsheets are used.

http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0942186

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THE STANFORD REVIEW Since 1987
Front Page News Opinion Features World Blog Search all articles
Elam In as New Vice Provost
BY CATHERINE LOWELL — SEPTEMBER 12, 2010 — FEATURES — VOLUME XLV, ISSUE 1
"People who are engaged in [the] humanities … *need* to have quantitative reasoning to survive…"

http://stanfordreview.org/article/elam-in-as-new-vice-provost

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AAC&U: QL is Essential

The Essential Learning Outcomes

Intellectual and Practical Skills, including

- Inquiry and analysis
- Critical and creative thinking
- Written and oral communication
- Quantitative literacy
- Information literacy
- Teamwork and problem solving

http://www.aacu.org/leap/documents/EssentialOutcomes_Chart.pdf.

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AAC&U Assessment: Six-Factor QL Rubric

1. Interpret mathematical data*
2. Represent/convert mathematical data*
3. Calculation
4. Apply: Make judgments, draw conclusions
5. Make and evaluate assumptions
6. Communicate quantitative evidence

* Mathematical data includes equations, graphs, diagrams, tables, and words.

Source: www.aacu.org/value/rubrics/pdf/QuantitativeLiteracy.pdf

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MAA Survey of Quantitative Graduation Requirements (QGR)

Fall 2009: MAA distributed SIG-QL survey to MAA liaisons at US four-year colleges.

Response rate:

- 26% at US four-year colleges: 275 /1,075.

Survey margin of error: ± 6 pts.

Source: www.statlit.org/pdf/2010SchieldJMM.pdf

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2009 Survey Results from US Four-year Colleges

87% have college-wide quantitative requirement

68% have a quantitative support center

43% can satisfy QR requirement outside math

QR assessment:

- 32% have pre/entry
- 20% have post/exit

90% listed specific courses satisfying QGR.

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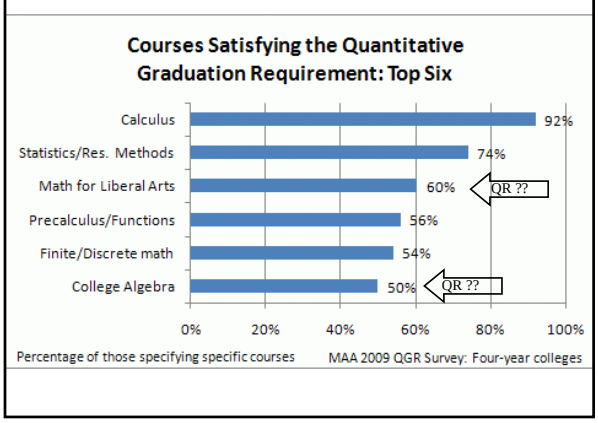

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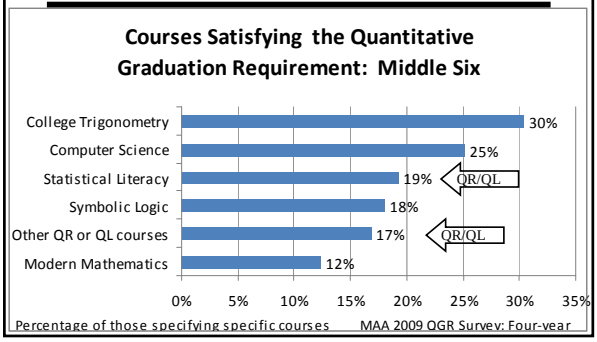
29% allow QR or StatLit; A fourth of these (7%) offer both



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QL Big Idea #1
Numbers in Context

Two interpretations:

1. **From numbers to context.**
   Many math word-problems:
   "A train travels west at 40 mph...."
   The birthday problem, voting paradoxes.
2. **From context to numbers.**
   "Circumcised men were two to three times less likely to contract HIV." AFP 5/28/2009.

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QL Big Idea #2:
Numeracy Across the Curriculum

Two approaches:

1. **Embed within many courses**
   Pro: Can't learn QL in just one course.
   Con: Everybody means "nobody"
2. **Offer a separate course:**
   Pro: Distinct content, outcomes.
   Con: What content? How much math?
   Who will teach? What department?

