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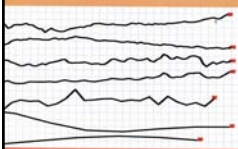
Statistical Literacy Teacher Training Online

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October 15, 2011
Paper at www.StatLit.org/pdf/2011SchieldNNN.pdf
Slides at www.StatLit.org/pdf/2011SchieldNNN6up.pdf

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Some Innovative Literacy-Based Textbooks

**JUST PLAIN
DATA ANALYSIS**

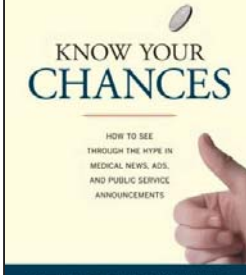


FINDING, PRESENTING, AND
INTERPRETING SOCIAL SCIENCE DATA
GARY M. KLASS

UNDERSTANDING HEALTH STATISTICS

**KNOW YOUR
CHANCES**

HOW TO SEE
THROUGH THE HYPE IN
MEDICAL NEWS, ADS,
AND PUBLIC SERVICE
ANNOUNCEMENTS



Steven Woloshin, MD, MS, Lisa M. Schwartz, MD, MS,
and H. Gilbert Welch, MD, MPH

THEMES
OF THE
Times
Quantitative Literacy
A COLLECTION OF ARTICLES FROM
The New York Times

Oct 2011

News-Based QR and StatLit

MAKING SENSE OF
STATISTICAL SERVICES

Case Studies for
QUANTITATIVE REASONING
A Casebook of Media Articles



Second Edition
Bernard L. Madelon • Stuart Borrone
Carol L. Dufresne • Sharon W. Dugman

Statistical Literacy
Seeing the story behind the statistics

Statistical Literacy 2009
Schield



Milo Schield

**STATISTICAL LITERACY ; STATISTICS
As
ART APPRECIATION : ART**



www.StatLit.org

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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

19% offer a course described as “statistical literacy”
17% offer a course described as QL or QR.

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TOPICS

1. Course goals
2. Course content (textbook)
3. Course delivery for student teachers
4. Feedback from student teachers

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1: Goals of QL

The content and the form of delivery for quantitative literacy (QL) depend on the choice of the goal.

The Augsburg Statistical Literacy course is based on:

- AACU Quantitative Literacy rubric (General Education)
- ASA GAISE College Guidelines for Statistical Literacy
- MAA QL publications

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AACU Gen-Ed QL Goals

Individuals with strong QL skills:

1. possess the ability **to reason and solve quantitative problems** from a wide array of authentic contexts and everyday life situations.
2. **understand and can create sophisticated arguments** supported by quantitative evidence ...
3. **can clearly communicate those arguments** in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate).

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

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ASA GAISE College Guidelines

The guidelines state that “students should recognize:

- Common sources of bias in surveys and experiments
- How to determine the population to which the results of statistical inference can be extended, if any, based on how the data were collected
- How to determine when a cause-and-effect inference can be drawn from an association based on how the data were collected (e.g., the design of the study).

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ASA GAISE College Guidelines

The ASA GAISE report defines statistical literacy as *understanding the basic language of statistics (e.g., knowing what statistical terms and symbols mean and being able to read statistical graphs), and understanding some fundamental ideas of statistics.*

This report noted that *students should develop statistical literacy and the ability to think statistically.*

The college report suggests assessing statistical literacy by students *interpreting or critiquing articles in the news and graphs in media.*

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MAA QL Documents

The MAA document (Steen, 2003) notes that

“Quantitative literacy empowers people by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently. These are skills required to thrive in the modern world.”

Meeting the goals of all three groups (AACU, ASA and MAA) is very demanding.

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2) Content & Student Needs

Students lack understanding of

1. the various kinds and forms of arguments.
2. the fact that statistics are numbers in context.
3. the fact that all statistics are socially constructed.
4. what is confounding and where is it found.
5. how comparisons, ratios, ratio comparisons, models and study design can “control for” various influences
6. how the choice of definition can influence a number
7. how chance can explain anomalies or deviations.
8. how bias can influence a number.

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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.'

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

| Year | Fresh Lemons Imported (Metric Tons) | Total US Highway Fatality Rate |
|------|-------------------------------------|--------------------------------|
| 1996 | ~250 | ~15.8 |
| 1997 | ~280 | ~15.7 |
| 1998 | ~350 | ~15.35 |
| 1999 | ~430 | ~15.3 |
| 2000 | ~530 | ~14.9 |

Sources:
U.S. NHTSA, DOT HS 810 780
U.S. Department of Agriculture

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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

Heart-Attack Survival Rate

| Minutes to Defibrillation | Survival Rate |
|---------------------------|---------------|
| 1 | ~38% |
| 2 | ~35% |
| 3 | ~32% |
| 4 | ~25% |
| 5 | ~28% |
| 6 | ~20% |
| 7 | ~15% |

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

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Statistical Literacy as Found in Arguments

Non-Math Content:

1. Distinction between association, causation and confounding.
2. Statistics are numbers in context.
3. All statistics are socially constructed. [Joel Best]

Argument-Driven Math Content:

Admonition: When dealing with statistics, "Take CARE"!

