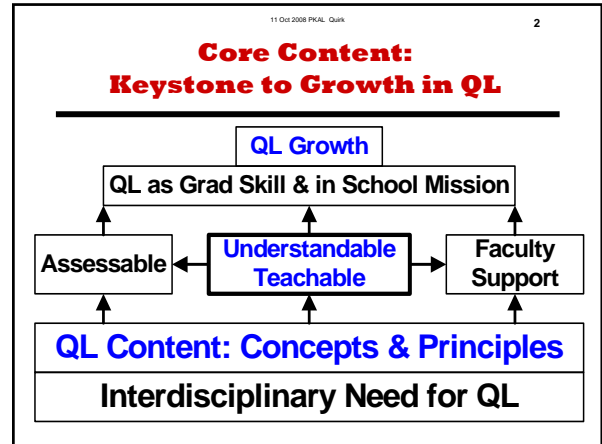---

Slide 1

11 Oct 2008 PKAL Quirk   1

StatLit Skills Survey

MILO SCHIELD,

Augsburg College

Director, W. M. Keck Statistical Literacy Project
Vice President, National Numeracy Network

Project Kaleidoscope (PKAL)
Carleton College: QUIRK Project
Quantitative Inquiry, Reasoning & Knowledge
11 October 2008

Slides at www.StatLit.org/pdf/2008SchieldPKAL6up.pdf

Slide 2

11 Oct 2008 PKAL Quirk   2

Core Content:
Keystone to Growth in QL

QL Growth

QL as Grad Skill & in School Mission

| Assessable | Understandable Teachable | Faculty Support |

QL Content: Concepts & Principles

Interdisciplinary Need for QL

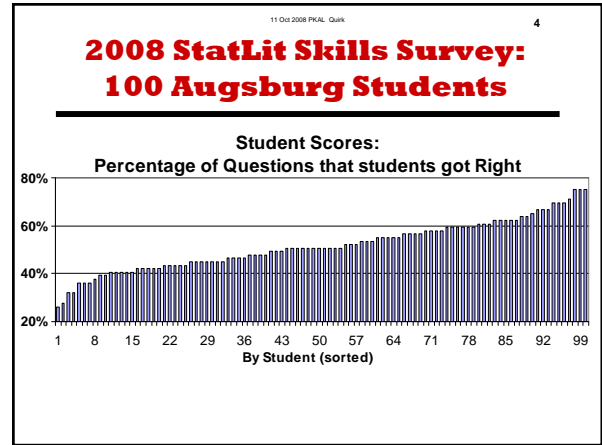**Slide 3**

11 Oct 2008 PKAL Quirk   3

Background

2002 W. M. Keck Statistical Literacy Survey.
• **International: US, UK, AuNZ & S. Africa.**
• **Found problems with rates and percentages**
   as presented in tables and graphs.

2007 & 2008 surveys of numbers in the news.
• **prevalence of comparisons and percentages**
• **opportunism: using association as causation**
• **opportunism: defining groups or measures**

Slide 4

11 Oct 2008 PKAL Quirk   4

2008 StatLit Skills Survey:
100 Augsburg Students

Student Scores:
Percentage of Questions that students got Right

By Student (sorted)

Slide 5

11 Oct 2008 PKAL Quirk   5

2008 StatLit Skills Survey:
69 Questions

Question Scores:
Percentage of Students that got question Right

By Question (Sorted)

Slide 6

11 Oct 2008 PKAL Quirk   6

Hard questions:
Which compare fits this table?

a. 9%
b. 25%
c. 53%
d. 8%
e. 5%

Adults	SEX		
RACE	Men	Women	ALL
Black	75%	25%	100%
White	51%	49%	100%
Other	40%	60%	100%
ALL	52%	48%	100%

a. Women are more likely among whites than blacks.
b. Blacks are more likely among men than women.
c. Either of the above   d. None of above e. Don't know.
'a' is correct.   91% missed this.   [R = 0.21]

Hard Questions:
Compare: 'Times more than'

Eight is three times more than two.
a. True   b. False   c. Don't know

     14%   82%   4%

Answer: A. True

Analysis: This statement means literally,
a) '8 is 3 times (two) more than 2' 8 = 6+2
86% missed this.   [R = 0.00]

