

May 2012 1

Statistical Literacy and Mathematics

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Slides at www.StatLit.org/pdf/2012Schield7Keene6up.pdf

May 2012 2

Quantitative Literacy & Numeracy

Quantitative literacy (QL) and Numeracy:

1. NO solid or rigorous definitions
2. NOT centered on any algebraic expressions
3. NOT defined by unique mathematics topics
4. ARE just different forms of math appreciation
5. ARE just various forms of Math-Lite

May 2012 3

Quantitative Literacy is More than Math Appreciation

Statistical literacy, quantitative reasoning, quantitative literacy, numeracy:

- are NOT mathematics because

[Audience suggestions]

May 2012 4

Statistical Literacy

Statistical literacy is the ability to read and interpret summary statistics in the everyday media: in graphs, tables, statements, surveys and studies.

Statistical literacy is needed by data consumers – students in non-quantitative majors.

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

Statistical literacy studies all the influences on statistics.

May 2012 5

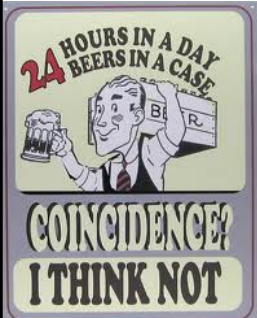

Statistical Literacy is Quite Different

Compared to Quantitative Reasoning (QR), Quantitative Literacy (QL) or Numeracy, Statistical Literacy focuses more on

- Randomness and Error/bias
- Context: what is taken into account
- Assembly: how things are defined or measured
- Causation: how well supported by an association

May 2012 6

Coincidence

May 2012 7

Coincidence?

$3.14 \rightarrow \pi$

$\pi \rightarrow 3.14$

coincidence? I think not!

May 2012 8

Seeing Coincidence

A3 =RAND(BETWEEN(0,9))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	Rice-10 sheet																																		
2	Find the largest group of high cells (red fill) that are touching each other.																																		
3	a. touching on sides in a row																b. touching on sides (but not just on points)																		
4	1	1	0	1	4	8	0	2	3	8	2	9	2	1	8	8	2	7	6	7	8	7	4	6	4	6	5	0	9	6	0				
5	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9	8	9			
6	6	7	7	6	0	3	1	7	8	2	0	5	4	9	6	4	8	1	1	9	6	3	4	4	7	2	3	7	4	7					
7	4	5	5	2	3	0	0	6	3	1	8	0	7	6	3	6	9	6	1	8	0	0	8	2	4	8	0	0	6	5	9	2			
8	0	7	8	6	0	3	2	2	1	6	9	4	6	4	4	7	2	5	1	9	4	6	7	5	5	8	3	2	2	7	3	6			
9	0	3	8	5	2	0	6	2	1	7	7	9	1	7	6	8	4	0	1	0	3	0	8	6	7	4	0	3	3	4	9	4	9	0	
10	2	3	7	1	9	0	4	5	6	7	9	1	5	3	9	8	7	4	7	5	6	3	8	6	6	2	3	9	5	3	2	0	2	0	
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20	5	6	9	1	8	3	4	8	8	5	6	5	0	1	5	3	7	5	4	2	8	3	7	9	0	6	2	1	3	9	8	9	2	9	

May 2012 9

Flip 8 sets of 3 coins each [24 flips]; A run of three heads is "expected"

Chance of 3 heads: one chance in eight.

1	2	3				1	2	3
1	2	3				1	2	3
1	2	3				1	2	3
1	2	3				1	2	3

Whale found dead in Wash. had swallowed golf ball

AP | By DOUG ESSER | Associated Press - 7 hrs ago

May 2012 11

Run of at least three heads: "Expected" in 10 flips of fair coin

1	1	2	3							
2		2	3	4						
3			3	4	5					
4				4	5	6				
5					5	6	7			
6						6	7	8		
7							7	8	9	
8								8	9	10
All	1	2	3	4	5	6	7	8	9	10

Key is "Overlap"

May 2012 12

Coincidence: Mathematical Principle

Seen: unlikely conjunction
 Unseen: # ways to generate that unlikely conjunction.

