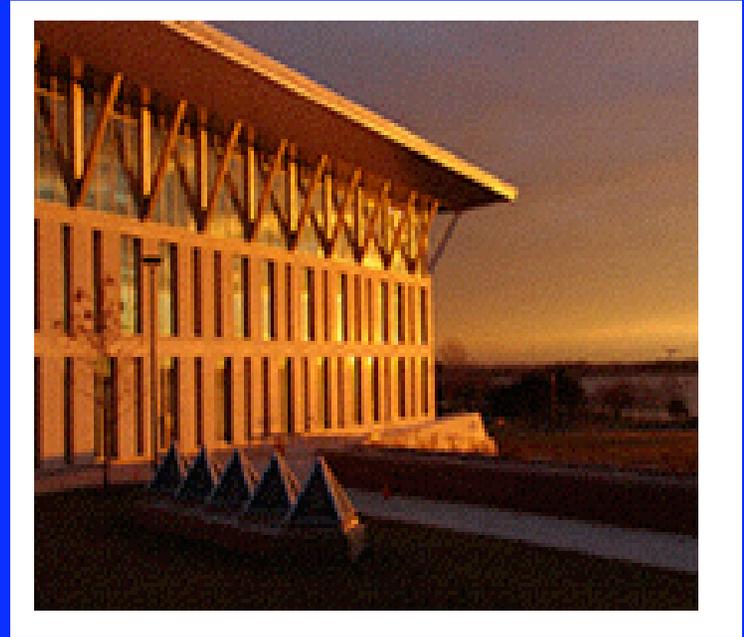


The Quantitative Reasoning Requirement at UMass Boston

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 - Mark Pawlak, Director, Academic Support Programs
- University of Massachusetts Boston

The University of Massachusetts Boston

- Urban mission: to provide a low-cost education to the people of the greater Boston area.
- Many students are low-income and the first in their family to attend college.
- The majority of students are older: mean age is 27; median age is 24.
- One-third of students are from minority groups.
- Many transfer students.
- There are no dorms - it is truly a commuter campus.



Why does UMass Boston need a Quantitative Reasoning course?

- Until a few years ago, students could graduate without taking a course emphasizing quantitative reasoning or mathematics.
- Those who did take a math course often took “Basic Algebra” (actually, high school algebra!).
- Basic Algebra was a traditional, usually terminal, course with an unacceptably high failure rate.
- Were students really prepared for higher-level courses and the workplace? Feedback indicated they were not.

The Math/QR requirement

- Part of our new general education program.
- **All** students must “demonstrate competence in mathematics/quantitative reasoning.”
 - B.S. students must take Calculus I (a traditional Calculus course)
 - B.A. students have several choices:
 - Test into PreCalculus or Calculus
 - Take College Algebra or Statistics
 - Take a Quantitative Reasoning course

Each semester, approximately 200 - 250 students choose to take a QR course.

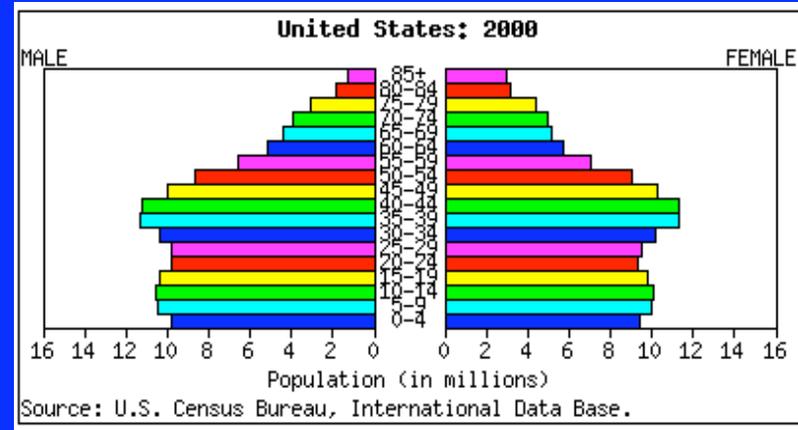
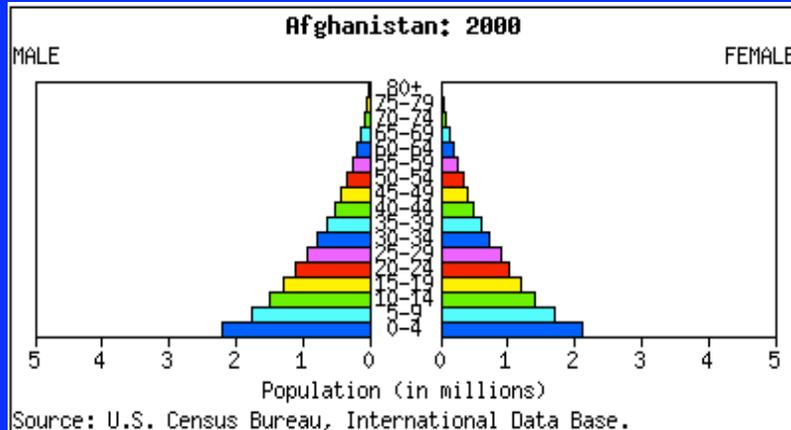
How do we define a QR course?

