

# Making Sense of Statistical Studies

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ISI 2011 Dublin

## Statistical Literacy and K-12 Education in the United States

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- “Piecemeal” in the math curriculum
  - Constructing graphs and numerical summaries
- Being able to construct a bar chart or compute a mean is NOT the same as being statistically literate...
- MSSS project focused on how to help bridge the gap between current school curriculum and statistical literacy.

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## Why MSSS?

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

- Blame it on Chris Wild...
- Chris said “drawing conclusions from incomplete data is like looking at the world through “rippy” glass.”
- Like when I don’t have my contact lenses in...



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## I see this...

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And I may not be sure if I am looking at...

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## But I can still learn from what I see...

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- I see more in the morning, even before I put in my contacts, than when I have my eyes closed, and even if it is “fuzzy” I can still make out quite a bit of what is around me.
- Even if I can’t be SURE if what I am seeing is my sister in a wild print blouse, a little dog in a zebra print dress, Elton John, or a real zebra, I have a pretty good idea!

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## Translating idea into a data setting

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- What allows me to conclude with confidence that what I am seeing is my sister? Two important ideas that translate to statistical literacy:
  - The process that generated what I am seeing is important—where am I? In my house? At the Dublin airport? In South Africa?
  - “Convincing evidence”—What I am seeing is walking upright—that might be enough to convince me it isn’t the little dog or a real zebra.

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### MSSS—Focus on Type of Statistical Study Rather Than on Statistical Method

- Literacy component missing
  - Students can construct graphs and summary measures, but may still not be an educated consumer of statistical information.
  - Students need to know what to believe and what not to believe.

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*Woman's World* (September 27, 2010)  
 (A popular weekly supermarket magazine with 1.6 million readers...)

- Should you eat garlic to prevent colds?
- Will doing tai chi (a type of slow exercises designed for relaxation and balance) one hour per week increase the effectiveness of your flu shot?
- Will eating cheese before going to bed help you sleep better?
- These three recommendations are just a few of many that appeared in just one issue. In fact, if you followed all of the recommendations in that issue, you would not only be doing tai chi and eating garlic and cheese, you would also be loading up on sweet potatoes, black tea, yogurt, walnuts, grape juice, olive oil, peanuts and strawberries!

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- Some of these recommendations are supported by evidence (data) from research studies, but...
  - How reliable is this evidence?
  - Are the conclusions drawn reasonable given the evidence, and do they apply to you?

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### Two Ideas Fundamental to Statistical Literacy

- Ability to draw reasonable conclusions depends on study design (even more so that the method of data analysis)
- “Statistical evidence”— what does it mean to say that we have statistical evidence or that two groups or two treatments are significantly different. (Ruling out chance)

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### Ruling Out Chance

- For statistical literacy, need to understand what “ruling out chance” means
  - in a sampling setting
  - in an experimental setting.

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### Focus on Study Design

- Two primary goals of project—focus on
  - Importance of study design.
  - Meaning of statistical evidence.
- By organizing investigations around type of study (rather than data type or statistical method), can accomplish both of these goals.

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## Making Sense of Statistical Studies

- Classroom investigations and supporting material for teachers
- Designed to provide a capstone experience through a coordinated and coherent set of investigations that can be integrated into mathematics courses to provide students with an understanding of the data analysis process and help them develop the conceptual understanding that provides the foundation for statistical reasoning.

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## MSSS

- Consists of an introduction and four distinct sections
- Sections are
  - Section I: Observational Studies
  - Section II: Surveys
  - Section III: Experiments
  - Section IV: Drawing Conclusions

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## MSSS

- Each section begins with an overview that contains essential background information for students. The overview is followed by a series of guided student investigations.
- Investigations start with a research question and the lead students through a series of questions that help them examine study design, analyze data, and interpret results.
- By completing the investigations in MSSS, students see the complete data analysis process in three contexts (observational studies, surveys, and experiments) and they are exposed to the ideas of sampling variability and the role that sampling variability plays in statistical inference.


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- Materials have been well received by teachers.
- Are being used in the classroom with students and in teacher in-service training, which was a use we had not originally anticipated.

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## Making Sense of Statistical Studies

**MAKING SENSE OF STATISTICAL STUDIES**



<http://www.amstat.org/education/msss/>

Information and a sample investigation

The American Statistical Association

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