- Influence of **Context**: What is controlled for (taken into account) by study design, comparison, ratio, ratio comparison and models.
- Influence of **Assembly** in defining groups and measures.
- Influence of **Randomness** in small and large samples.
- Influence of **Error** (bias) in subjects, measurement and sampling

**Where Do Statistics
Come From?**

Setting the Table for Introductory Statistics

Marc Isaacson
Dept. of Business Admin
Augsburg College

Where do statistics come from?

Why not say "Statistics come from data"?

- This is a common answer from students. What is wrong with this answer?
- Saying that "Statistics come from data" is like saying "Babies come from hospitals". Both are true. Both leave out a whole lot of the story.

Fall 2008 19

Hyatt: Close to the US Capital




Oyster.com thinks this photo more accurately reflects the distance from the hotel to the Capitol.

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Startling Stats: Making small things big

7 nanograms per gram = 7 parts in a billion



4/2010 National Geographic

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Assembly on "bullying"

1. Almost all students are involved in bullying
2. Very few students are involved in bullying

How could both claims be true?

Source: <http://www.kare11.com/rss/article/922571/14/Study-Half-of-Minn-students-bullied-or-bullies>



Fall 2008 22

Loudest Animal on Earth



Adult = *Corixidae*
Photo: Stegner, College of Natural Resources, U of CA - Berkeley

Pond insect 'loudest animal on Earth'

A tiny 'water boatman' insect is the world's loudest animal relative to its body size, according to a new study.

Fall 2008 23

Two Per Cent Milk



Fat by Weight

$$2\% = \frac{5}{244}$$

Fat by Calories

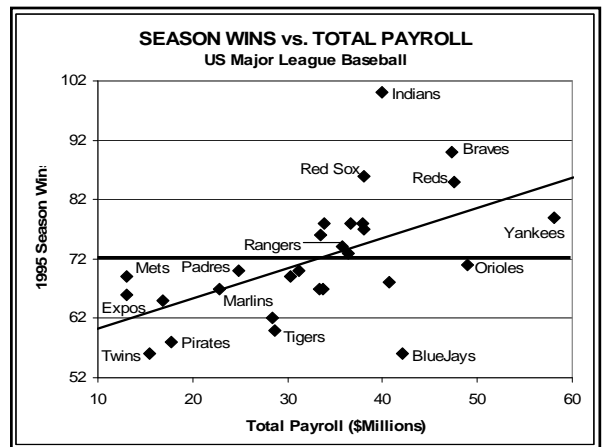
$$\frac{43}{122} = 35\%$$

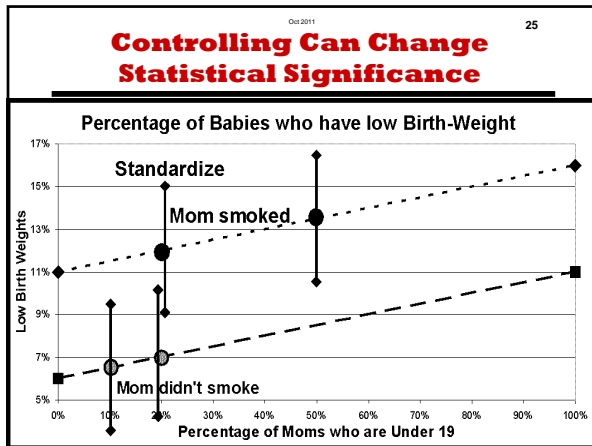
Fat by Daily Value

$$7\% = \frac{43}{65 \times 9}$$

Divide 43 calories from fat by daily fat calories allowed = 65 grams of fat times 9 calories per gram of fat

| Nutrition Facts | |
|------------------------|----------------------|
| Serving Size 244 g | |
| Amount Per Serving | |
| Calories 122 | Calories from Fat 43 |
| % Daily Value* | |
| Total Fat 5g | 7% |
| Saturated Fat 3g | 15% |
| Trans Fat | |
| Cholesterol 20mg | 7% |
| Sodium 100mg | 4% |
| Total Carbohydrate 12g | 4% |
| Dietary Fiber 0g | 0% |
| Sugars 12g | |
| Protein 5g | |
| Vitamin A | 5% |
| Vitamin C | 15% |





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Textbook

Introduction

- Ch. 1: Story behind the Statistics
- Ch. 2: Take CARE
- Ch. 3: Understanding Measurements
- Ch. 4: Describing Ratios
- Ch. 5: Comparing Ratios
- Ch. 6: Understanding Ratios
- Ch. 7: Chance and Confidence

- Appendix: Additional Tables
- Tables of Figures, Tables and Stories

Statistical Literacy
Seeing the story behind the statistics

Statistical Literacy 2011 Schield

Milo Schield

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3) Teacher Training Online

Six weeks: May 19 – June 30, 2011.

