## Quantitative Reasoning: An Activity-based Course with Real Data and Relevant Issues

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- Goals of the course
- Topics
- Contexts for Applications
- What students do
- Assessment

### Goals of the Course

Develop and increase students' ability to

- formulate, analyze and solve real problems
- reason quantitatively; make numerical arguments
- explain and interpret their results
- use technology and internet resources

Improve students' attitudes

### Our Reasoning for Choice of Topics

- Emphasize the quantitative concepts an educated person should know.
- Emphasize contextual interpretation.
- Encourage wise use of Excel or a graphing calculator and internet information.
- Use contexts relevant to students.

### **Topics**

**Section I: Numerical Reasoning** 

**Section II: Logical Reasoning** 

**Section III: Statistical Reasoning** 

### **Section I: Numerical Reasoning**

Topic 1: Organizing Information Pictorially

Topic 2: Bivariate Data

Topic 3: Graphs of Functions

Topic 4: Multiple Variable Functions

Topic 5: Proportional, Linear, and Piecewise Linear Functions

Topic 6: Modeling with Linear and Exponential Functions

Topic 7: Logarithms and Scientific Notation

Topic 8: Indexes and Ratings

Topic 9: Personal Finances

Topic 10: Introduction to Problem Solving

### **Section II: Logical Reasoning**

Topic 11: Decision Making

Topic 12: Inductive Reasoning

Topic 13: Deductive Reasoning

Topic 14: Apportionment

Topic 15: More on Problem Solving

### **Section III: Statistical Reasoning**

Topic 16: Averages and Five-Number

Summary

Topic 17: Standard Deviation, z-Score and

**Normal Distributions** 

Topic 18: Basics of Probability

Topic 19: Conditional Probability and Tables

Topic 20: Sampling and Surveys

Topic 21: More on Decision Making

### **Context for Applications**

### **Ecological Issues**

Hazardous waste site data
Water use for various activities

### **Education**

SAT scores

Student loan default data

Enrollment in US K-12 schools

### Health

Body Mass Index Secondhand smoke risks Blood alcohol levels

### **History**

Colonial population estimates

Quotes from significant speeches

Vote tally for congressional votes

### **Sports and Games**

Scrabble word point value
Winning times in Olympic speed skating races

### Weather and Science

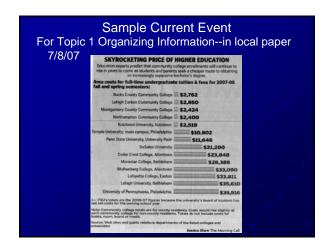
Wind chill equivalent temperature Earthquakes and the Richter scale

### Other Social and Economic Issues

Federal debt over time

Rating system to measure well-being of children Murders in NYC over time

# What Students Do Current events Examples Explorations Activities Projects



From NYTimes article: The Richest of the Rich, Proud of a New Gilded Age, 7/15/2007

Share of Income for the top 0.01%
The share of income going to the top one hundred of a percent is now about the same as it was early last certary.

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Sample Worked-out Example From Topic 3 Graphs of Functions

Example 3.3: The graph (given in the text) shows fluctuations in annual mean temperature in New York City's Central Park for the years 1876 to 2003.

Disregarding small oscillations, explain the general behavior of annual mean temperature in Central Park.

### Sample Exploration

From Topic 16 Averages and 5-Number Summary

Use the table that appeared in the NYTimes giving median yearly earnings for families with mothers ages 40 to 44, by Manhattan neighborhood and # of children (1, 2, <u>></u>3)

- Describe trends
- Explain why median instead of . . .
- What other information would be useful?
- Present the data graphically.

### Sample Activity

Activity 8.2 from Topic 8 Indexes and Ratings

Use the table giving the median weekly earnings of full-time adult workers by educational attainment (high school only; 1 to 3 years of college; 4 or more years of college) for the years 1980 to 2000 . . .

### After some preliminary questions,

- Create a graph showing the median weekly earnings of the three groups of workers
- Convert all salary figures into constant 2000 dollars.
- Create a graph showing the median weekly earnings converted to constant 2000 dollars.
- Write about the results.

### Sample Project

For Topic 7 Logarithms and Scientific Notation

Explain what the United Nations' Human Development Index is designed to measure and how it is set up. (A useful website might be <a href="http://hdr.undp.org/">http://hdr.undp.org/</a>.) Also explain how and why logarithms are used in this index.

### Assessment

Attitude Survey

Pre-test and post-test

- Basic Quantitative Skills test (Wonderlic)
  Pre-test and post-test
- Course completion data

### Attitude Survey (2000-2001)

Paired comparisons showed statistically significant improvements in:

- The students' confidence about using a computer for work with numerical data.
- The students' experience using computer programs that work with numerical data.
- The students' experience and confidence using the World Wide Web to obtain reliable data.

### Basic Skills test (2000-2001)

Paired comparisons showed statistically significant improvements in:

- Students' quantitative skills as measured by increased grade level.
- Students' Algebra and Geometry skills.
- Students' skills in solving practical applied problems.
- Students' skills in solving problems which require interpreting, evaluating and using quantities presented in diagrams, charts, tables, and graphs.

## Course Completion Data Fall 2000 – Spring 2007

Total enrollment (in 15 sections): 340

Withdrew:

Failed: 15

Completed course with passing grade: 312 (92%)

### **Sample Student Comments**

"Working with Excel was beneficial. I believe it informed many of the basics, especially me. The professor coordinated our excel activities very well with what we were learning at the time. She also varied classes occasionally, with group activities."

"I enjoyed this class. As a student who usually struggles with math I thought the analytical skills and useful real life examples will help in the future."

"Using the explorations w. activities really helps because you see the explorations being applied to real life scenarios. It makes them easier to understand."

"I really struggle in Math especially on tests. The graded class assignments allowed me to do well by not being only graded on tests but I could prove I knew the information on a daily basis."

"Interesting course material. Enjoyed incorporation of Excel."

"The lab assignments were great; however, I believe the instructions in our book made the labs too easy. Make it a bit more challenging so the class learns the material instead of just following instructions."

"Give more steps and instructions for assignments."

Sevilla and Somers, *Quantitative*Reasoning: Tools for Today's Informed
Citizen, 2007, Key College Publishing

To see a sample topic and activity and a list of activities:

www.keycollege.com/QRTools

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