The Lottery:
A Tax on Those Who Flunked Math

- Monique Lloyd

Lecture5

Developing a QL Program: How Does Your Garden Grow?

Judith Moran
Director of the Math Center
Trinity College Hartford CT
judith.moran@trincoll.edu

PREP Workshop Macalester College
June 2005

1. Overview of Trinity's QL Program
2. Second Tier QL Course
3. Discipline/QL Course
4. QL-enriched course
5. QL-course-specific presentation

Components of Trinity's QL Program

1. **QL Requirement** instituted and overseen by full faculty

2. **Math Center Advisory Committee** of nine faculty from across campus, including one (other) member of the Math Department, and Associate Dean of Faculty

3. **Assessment of all incoming students** in four areas:
   - Numerical Relationships
     proportions, percents, estimation
   - Statistical Relationships
     data analysis, elementary probability
   - Algebraic Relationships
     modeling, functions, algebra
   - Logical Relationships
     fallacies, arguments, counterexamples

4. Foundation Courses and Quantitative Support

(peer tutoring center)

- *Contemporary Applications: Math for the 21st Century*
- *Cityscape: Analyzing Urban Data*
- *Earth Algebra: Modeling the Environment*
- *Hartford Current Issues: Logic in the Media*

5. Other QL courses:

- *Fallacies for Fun and Profit* (First-year Seminar)
- *Mathematics of Equity* (Math Distribution Credit)
- *Skepticism and Belief* (Science Distribution Credit)
- *Visually Displaying Data: Graphical Literacy* (Math Distribution Credit)
- *Mathematics of Patterns* (Math Dist. Credit)
- *Geometry in Art and Architecture* (Math Dist. Credit)

6. QL-enriched courses:

QL Across the Curriculum

courses supported by grants from the Dean of Faculty and the NNN:

Introduction to Earth Science
Adjustment and Transition: The Political Economy of Sub-Saharan Africa
Introduction to Environmental Science
Math, Disease, Race and Colonialism in the Americas
Introduction to Health and Human Rights
Introduction to American Public Policy
Foundations of Modern Science
Math as Music, Music as Math **(Tutorial College)**
World Population

7. Presentations in other non-mathematics courses:

Art and History in Venice
Dante Seminar
Symmetry & Patterns in Science, Art, Math and Music
Colonialism in Latin America
Interdisciplinary Science Seminar **(with Barbara Walden)**
one week's work on math and physics of quasicrystals

8. College and Area Presentations

Tutorial College – Mathematics in *Arcadia*
College wide and public lecture: *The Art and Geometry of Italian Pavements*
Diaspora series, Trinity. *Cultural Manifestations of Mathematical Patterns: from Moorish Ornament to Escher's Prints*

9. Interaction with colleagues in other institutions

MAA SIGMAA
NECQL (Northeast Consortium for Quantitative Literacy)
10th annual meeting April 2006 Amherst College
NNN first meeting June 2005

10. Professional Development

PREP QL Workshops last three summers and in June 2005 Macalester College NOW
Contributed paper session at next January's combined math meetings in San Antonio

11. Program and QL Assessment

Along with other NNN sites Hollins University and The Washington Center, Trinity participated in an NSF QL assessment grant in 2004.

This is an area where there is much to be done!

There Are Many Paths to Enlightenment…

Lao Tzu

Second Tier QL Course:

Visually Displaying Data: Graphical Literacy

Visually Displaying Data: Graphical Literacy

Components of Course:

1 Analysis and creation of graphics including:

tables, bar graphs, stacked bar graphs, data maps, multiple bar graphs, line graphs, Pareto charts, stacked line graphs, space-time narratives, pie charts, time-series, histograms, projections, binning and aggregating data, small multiple displays, scatter plots, demographic displays, double y-axis graphs

Visually Displaying Data: Graphical Literacy

2. Workshops and Speakers:

Excel Workshop
GIS Workshop (ArcView)
Ivan Kuyzk Director, Cities Data Center,
"Using Hartford Data"
Professor Noreen Channels
"Literacy Rates in Hartford County"

Visually Displaying Data: Graphical Literacy

3. Readings:

The Visual Display of Quantitative Information, 2nd edition, Edward R. Tufte

Visual and Statistical Thinking, Edward R. Tufte

The Cognitive Style of PowerPoint, Edward R. Tufte

Handouts from the Visual Revelations column of *Chance* Journal, *Mapping it All Out*, and *How to Lie with Maps*, by Mark Monmonier,

Articles including "Big and Bad," *The New Yorker*, "Estimates of Adult Literacy Rates in Hartford, CT,"

Visually Displaying Data: Graphical Literacy

4. Notebook:

This contains examples of both good and bad graphics, collected by each student over the semester, and includes a discussion of each graph in terms of what about it is effective or data distorting.