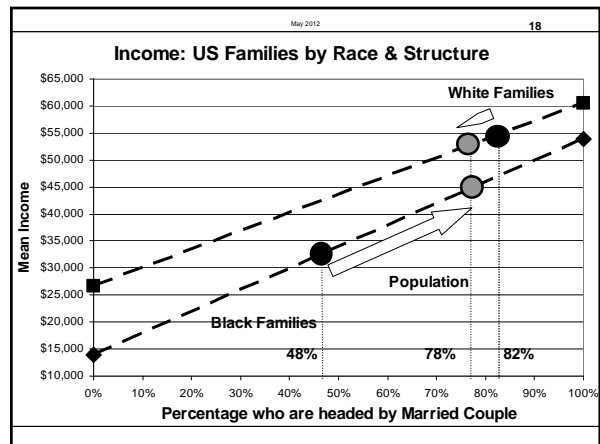
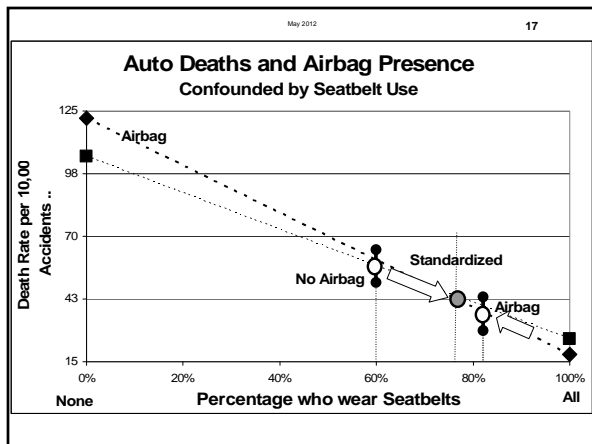
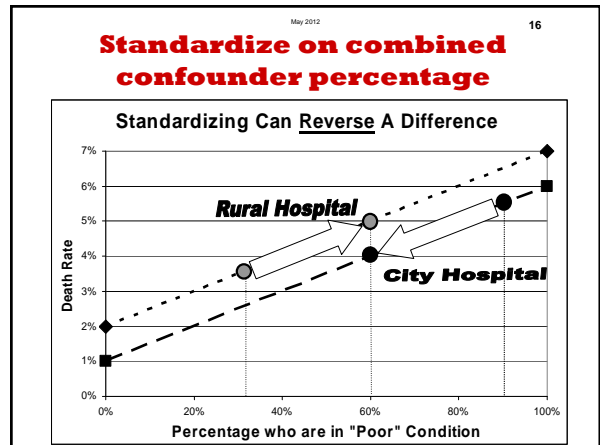
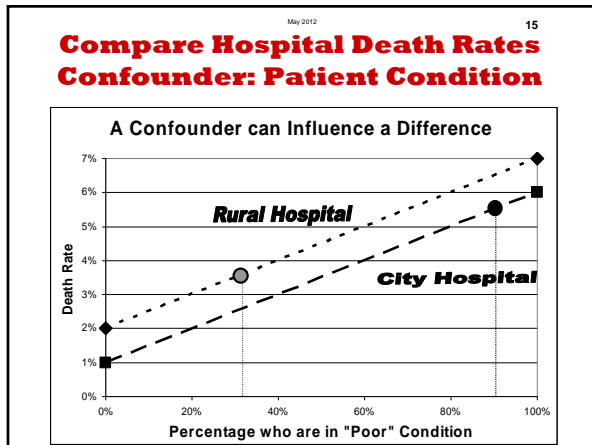
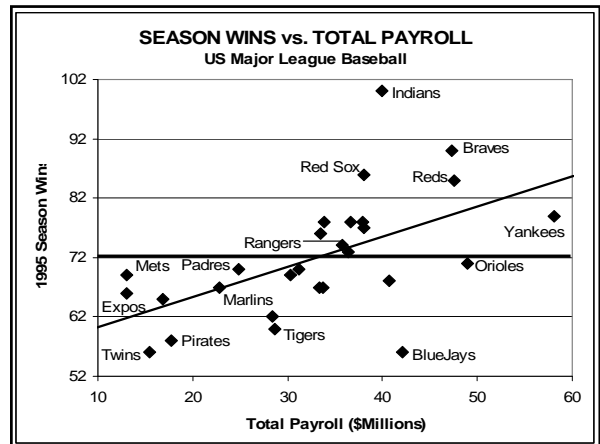
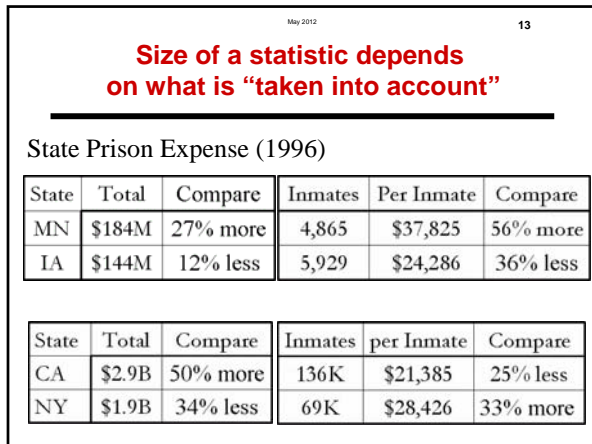
Mathematics reveals hidden connections.

