STATISTICAL LITERACY FOR ADULTS: A SHORT COURSE

Gerry Hahn, Necip Doganaksoy, Ricki Lewis, Jane Oppenlander and Josef Schmee

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WHAT IS STATISTICAL LITERACY?

Katherine Wallman: Statistical literacy is the ability to understand and critically evaluate statistical results that permeate our daily lives.

THE NEED

- **Our responsibility: Helping build a statistically literate community**
  - **Better understanding of media**
  - **Informed consumers**
  - **Improved decisions**
- **Target areas**
  - **K to 12 education (including AP course)**
  - **College undergraduate and graduate courses**
  - **Adults: Focus of this talk**

SOME VENUES FOR BUILDING ADULT STATISTICAL LITERACY

- **Standard college courses**
- **Short courses, e.g., part of "lifelong learning" programs (this talk)**
- **Invited lectures**
- **Articles and books**
- **Web sites**

HOW WE GOT INVOLVED

- **Invite from Union College (Schenectady, NY) Adult Lifelong Learning (UCALL) Program to give short course in April 2008**
- **UCALL short courses: Five two-hour weekly lectures (in April and October)**
- **UCALL membership: "Open to any adult who wishes to continue learning in an intellectually stimulating environment."**
- **Other April 2008 offerings**
  - **The Roaring Twenties**
  - **Leonardo daVinci**
  - **Local theater: Behind the scenes**
  - **Eastern religions**
  - **Four 20th century operas**
- **Typical of similar programs nationwide**
- **Concept not limited to seniors**

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WHO ARE "WE?"
(The Gang of Five)

- **Gerry Hahn:** Retired statistician (and manager) of Statistics Laboratory: GE Global Research Center
- **Necip Doganaksoy:** Principal technologist/statistician at Statistics Laboratory: GE Global Research Center
- **Ricki Lewis:** Geneticist and science writer
- **Jane Oppenlander:** Adjunct Professor, Union Graduate College
- **Josef Schmee:** Retired Professor, Union College
- **Supported by Jim Comly:** Retired GE scientist





DECISION #1: SCOPING OF COURSE

- Sessions on
  - Some examples and basic concepts (Gerry and Jane)
  - Public opinion polls and election forecasts (Josef)
  - Medical and health studies (Ricki)
  - Business and industrial applications (Necip)
  - Further examples and wrap-up (Gerry and Jane)
- Course level
  - Focus on applications, concepts and misuse
  - NOT a course on statistical methods
  - Most advanced technical concept: Confidence interval

DECISION #2: COURSE MARKETING

- Course Name
  - Avoid "Statistics" in title
  - Decided on "Numbers in Everyday Life"
- Brochure course description:

  "Open a newspaper or turn on a TV—numbers are everywhere from political polls to health studies to sports. They can provide valuable, even life-and-death, information—or mislead. This course will provide insights to interpreting numbers and being well-informed citizens. Seasoned experts (all Ph.D.'s) will help you understand the latest statistics from medical studies, public opinion polls, business and industry, to this week's media and more."
- Welcome message to registrants: Invite to identify "media items…they would like to see discussed"

60 STUDENTS: CHARACTERISTICS

- **Major Focus: Consumers of statistics —want to make sense of statistics**
- **Voluntary enrollment: No grades, tests or homework**
- **Diversity of backgrounds**
- **Diversity of past training in statistics**
- **Commonalities**
  - **Appreciable life experience**
  - **High level of intellectual curiosity**
  - **Interest in subject**

THE CHALLENGE: FINDING THE RIGHT BALANCE

CLASS 1: SOME EXAMPLES AND BASIC CONCEPTS

- Course goal and overview
- Need to differentiate causation from correlation (and observational from controlled studies) illustrated by
  - Assertion "fewer New Yorkers have been treated for heart attacks since the State's wide ranging no smoking law took effect..."
  - Study linking marriage to longevity
- Headline: "Study finds prayer may make patients worse," illustrating
  - Need to read beyond the headlines
  - Need to find out how study was conducted
  - Publication in refereed journal adds credibility
- That magic bell-shaped curve
- Beware of on the average: Illustrated by President George W. Bush claim

  "On the average the folks who sign up for the (then) new prescription drug program are going to save $1,300 a year"
- What is data mining? Illustrated by NBA coaches' use of software to optimize basketball strategies