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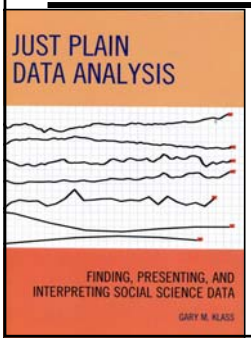
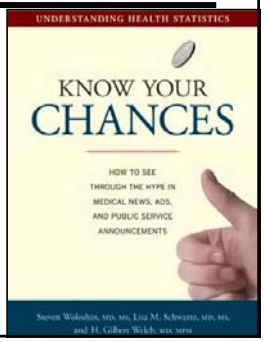
Some Innovative
Literacy-Based Textbooks





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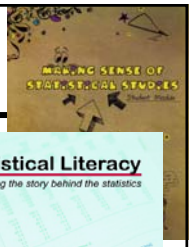
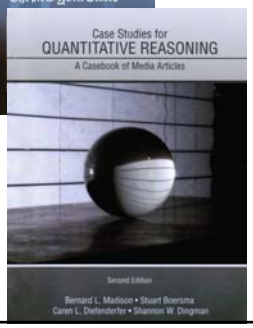
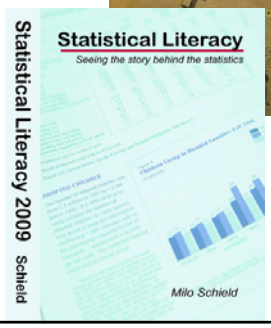
News-Based
QR and StatLit







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Importance of
Statistical Literacy

I've been increasingly impressed by how important statistical literacy has become for all of us around the globe.

Statistical literacy has risen to the top of my advocacy list, right alongside numeracy, and perhaps even ahead of "algebra for all."

J. Michael Shaughnessy, NCTM President
www.StatLit.org/pdf/2010Shaughnessy-StatisticsForAll-NCTM.pdf

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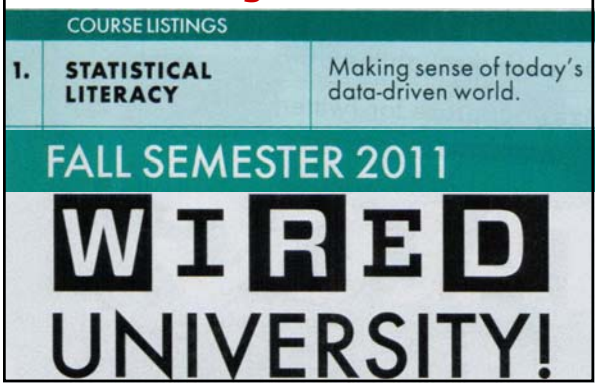
Wired Magazine: Oct 2010



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Statistical Literacy: Association-Causation

Statistical literacy is the ability to **read and interpret** summary statistics in the everyday media: in graphs, tables, statements and essays. Statistical literacy is needed by 'data consumers.'

#1: Can distinguish association from causation

1. Association is not causation
2. Association is not necessarily causation.
3. Association is often a good sign of causation.

Schield (2010) in *Assessment Methods in Statistical Education*

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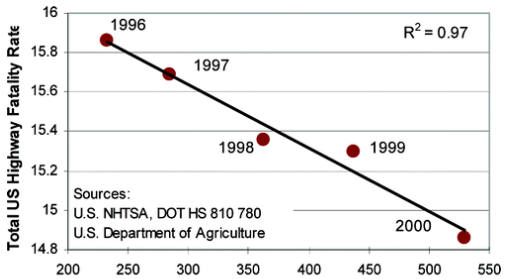
Math-Stats: Association is not Causation



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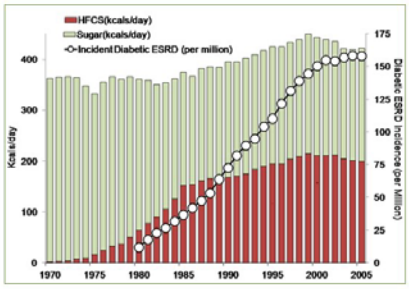
Statistical Literacy: Association May Signify Causation



U.S. Trends in Total Sugar and High Fructose Corn Syrup (HFCS) availability, and Incident Diabetic End-Stage Renal Disease (ESRD)

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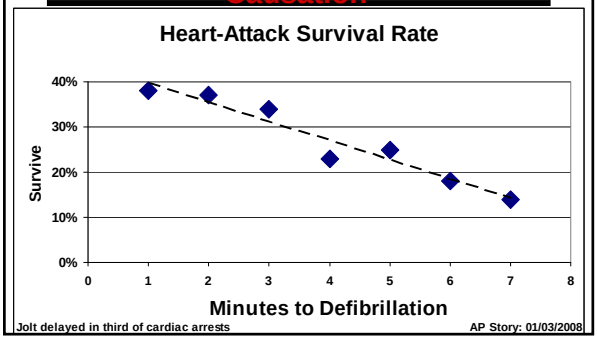
Statistical Literacy: Association May Signify Causation



Jolt delayed in third of cardiac arrests AP Story: 01/03/2008

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Statistical Literacy "Word" Problems

"Literacy" is a big idea in statistical literacy

Able to describe and compare percentages and rates presented in tables and graphs.