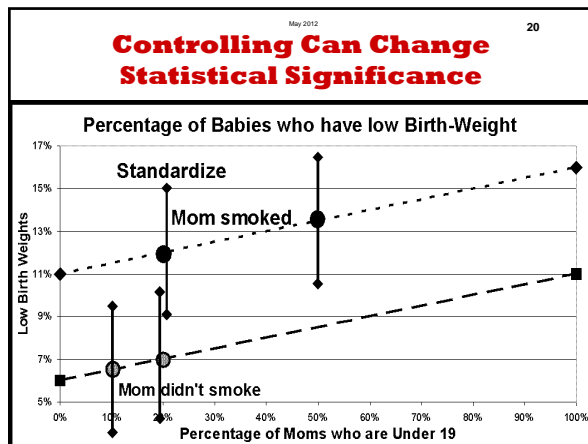
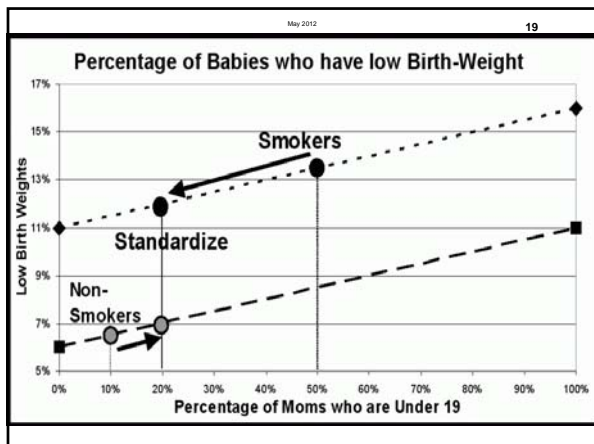
N logical events (k at a time) map onto n physical events

$$n = N + k - 1. \quad n \ll N^*k; \quad n \sim N$$

$$10 = 8 + 3 - 1. \quad 10 \ll 24 [8*3]; \quad 10 \sim 8$$

Analogous to combinations vs. permutations.





Ratios: influenced by confounders
Math-Stat Principles

Partial derivative can have a different magnitude and a different sign than a total derivative.

Statistical significance can be influenced by what is taken into account

Conclusion

If courses or programs involving numeracy, quantitative literacy or statistical literacy are to survive – much less to thrive – they must be strongly supported by mathematics and statistics departments and faculty.

Recommendation

Mathematics departments should give strong support for quantitative literacy courses and programs provided they embody high-level principles that are taught in upper-level math and stat courses – even if those principles are taught in an introductory manner.

References

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Schield, Milo (2012). Coincidences. MAA Boston. See www.StatLit.org/pdf/2012SchieldMAA.pdf www.StatLit.org/Excel/2012Schield-Runs.xls www.StatLit.org/Excel/2012Schield-Rice.xls www.StatLit.org/Excel/2012Schield-Bday.xls