I provided nearly thirty topics and questions such as:

"Find an example of a 3-dimensional display in a recent news report. Are three dimensions needed, or are they included for cosmetic reasons? Comment on the effectiveness of the display. Could another display have been used to depict the same data?"

Visually Displaying Data: Graphical Literacy

5. Community Learning Project

Each student will be assigned to one city or town in Hartford County. Using the Hartford County data set supplied by Ivan Kuyzk, present a graphical portrait of "your town." How does it differ from and resemble other towns in your group, and the other towns in Hartford County? Present your information using Excel and Power Point and coordinate your presentation with those of the other students in your group.

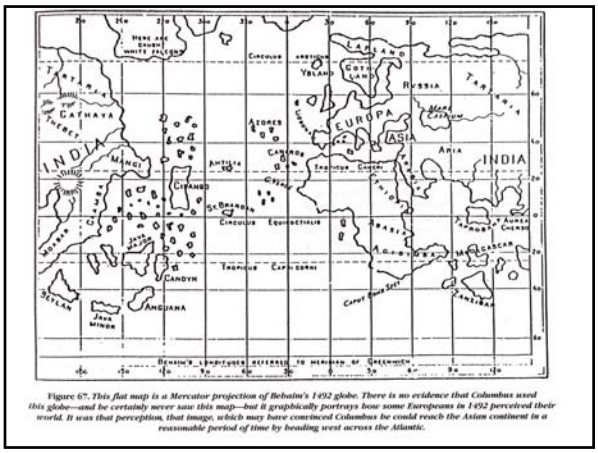
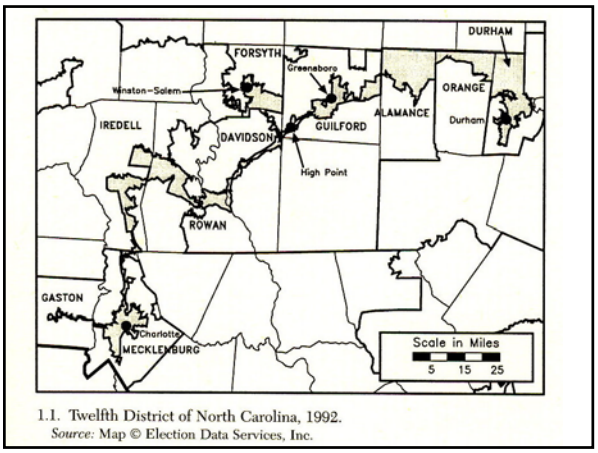
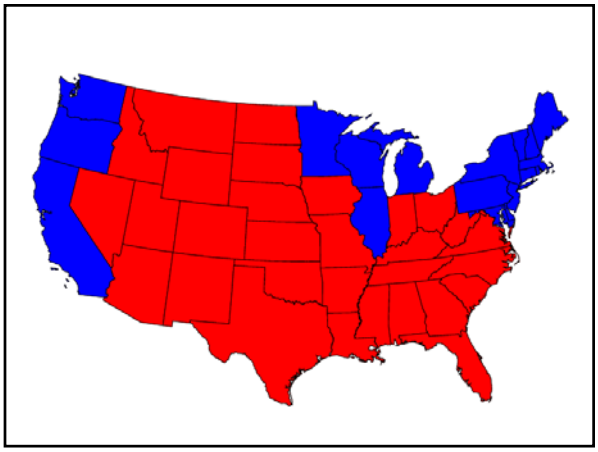
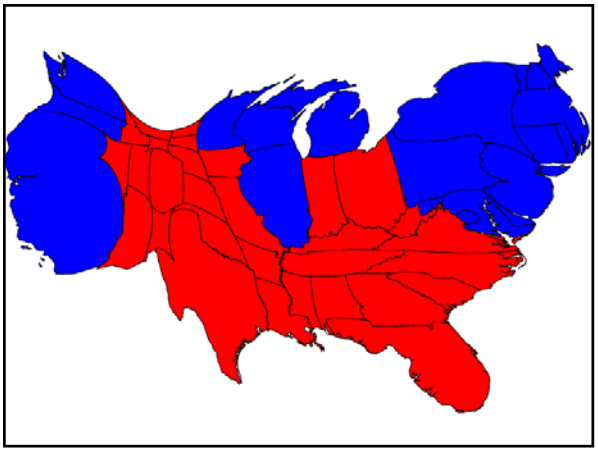