Is *the percentage of men who smoke* the same as *the percentage of smokers among men?* Yes

Is *the death rate of Minnesotans* the same as the *Minnesotan's rate of death*? Yes

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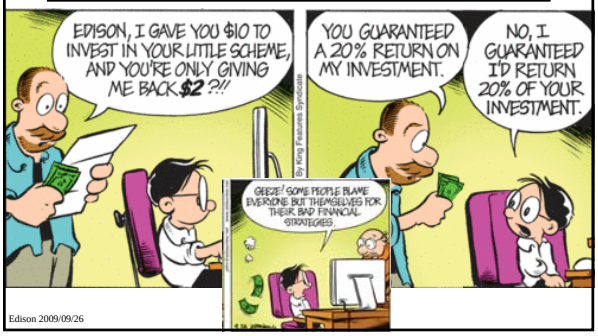
Small Change in Syntax; Big Change in Semantics



Edison 2009/09/26

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"Confusion of the Inverse"

AP: 9/30/09. **Too much candy could lead to prison**

LONDON, England —
Of children who ate candies daily at age ten,
***69% were arrested** for violent offenses by age 34.*

The real statistic:
***69% of those arrested** for violent offenses by age 34 ate candies daily at age ten.*

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"Word" Problems: Syntax vs. Semantics

Frequently vs. likely
- Car most *frequently* stolen: Honda Civic
- Car most *likely to be* stolen by thieves: Escalade
- Car most … stolen : _____??
- Thieves are most likely to steal this car ____??

Times more:
- Eight is four times [as much as] two: Statisticians
- Eight is four times **more than** two: Journalists

Times less
- Two is 75% less than eight: Statisticians
- Two is four times **less than** eight: Journalists

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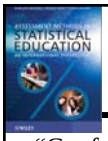
Startling Stats: Making small things big

7 nanograms per gram = 7 parts in a billion



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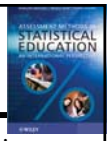
Statistical Literacy: Confounding

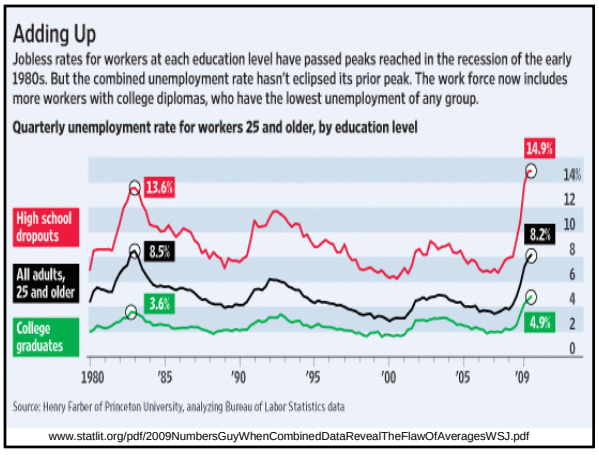


"Confounding" is a big idea in Statistical Literacy.

Controlling for a confounder can influence:
- the size of rates, percentages and relative risks
- the percentage or # of cases attributed to X
- whether a difference is statistically Significant

Statistically-significant differences can become *statistically **in**significant* (and vice versa).

Intro statistics textbooks do NOT mentions this!



www.statlit.org/pdf/2009NumbersGuyWhenCombinedDataRevealTheFlawOfAveragesWSJ.pdf

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Conclusion #2: Exciting Times for QL

29% of US 4-year colleges offer QR, QL or SL.

Designing an effective QR program is inherently challenging due to the interdisciplinary nature of the subject. Grawe and Rutz, Numeracy 2.2.2.

See what fits at your school:
- Sustained without grants or special support
- Supported by Math, Stat & Humanities faculty
- Valued by students