

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

Sample Current Event

For Topic 1 Organizing Information--in local paper
7/8/07

SKYROCKETING PRICE OF HIGHER EDUCATION

Education experts predict that community college enrollments will continue to rise in years to come as students and parents seek a cheaper route to obtaining an increasingly expensive bachelor's degree.

Area costs for full-time undergraduate tuition & fees for 2007-08 fall and spring semesters:

Bucks County Community College	\$2,762
Lehigh Carbon Community College	\$2,850
Montgomery County Community College	\$2,424
Northampton Community College	\$2,400
Kutztown University, Kutztown	\$2,519
Temple University, main campus, Philadelphia	\$10,802
Penn State University, University Park	\$11,646
Drexel University	\$21,200
Cedar Crest College, Allentown	\$23,848
Moravian College, Bethlehem	\$28,368
Muhlenberg College, Allentown	\$33,090
Lafayette College, Easton	\$33,811
Lehigh University, Bethlehem	\$35,610
University of Pennsylvania, Philadelphia	\$35,916

U.S. PSY's totals are the 2006-07 figures because the university's board of trustees has not set costs for the coming school year.

Note: Community college totals are for county residents. Costs would rise slightly at such community college for non-county residents. Totals do not include costs for books, room, board or meals.

Source: Web sites and public relations departments of the listed colleges and universities.

Jessica Shaw/The Morning Call

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 hundredth of a percent is now about the same as it was early last century.

In 2005, the 14,588 families who made more than \$9.5 million had 5% of income.

Source: Thomas Piketty and Emmanuel Saez

The New York Times

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, ≥ 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 <http://hdr.undp.org/>.) 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: 13
- 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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