Figure 67. This flat map is a Mercator projection of Behaim's 1492 globe. There is no evidence that Columbus used this globe—and he certainly never saw this map—but it graphically portrays how some Europeans in 1492 perceived their world. It was that perception, that image, which may have convinced Columbus he could reach the Asian continent in a reasonable period of time by heading west across the Atlantic.

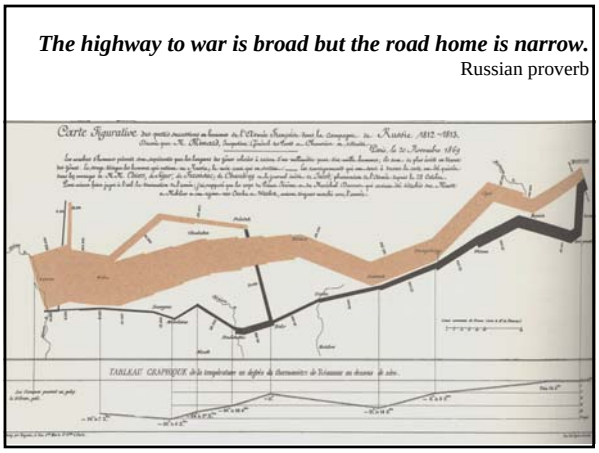


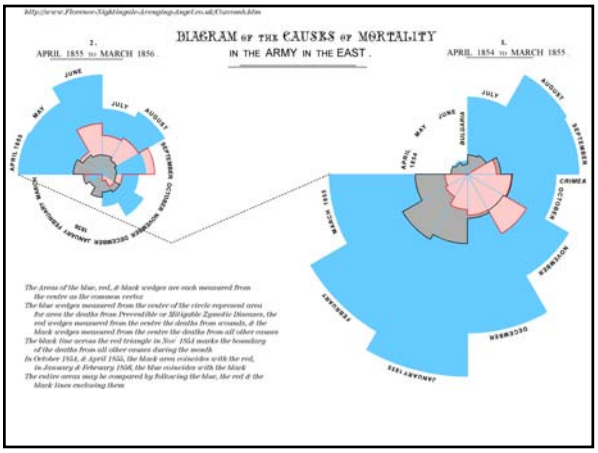
1.1. Twelfth District of North Carolina, 1992.
Source: Map © Election Data Services, Inc.

