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## Statistical Literacy 2010: An Update

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*Intl. Conference on Teaching Statistics*  
Ljubljana Slovenia    ICOTS-8    July 2010  
[www.StatLit.org/pdf/2010Schield2ICOTS6up.pdf](http://www.StatLit.org/pdf/2010Schield2ICOTS6up.pdf)

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## Statistical Literacy Tues. July 13th, 12:45-13:45

**Presenter:** Milo Schield (US)



**Abstract:** Discuss statistical literacy.

Learn about Milo’s experience in teaching and assessing statistical literacy using the “Take CARE” approach highlighted in “*Assessment Methods in Statistical Education: An International Comparison*” (Wiley, 2010).

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## Statistical Literacy: 2010: An Update

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1. **19% of US four year colleges offer a course titled Statistical Literacy.** 2009 MAA Survey
2. **Assessing statistical literacy: Take CARE**  
Chapter 11 in *Assessment Methods in Statistical Education: An International Perspective*
3. **Statistical Literacy Survey: 2010**
4. **Statistical literacy course taught entirely online.**  
Uses new Odysseys anonymous peer-review game.
5. **News story database – Indexed (> 2,000 stories)**

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## 1. MAA QR Survey

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### Quantitative Graduation Requirements at US Four-Year Colleges.

Sponsored by the Quantitative Literacy Special Interest Group of the MAA: MAASIG-QL.  
Administered by the MAA in Fall of 2009 via its campus representatives.  
Directed by Milo Schield.  
Preliminary report at  
[www.statlit.org/pdf/2010SchieldJMM.pdf](http://www.statlit.org/pdf/2010SchieldJMM.pdf)

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## 1. MAA QR Survey Results – Part 1

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Of those US four-year colleges responding

- 87% have college-wide quantitative requirement,
- 68% have a quantitative support center,
- 43% can satisfy QR requirement outside math,
- 32% have a pre/entry QR assessment and
- 20% have a post/exit QR assessment.

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## 1. MAA QR Survey Results – Part 2

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Of those US four-year colleges responding and giving specific courses that satisfied any part of their quantitative graduation requirements,

- 92% listed Calculus,
- 74% listed Statistics or Research Methods,
- 60% listed Mathematics for Liberal Arts,
- 54% listed Discrete or Finite Mathematics,
- 50% listed College Algebra,
- 30% listed College Trigonometry,

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## 1. MAA QR Survey Results - Part 3

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Of those US four-year colleges responding and giving specific courses that satisfied any part of their quantitative graduation requirements,

- 25% listed Computer Science,
- **19% listed Statistical Literacy,**
- 18% listed Symbolic/Mathematical Logic and
- **17% listed "Other QR/QL courses."**

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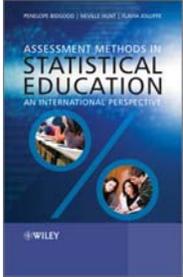
## 2. Assessing Statistical Literacy: Take CARE

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**Assessment Methods in Statistical Education: An International Perspective**  
 edited by Penelope Bidgood, Neville Hunt and Flavia Jolliffe.

Chapter 11: **Assessing Statistical Literacy: Take Care**  
 by Milo Schield

[www.statlit.org/pdf/2010SchieldExcerptsAssessingStatisticalLiteracy.pdf](http://www.statlit.org/pdf/2010SchieldExcerptsAssessingStatisticalLiteracy.pdf)



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## Statistical Competence

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**Statistical competence** is the ability to **produce, analyse and summarise detailed statistics** in surveys and studies.

**Statistical competence is needed by 'data producers'** – students in quantitative majors that have a statistics requirement, such as business, psychology, sociology, economics, biology and nursing ...

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## Statistical Literacy

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**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** – students in non-quantitative majors: majors with no quantitative requirement...

About 40% of all US college students graduating in 2003 had non-quantitative majors .

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## Comparison with SRTL

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**SRTL: *Statistical Reasoning, Thinking and Literacy***  
 SRTL is more like **factor analysis**.  
 What are the components that distinguish different levels of statistical thinking?

**SLC: *Statistical Literacy and Competence***  
 SLC is more like **classification analysis**.  
 What do different groups of students need to know about statistics?

Neither approach is wrong. They are just different.