- Required topics are:
 - descriptive statistics
 - linear models
 - exponential models or probability
 - use of technology (graphing calculators, computers)
- Students must:
 - engage in critical reading and analysis
 - speak, listen and write effectively
 - use technology to further learning
 - work independently and collaboratively
 - reason logically and quantitatively

Math Q114 - Quantitative Reasoning

- Currently, Mathematics offers the primary QR course
- This is the lowest-level course Math offers
- Prerequisite: (outdated) placement test
- All sections are taught in a Mac computer lab
- Class size is small - about 20 students
- Many students come out of developmental math courses and are math phobic; have weak skills; **hate math**
- All topics are motivated using real data, course follows an investigations pedagogy
- Technology is used as a tool and as way of seeing patterns.

Reading graphs and tables: Population Pyramids



- Describe 2 similarities and 2 differences between the populations. Be sure to refer to specific elements in the histograms that support your points of comparison.
- Identify the main feature that distinguishes the populations of these two countries. Answer in complete sentences.

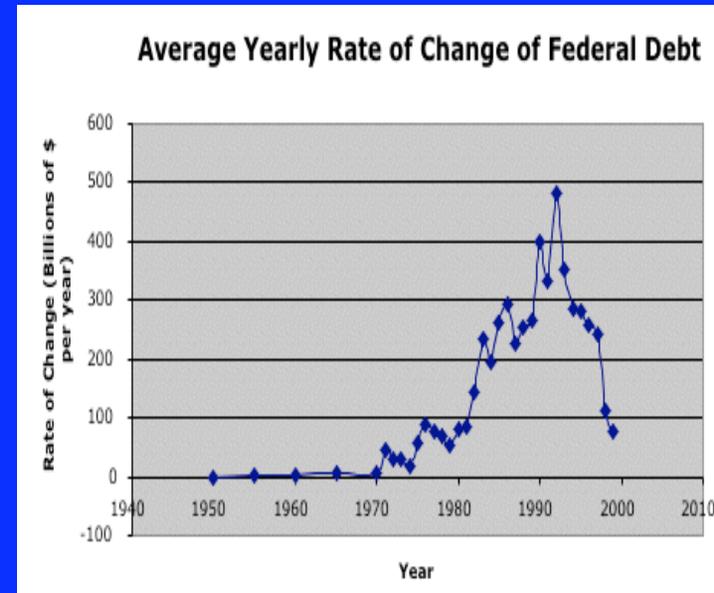
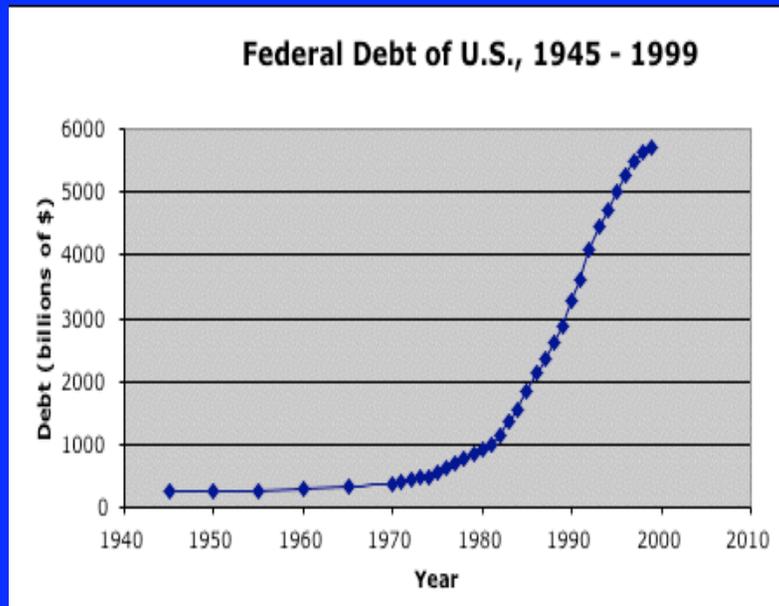
Group project: lying with data