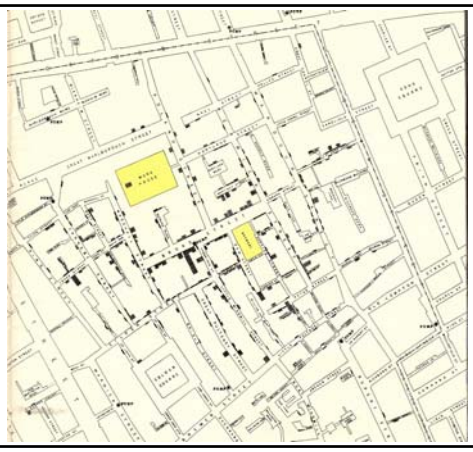


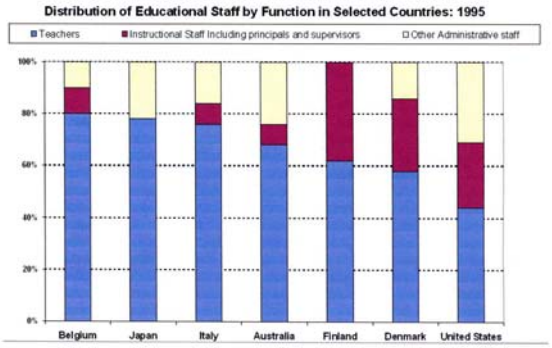


The highway to war is broad but the road home is narrow.
Russian proverb

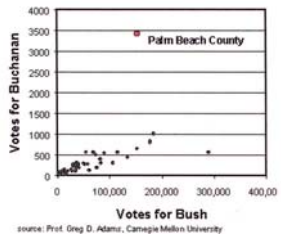


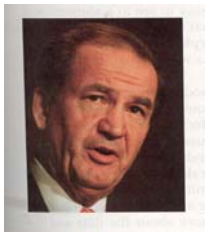


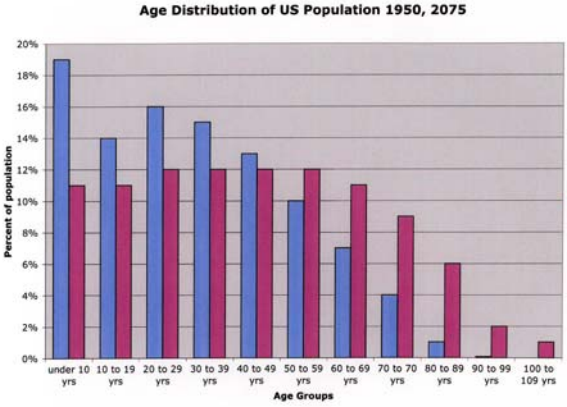




Take-Home Question from Exam 2

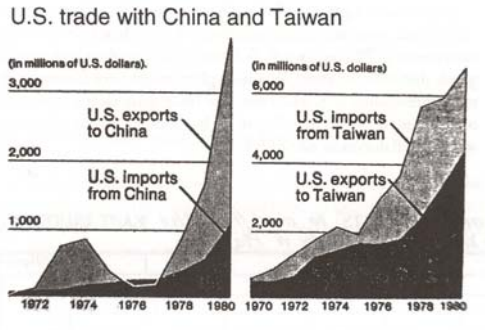






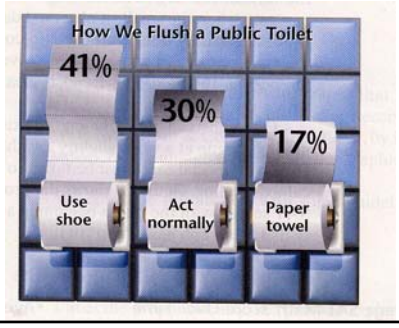
In-Class Question from Exam 1

The graphic below is from the *New York Times*. Analyze the misleading features of these two graphs



In Class Question from Exam 2

The graphic below is from a USA Today "Snapshot." A survey was conducted by Impulse Research for Quilted Northern Confidential in which individuals were asked how they would flush a toilet when the facilities are not sanitary. What's wrong with the graphic?



Science/QL course

Skepticism and Belief

Judith Moran
Department of Mathematics
Barbara Walden
Department of Physics
Trinity College, Hartford

- **Audience**:
  - non-science, non-math majors
  - students fulfilling "natural sciences" distribution requirement
- **Our Goals**:
  - develop quantitative & scientific literacy
  - foster understanding of how this literacy is relevant to students' lives
  - active engagement of students in every class session

Course Structure

- What's the *chance* of that?
  - Probability, statistics, and the lottery
  - Probability & coincidence
- Seeking patterns; making a logical argument
  - Collecting & visualizing quantitative information
  - Case study: Snow and Cholera
  - Case study: The Space Shuttle Challenger
- Experimentation and the scientific method
  - Design, carry out, and present an experiment

Assignment #4

Reading and class preparation

1. What is the most amazing coincidence you have experienced? Write a description of what happened and why you were amazed. What do you think is the probability of such an event occurring by chance? NOTE: Please type or word-process your essay.

Coincidence (Diaconis & Mosteller):

A surprising concurrence of events, perceived as meaningfully related, with no apparent causal connection.

Lecture5

Factors Affecting Apparent Coincidences

- Hidden causes
- Selective memory
- Multiple end points
- Close but not exact matches
- Faulty probability calculations
- Human tendency to look for patterns

Lecture 6

The Law of Truly Large Numbers

With a large enough sample, any outrageous thing is likely to happen.