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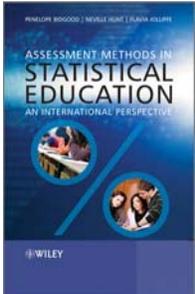
## Assessing Statistical Literacy: Take CARE

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**Four kinds of influence on every statistic:**

- C: Context**
- A: Assembly**
- R: Randomness**
- E: Error/bias**

Relative weights:  
 4, 3, 2, 1



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**Take CARE:  
C: CONTEXT**

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**The influence of factors taken into account**

1. by comparisons of counts, averages, ratios and comparisons of averages and ratios;
2. by epidemiological models (deaths due to obesity);
3. by regression models; and
4. by the study design (cf., controlled vs. uncontrolled; longitudinal vs. cross-sectional; experiment vs. observational study) or by selection in tables & graphs.

**The influence of factors (confounders) not taken into account and not blocked by the study design.**

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**Take CARE:  
A: ASSEMBLY**

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**The influence of choices**

1. in defining groups or measures,
2. in selecting the summary measure (e.g. mean vs. median), the type of comparison (e.g. simple difference versus times more), and the type of ratio (e.g. the confusion of the inverse or the prosecutor’s fallacy),
3. in selecting the group in forming an average, the base in a comparison of numbers and the denominator in a ratio (e.g. rate or fraction) and
4. in selecting the graph, table or statistic in presenting statistical results and summaries.

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**Take CARE:  
RANDOMNESS**

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The influence of chance on averages and coincidences (e.g. hot hand, too unlikely to be due to chance and regression to the mean).

The difference between *statistical significance* and *practical significance* in large samples or between *no statistical effect* and *no effect* in small samples.

The influence of a confounder on statistical significance.

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**Take CARE:  
ERROR/BIAS**

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The influence of any factor that generates a systematic difference between what is observed and the underlying reality:

1. subject bias (people can lie),
2. measurement bias (instruments can fail, questions may lead and researchers may manipulate) and
3. sampling bias (the difference between the sampled and the target population influences the result).

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**Take CARE:  
Summary**

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If students were to remember to ‘Take CARE’ in analysing statistics, that would be a considerable achievement.

The choice of ‘Context’ for the first category is based on the importance that context plays in the liberal arts and on the importance that statisticians place on context in distinguishing statistics from mathematics.

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**Take CARE:  
Summary**

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A statistical literacy course should be designed to satisfy the needs of citizens in a modern, data-driven society, to help them think critically about statistics when used as evidence in arguments.

If a course is to carry a statistical literacy designation and meet these goals it should: (1) study all sources of influence on a statistic; (2) choose topics based — in large part — on their prevalence in the everyday media; and (3) inspire data consumers to see a positive value in the material presented.

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### 3. Assessing Statistical Literacy

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Schild (2008) Statistical Literacy Skills Survey at [www.statlit.org/pdf/2008SchildPKAL.pdf](http://www.statlit.org/pdf/2008SchildPKAL.pdf)

Schild (2009) Numeracy: Assessing Basic Skills and Knowledge. Copy of paper at [www.statlit.org/pdf/2009SchildMAA.pdf](http://www.statlit.org/pdf/2009SchildMAA.pdf)

Schild (2010): Assessing Statistical Literacy with 20 questions. In progress.

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### 4. Teaching Statistical Literacy Online

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Offered entirely online in May-June 2010.

Moodle exercises: Students worked ~60 exercises with 5 to 20 questions each (typically 10). Two attempts with immediate feedback. Usually multiple choice.

Web tutorial on writing descriptions and comparisons of percentages in statements, tables and graphs.

Critical thinking taught using a Odysseys: a new web-based game using anonymous peer-review to generate power scores for all participants.

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### 5. Database of Number-News Stories

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Accumulated pdfs of over 2,500 news stories involving numbers (Adding 100 per month)

Text is placed into an Access database and queried on various keywords and phrases by story.

Currently working on a manually-generated index that is simple, fundamental and helpful to users.

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### Small Change in Syntax; Big Change in Semantics

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### 20% more OR 80% more

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**Who cries at weddings**

Women 45%  
Men 25%

Source: *Just Married* by Barry Sinrod and Marlo Grey

**Veil of tears**

Twenty percent more women than men say they cried at their own wedding.

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### Startling Stats: Making small things big

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7 nanograms per gram = 7 parts in a billion

2% Cefazolin sodium  
46% Non-Fluorinated  
20% Fluorinated  
33% Ceftriaxone sodium