Entirely on-line. No face-to-face.

Materials presented via textbook, PowerPoint & audio.

Keene College (VT): 8 Teachers

Completed 73 Moodle exercises; worked 730 problems

Completed 14 news-based challenges in Odyssey: an online anonymous forum with peer-review.

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Odysseys: Teach Critical Thinking

Milo Schield: Dept. of Business Admin. Augsburg College

Larry Copes: Educational consultant, editor, software developer

General Problem

The most comprehensive assessment of teaching among college students revealed that 14 percent of students show an algorithmic approach to the key components of critical thinking, complex reasoning, and writing to the end of the sophomore year. (Kane and Frank 2001)

A "Solution" GSA Forum

Deliberate Moodle (Q & A forum) requires students to post their perspective before viewing others' postings. This allows equal participation opportunity among all students, thus encouraging original and independent thinking.

Advantages

For Moodle, see the Moodle Statistics. Allows teacher monitoring of student interactions.

Disadvantages

Knowing who refers who can take time from services. Students looking to critique their peers. Students are reluctant to refer responses to peers involving each student's own live interaction.

Conclusion

Q&A online forum. Each person does original thinking. Each day's thinking becomes available. Each student has the ability to give constructive feedback to anyone in the participant.

Contacts

Larry Copes: larrycopes@augsburg.edu or larrycopes@augsburg.edu

References

Kane, A. & Frank, C. (2001). The state of critical thinking in college: A national study. *Journal of Management Education*, 35(1), 2-18.

Real Solution: Odysseys

- All points are anonymous.
- Each post requires approval of other peers.
- Each post requires approval based on ratings.
- Rating composite required to make points.
- Students can rate and comment on all posts.
- File version 1.0.0 at www.augsburg.edu/~mcschield/odysseys

Other Benefits

- Fast reply to posting.
- Free training and teaching.
- Immediate feedback, even in large classes.
- Flexible about evidence.
- Flexibility about time.

Student Responses

- 10 posts in 10 days (10/20/2011)
- 47% based on "realistic"
- 70% used 4 approved basic critical thinking
- 70% justified (comment to another system)

Positive student comments:

- Grading was fair and motivating
- Some feedback learning
- Comments, though not perfect, were helpful
- Thought-provoking questions
- Received critical feedback from other staff
- ABA to college others

Audience: Teacher reading critical thinking in large classes, online content in sophisticated courses

Word Mosaic

Students from student comments. Larger font means more frequent comments.

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Course Management

Moodle: 130 Exercises (~10 questions each)

Student-tested by over a thousand students.

Quant Reasoning/Statistical Literacy (GST200_2011SEM1-B)

You are logged in as Milo Schield: Stud

Moodle > GST200_2011SEM1-B

Topic outline

- Overview/Introduction
- Announcements Forum
- Welcome
- CDO
- Syllabus
- Resources: Forwarding E-mail for "students"
- Intro: What is Moodle

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4) Teacher Training Feedback

To improve students' critical thinking the most, which would you recommend? **Odyssey forum** (5/7); Regular online forum (2/7); Written assignments (0/7).

In learning the material, the Moodle exercises had **moderate value** (4/7).

Split on which course is most useful to math-phobic students in understanding numbers in everyday media: Quantitative Reasoning (3/6), Statistical Literacy (3/6).

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Teacher Training Feedback #2

The focus on Context (choice in comparisons, ratios, study design) had **high value**. (4/7)

The focus on Assembly (choice in defining and presenting statistics) had **high value**. (4/7)

The focus on Randomness had **moderate value** (3/7).

The focus on Error/bias had **high value**. (4/7)

Agreed (4/7): text is suitable as a reference for QL course.

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Teacher Training Feedback #3

The use of and emphasis on math in this course in understanding numbers in the media is **very adequate** (4/7).


This course is **extremely valuable** (4/7) in reading and interpreting statistics in the media?

Take CARE approach had **moderate to high** value (6/7).

Very likely that students need the skills from this course as citizens in a data world. (5/7)

Strongly agreed (5/7) that statistical literacy should be required of all college students for graduation.

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SUMMARY

Peter Holmes

W. M. Keck Statistical Literacy course

- “is *different*”: “different emphasis”, “different background”, “a different package”
- “goes beyond Numeracy”
- is more in line with the statistical literacy “needed by most people in everyday life to read the news, by those in business commerce or management, and by policy makers.”

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Invitation

Check out www.StatLit.org

Check out some Statistical Literacy papers.

- *Statistical Literacy and Liberal Education@Augsburg*
- *Epidemiological Models and Spotty Statistics*
- *Teaching Statistical Literacy as a Quantitative Rhetoric Course*
- *The Social Construction of Rankings*

Sign up for information on teacher-training courses. It will expand your view of QL!!!