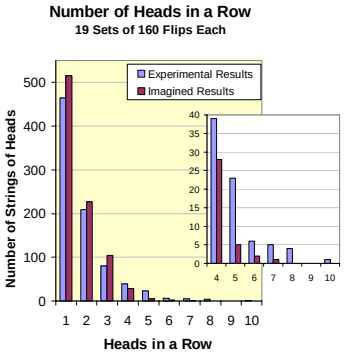
Lecture 6

Distinguish between:

- How likely is this to happen?
- How likely is an event like this to happen to *me*?

Lecture 6

Coincidence & Coin Flipping



Developing the ability to think independently and quantitatively about science

doing well-defined statistics problems

critiquing presentations of statistics found in the media

critiquing other people's use of statistical analyses and their subsequent conclusions & decisions

designing and presenting original experimental work

Assignment #4

Reading and class preparation

2. Read Handout 6 about Evelyn Adams, who won the New Jersey lottery twice. The article, condensed from *The New York Times*, gives the probability of such a coincidence occurring as about 1 in 17.3 trillion.

a) How did the lottery officials arrive at this probability?

b) Can you think of any factors that the lottery officials many have neglected to take into account in their determination of this number?

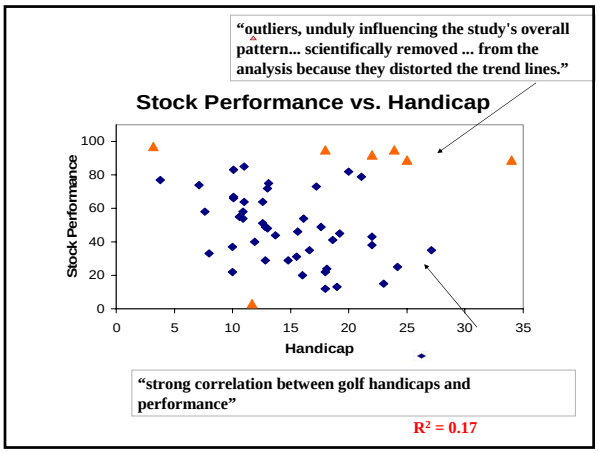
Stock Performance & CEO Handicap

Investing It; Duffers Need Not Apply
by Adam Bryant
The New York Times, May 31, 1998

"... If a chief executive is a better-than-average golfer, he is also likely to deliver above-average returns to shareholders.

...

'For all the different factors I've tested as possible links to predicting which C.E.O.'s are going to perform well or poorly, this is certainly one of the oddest -- but also the strongest -- I've seen,' he said. 'There's got to be something here.' "



Our Favorite Student Experiments

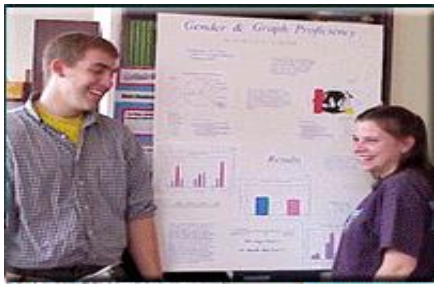
What's So Great About Breakfast?

- Marcia Greenblatt & Claire Matteson

Does eating breakfast affect your mental performance?

Gender & Graph Proficiency

Rob Champagne & Desiree Pearson



Do poor graphs lead people to draw erroneous conclusions based on their own prejudices?

Is the Motion of a Pendulum Affected by the Proximity of a Man Compared to a Woman?

Daphne Konstantinides & Greg Pagnini

Useful Resources

- ***How We Know : An Exploration of the Scientific Process***, by Martin Goldstein
- ***Visual & Statistical Thinking : Displays of Evidence for Decision Making***, by Edward R. Tufte
- ***What Do You Care What Other People Think? : Further Adventures of a Curious Character***, by Ralph Leighton and Richard Phillips Feynman

- Class website: http://caribou.cc.trincoll.edu/~bwalden/coll155.html
- Dartmouth *Chance* website: http://www.dartmouth.edu/~chance/

QL-enriched course:

Colonialism in Latin America

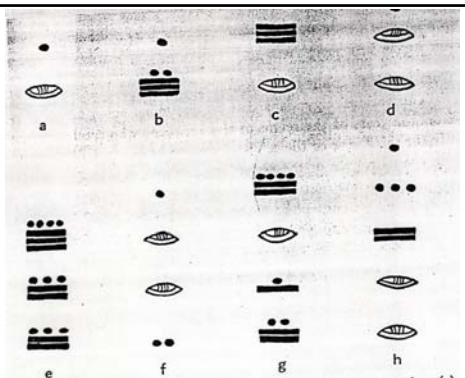
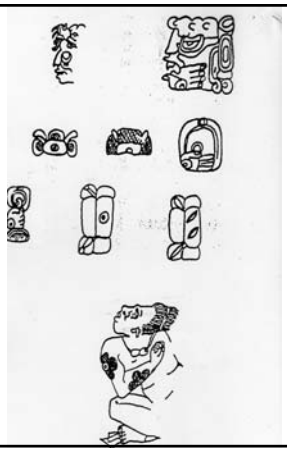
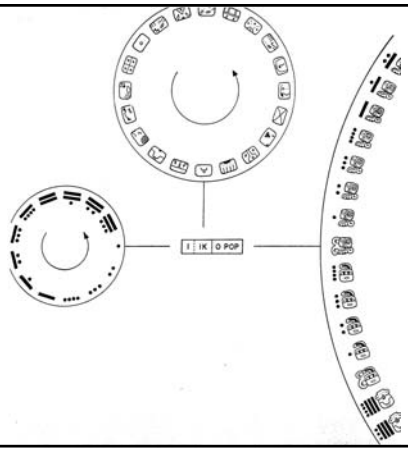


Fig. 24.—Examples of Maya numbers above XIX in bar-and-dot notation: (*a*) 20; (*b*) 37; (*c*) 300; (*d*) 360; (*e*) 7,113; (*f*) 7,202; (*g*) 100,932; (*h*) 169,200.





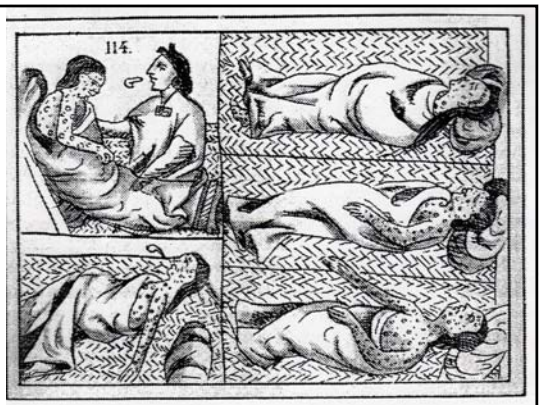


Figure 2.1. Mexicans ill with smallpox, from *Florentine Codex*.

Table 1.1. *Hispaniola's estimated native population*

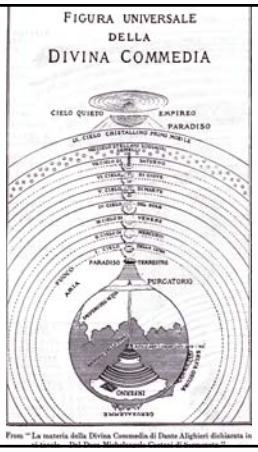
Source	Year	Estimate
Verlinden (1973)	1492	60,000
Amiama (1959)	1492	100,000
Rosenblat (1959, 1976)	1492	100,000
Lipschutz (1966)	1492	100,000–500,000
Moya Pons (1987)	1494	377,559
Cordova (1968)	1492	500,000
N. D. Cook (1993)	1492	500,000–750,000
Moya Pons (1971)	1492	600,000
Zambardino (1978)	1492	1,000,000
Denevan (1992)	1492	1,000,000
Guerra (1988)	1492	1,100,000
Denevan (1976)	1492	1,950,000
Watts (1987)	1492	3,000,000–4,000,000
Borah & Cook (1971)	1492	7,975,000

Note: From Noble David Cook, "Disease and Depopulation of Hispaniola, 1492–1518," *Colonial Latin American Review* 2 (1993):215.

QL presentation in course:

Dante Seminar

Tutorial College



…Be sure to take one with a heart