- Students work in groups, using UMass student data to argue opposite sides of a given issue.
- They organize presentations to be made to class
- Each individual student turns in a summary analyzing one aspect of the data.
- Peer-grading is used for this exercise.
- Example:
 - Group 1: You are a student activist trying to convince the Board of Trustees that they have not done enough to increase diversity on campus.
 - Group 2: You are the Affirmative Action Officer arguing that your office has done a good job of increasing the diversity of the student body.

Using data sets to teach rate of change

Linear growth is introduced using rate of change. We use lots of examples, some with constant rate of change and most where rate of change is not constant.

For example, compare the graph of the federal debt to the rate of change graph. What additional information does the rate of change graph give us?



Examples of number sense

- From an article in The Boston Globe: Two people put their son through four years of college at Harvard University by collecting soda cans. Is this possible? What assumptions do you need to make to answer this?
- Are you 1000 seconds old? A million seconds old? A billion seconds old? How about a trillion seconds old?

Exponential Growth and Decay

- We introduce the concepts here using different data sets and situations.
- Students are now quite comfortable using Excel to graph and to find rate of change.
- The approach is to use Excel to find patterns, and from those patterns construct the exponential function.
- As with the other topics, we push students to analyze and interpret what they see.

Some conclusions from recent assessment

- Over 60% of students rated group work as “effective” (14% said it was “very effective”)
- 56% reported an “improved” ability to draw conclusions from data sets, with 31% reporting “much improved” ability
- Approximately 15% of students were already using QR-related skills in their other classes or in their employment.
- 72% of students agreed that they now read articles containing data, charts or graphs more critically.

Challenges to teaching the course

- It can be difficult to use the computers in a meaningful way every day
- Not all students have computers (especially Macs) or internet access at home
- The computers can be a distraction, both because of their size and because of the easy access to the internet
- It has been difficult to recruit, train, and support instructors to teach this type of course
- It is difficult to find tutors with knowledge of the software, knowledge of the math, and ability to do quantitative reasoning
- The balance between algebra and QR/QL is challenging

Larger challenges

- Is it better to teach traditional mathematics, or should resources be focused on teaching quantitative reasoning?
- Is QR just watered-down mathematics?
- Is it appropriate to call this a Math course?
- Should we focus more on numeracy and less on the traditional mathematics topics?
- How can we integrate the QR material and principles into other courses in other departments?

Why this is a good course

- Students really learn by doing. It is very “hands on” and exploration-based
- We use real data that is relevant to the students
- The students like the applications and they like the idea that they have learned how math is useful
- It gives many students a positive experience of mathematics. They may not like mathematics, but they feel that they don't hate it as much!

Some student responses

- I loved it and feel almost a sense of regret that it wasn't just a little bit longer... Math came alive from the very first class. It became clear to me that without realizing it before, I was engaged in mathematical concepts on a daily basis.
- I am convinced that the concepts, topics and skills learned in this class will be extremely useful in my future studies and/or career, as well as in my life. Nowadays, when I see a chart of a graph in a book or newspaper I go looking "beyond" the numbers and try to come up with my own interpretation of the data.
- Before (this course),... I hated math. But after taking this course, I feel much more comfortable with difficult math problems. I feel I now have a better understanding of the basics of mathematics. This course dealt with some real life problems, which make it interesting as well as useful. I have most definitely learned things that will be useful to me in the future.