CLASS 2: PUBLIC OPINION POLLS AND ELECTION FORECASTS

- Topics
  - What is a poll?
  - Why do we need polls?
  - How are polls conducted?
  - Why do polls work (sometimes)?
  - When can we trust a poll?
- Examples
  - 1936 Literary Digest poll
  - 2008 U.S. Presidential primaries
  - N.Y. Times: "How the poll was conducted"
- Discussion: How to ask questions, sampling, bias in polls, margin of error

CLASS 3: MEDICAL AND HEALTH STUDIES

- Anatomy of a medical journal: Critical examination of eight articles in 28 February 2008 New England Journal of Medicine
- The drug approval process in the U.S. (and future improvements)
- Sources of distortion, e.g.,
  - Inappropriate extrapolations
  - Errors of omission
  - Confounding factors
  - Test duration and sample size limitations

CLASS 4: BUSINESS AND INDUSTRIAL APPLICATIONS

- Some examples
  - Identifying yield differences between two plants and their causes
  - Improving quality of TV program closed captions
  - Assessing impact of warning letters on fraudulent copyright infringement activities
  - Understanding failure to avert NASA Challenger space shuttle disaster (o-ring failures)
- Recommendations
  - Find out how numbers are defined
  - Graphical displays are highly useful—but can also mislead
  - Be wary of advocates with numbers
  - Find out how numbers were obtained

CLASS 5: FURTHER EXAMPLES AND WRAP-UP TOPICS

- College rankings: Quantifying the subjective
- Testing in schools
- More on data mining
  - Wal-Mart's massive data warehouse and its use
  - Assessing pollution in Lake Champlain watershed
  - Databases and personal privacy
- Diagnosis of claimed "one in a million" chance event
- Various sports applications
- Good and bad graphics
- Some (more) misapplications
- More numbers studies that further knowledge
- Some good reading and surfing
- Eight major course take-aways

MAJOR COURSE TAKE-AWAYS

1. Numbers are an essential and highly valuable element of numerous human endeavors—you can't escape them
2. Always ask
   - Who is taking/reporting the numbers?
   - How were they obtained?
   - Have they been peer-reviewed?
   - What are the underlying assumptions?
3. Be wary of
   - Advocates' numbers
   - Cherry picking
   - Before and after comparisons
4. Remember news media seek newsy/surprising numbers
5. Appreciate limitations of observational studies and differentiate correlation from cause and effect
6. Gold standard is controlled (randomized) experimentation—but often not attainable
7. Recognize uncertainty: Nothing is certain but death and taxes (Ben Franklin)
8. Let number help you gain understanding—not intimidate you!

CLASS MOTTO:Numbers are useful,but can be readily abused—handle with care!

SOME OBSERVATIONS

- Class survey results highly favorable
- No major suggestions for improvement
- Succeeded in limiting technical discussion
- Extensive class discussion--but no new problems
- Gang of five approach worked well
- Undertaking was fun
- How can we
  - Reach beyond seniors?
  - Reach those that don't sign on?

IN CONCLUSION

- Improving statistical literacy is a key professional concern
- Major emphasis to date has been on youth education
- We need help provide statistical literacy to ALL
- Mini-course approach appealing to adult audiences
- Course was directed at higher end of age spectrum—but has wider applicability

OUR HOPE: COURSE WILL BE STARTING POINT FOR OTHERS

ACCESSING OUR COURSE MATERIALS

- Most of our course materials and commentaries are accessible via Milo Shield's site Statlit.org:
  - February 2009 Amstat News article on Numbers in Everyday Life
  - Expanded version of preceding article
  - Powerpoint slides on 4 of the 5 lectures (and detailed summary of 5th)
  - Class summary and reading list
- How to do it
  - Access statlit.org
  - Go to Statlit News
  - Go to Statlit 2009
  - Go to Numbers in Everyday Life
  - Hit links shown about third of the way down (most on right hand side)
- For copies of slides of this talk: gerryhahn@yahoo.com

CONTACT INFORMATION

- Gerry Hahn, 1404 Orlyn Drive, Schenectady, NY 12309
- Email: gerryhahn@yahoo.com
- Home phone: 518: 374-0713
- Cell phone: 518: 852-8352