Quantitative Reasoning and Informed Citizenship: An activity-based course for non-science majors

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Moravian College, Bethlehem, PA
2012 Annual Meeting of The National Numeracy Network
This Talk

• What quantitatively literate students should be able to do
• What students study in our course
• What students do in our course
• What students say about our course
What quantitatively literate students should be able to do

1. Exhibit a positive, or at least a non-negative, association with anything quantitative.
Students should be able to . . .

2. Read news reports and think critically about the quantitative information reported there.
Students should be able to . . .

3. Estimate with very large or very small numbers.
Students should be able to . . .

4. Know when quantitative analyses might be useful for an argument or a discussion.
Students should be able to . . .

5. Think about the “reasonableness” of quantitative results.
Students should be able to . . .

6. Use technology appropriately and wisely.

• Be critical users of the Web.

• Be able to carry out basic computations without technology.
Students should be able to . . .

7. Use quantitative analyses in their own studies and research in various fields, and explain the results of quantitative analyses.
What Students Study

Section I: Numerical Reasoning
Section II: Logical Reasoning
Section III: Statistical Reasoning

... in the context of real data
Numerical Reasoning

Topic 1: Organizing Information
   Pictorially Using Charts and Graphs

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
Logical Reasoning

Topic 11: Decision Making
Topic 12: Inductive Reasoning
Topic 13: Deductive Reasoning
Topic 14: Apportionment
Topic 15: More on Problem Solving
Statistical Reasoning

Topic 16: Average 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
What Students Do

• Background reading, worked-out examples
• In-class examples to investigate
• Explorations for homework
• Activities
• Projects
The graph below shows the percent of people in the U.S. living in poverty in three different age groups over the years 1966 to 2009. Write a clear explanation of the story this graph tells. (Source: U.S. Census Bureau, www.census.gov)
Activity 3.2
Rate of Change and Concavity

In this activity, students investigate the link between the rate of change and the graph of a function by looking at data on cases of tuberculosis, life expectancy, and military personnel.
iii. Explain how these rates of change confirm that the graph is concave upward. **The rates of change confirm that the graph is concave upward because the rates of changes are getting less negative, which is an indication that the graph is concave upward.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Life Expectancy at Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>62.9</td>
</tr>
<tr>
<td>1950</td>
<td>68.2</td>
</tr>
<tr>
<td>1960</td>
<td>69.7</td>
</tr>
<tr>
<td>1970</td>
<td>70.8</td>
</tr>
<tr>
<td>1980</td>
<td>73.7</td>
</tr>
<tr>
<td>1990</td>
<td>75.4</td>
</tr>
<tr>
<td>2000</td>
<td>77.0</td>
</tr>
</tbody>
</table>

b. 

i. Use the table to find the average rate of change in life expectancy at birth per year.

- From 1940 to 1950:
  \[
  \frac{68.2 - 62.9}{1950 - 1940} = \frac{5.3}{10} = 0.53
  \]

- From 1950 to 1960:
  \[
  \frac{69.7 - 68.2}{1960 - 1950} = \frac{1.5}{10} = 0.15
  \]
Activity 8.2
Consumer Indexes

In this activity, students look at median weekly earnings, in dollars, of full-time wage and salary workers, 25 years and over, by educational attainment over the years 1980 to 2010.
Median Weekly Earnings in 2010 $

- **High School Diploma, No College in 2010 $**
- **Some College or Associate's Degree in 2010 $**
- **Bachelor's and Higher in 2010 $**
Project 1

Students were asked to choose an issue related to poverty and inequality, find data on the web, evaluate the website(s), and create 3 different graphs with explanations to help understand their issue.
Sample Student Topics

• *Poverty Hitting our Schools*—States’ poverty rates and high school graduation rates
• *What does your child really mean to America?*—public school spending in various states
• *Families in poverty in New York*
• *The income and wealth gap between rich and poor*
Context for Applications

• Social and economic issues
• Ecological Issues
• Education
• Health
• History
• Sports and games
• Weather
“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.”
“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, with group activities.”

The National Science Foundation (Grant No. 9950229) helped support the development of this text.
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