Hard Questions:
Confusion of the Inverse

A medical test for HIV has 95% accuracy:
>   *95% of those with HIV test positive.*
Suppose that most of the subjects are like you.
No risky sex practices; no intravenous drugs.
You test positive. What is your chance of having HIV?
What percentage of these positives have HIV?
a. Less than 95%   b. 95%
c. More than 95%   d. Don't know or Not sure

Answer: A   **84% missed this** (R= 0.05)

Hard versus Good:
Difficulty vs. Correlation

Percentage OK vs. Question-Score Correlation

Good Question:
Read a Pie Chart [R=0.53]

Does this statement accurately
describe the data in this chart?
**The percentage of Protestants
who are smokers is 40%.**
a. Yes   b. No   c. Don't know

Answer: B **30% missed this**

Protestant is a part (numerator) in the pie chart
but is the whole (denominator) in the statement.

Good Question:
Do Arithmetic   [R=0.48]

An oil tanker hit a rock offshore from your city
and spilled about 180,000 gallons of crude oil.
How many swimming pools would this oil fill
if a swimming pool holds 12,000 gallons?
a. 0.07   b. 1.5   c. 7   d. 15
e. 70   f. 168,000   g. None of these

Answer: D: 180,000 / 12,000 = 15.
22% missed this.

Good Question:
Understand Assembly [R=0.44]

Which definition of 'heat-wave deaths' gives the
    largest number?
a. deaths caused by a heat wave
b. deaths occurring during a heat-wave
c.   No difference
d. d. Don't know/not sure

Answer: B.   **51% missed this**.
       28% choose A, 49% B, 17% C and 6% D

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11 Oct 2008 PKAL Quirk   **13**

Good Question:
%% vs. $$ Change [R=0.35]

If incomes of rich and poor both increase at the same rate, the **income gap** between rich and poor will

a. decrease   b. stay the same
c. increase   d. Don't know.

Answer: C.   **81% missed this**.

How: $90K versus $30K is a $60K difference.
Doubling both incomes doubles the difference.

Percentage change (multiplicative) is not additive.

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11 Oct 2008 PKAL Quirk   **14**

Modeling Error

# Questions	10 Q	15 Q	20 Q	25 Q	30 Q	35 Q	69 Q
Correlation	0.82	0.88	0.90	0.90	0.94	0.94	
Min	0%	7%	15%	16%	20%	20%	26%
Max	90%	87%	85%	84%	83%	83%	75%
Average	58%	60%	55%	52%	52%	53%	52%
StdDev	17%	15%	14%	14%	12%	12%	10%
R-sq	0.82	0.91	0.94	0.96	0.97	0.98	
Adj. R-sq	0.81	0.89	0.93	0.95	0.96	0.97	

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11 Oct 2008 PKAL Quirk   **15**

Sampling Error

Suppose a student scores 50% on a true-false test.

What is the margin of error due to sampling?

For a 100 question test, the 95% margin of error is 10%. The true score is between 40% and 60%.

For a 25 question test, the 95% margin of error is 20%. The true score is between 30% and 70%.

Sampling error is separate from modeling error.

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11 Oct 2008 PKAL Quirk   **16**

Content Validity

Even if an instrument had no modeling error and no sampling error, it might lack **content validity**.

Content validity is the extent to which experts believe a measure represents a social concept -- such as depression, intelligence or statistical literacy.

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11 Oct 2008 PKAL Quirk   **17**

Next Step

The content validity of any measure of numeracy, quantitative literacy or statistical literacy must be appraised by subject matter experts.

Once an instrument is found to have content validity and reliability then trade offs between number of questions and error (model and sampling) can be addressed.

At that point, a short reliable survey to assess statistical literacy can be designed.

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11 Oct 2008 PKAL Quirk   **18**

Statistical Literacy
Assessment References

Schield, Milo (2008). *Statistical Literacy Skills Survey*. PKAL-QuIRK conference at Carleton College. See www.StatLit.org/pdf/2008SchieldPKAL.pdf

Schield, Milo (2008). *Statistical Literacy: Assessing Case Studies*. Draft of paper submitted to ViSA: Variety in Statistics Assessment (UK). See www.StatLit.org/pdf/2008SchieldViSA.pdf.