Global Warming-Based Calculus

Andy Long

longa@nku.edu

Northern Kentucky University

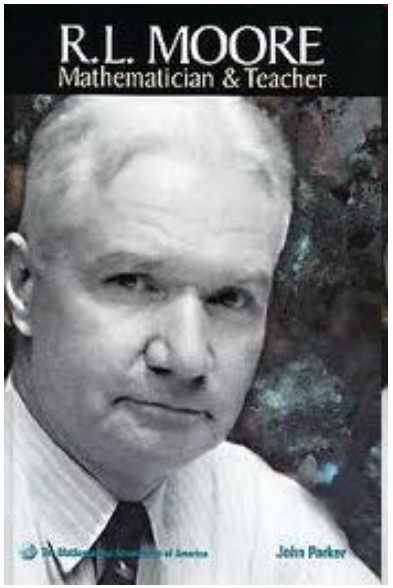
1/7/2011

Joint Meetings, New Orleans

Outline

- Motivation and Inspiration
- Labs and Materials Freely Available
- Results of a First Trial/Conclusions

Motivation and Inspiration



R. L. Moore: "**That student is taught the best who is told the least.**"

David Bressoud:
AP calculus is often taught by those without advanced mathematics degrees, some of whom actually fail to appreciate the beauty and value of calculus. And so it **is taught in a robotic, joyless fashion, to less-than-interested students.**

Motivation and Inspiration

Keith Devlin:

The culprit responsible for the decline of interest and ability in mathematics: **"In the majority of classrooms, mathematics is taught in a rigid, rule-based fashion.“**

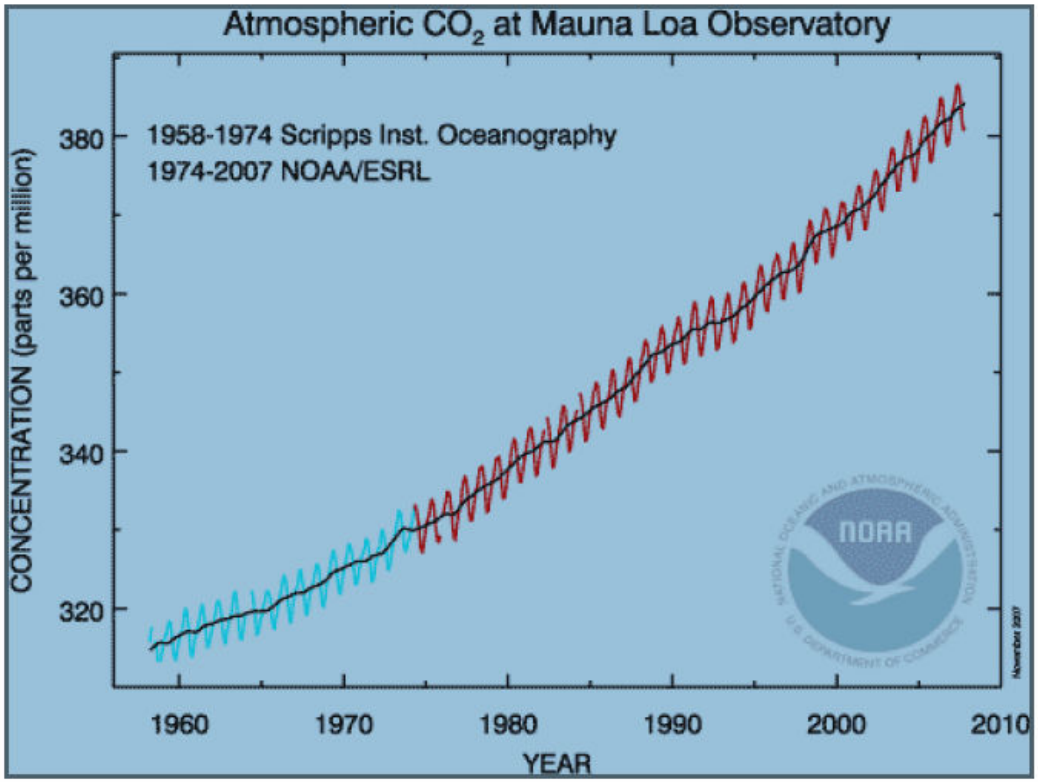
Also: Mathematics is a way of thinking about problems and issues in the world. Get the thinking right and *the skills come largely for free.*

Hence my “Big Idea for calculus”:

Teach it with little lecture, but rather via labs with real-world import. Focus on the thinking (get skills free!).

Labs and Materials Freely Available

Modeling the Keeling Curve with Excel



At last year's joint meetings Sten Odenwald (of NASA's Goddard Space Center) gave a talk on how to capture student interest in mathematics by using space science topics from NASA (Introducing Students and Teachers to the Connections Between Science and Mathematics using NASA Space Science Discoveries as a Vehicle for Mathematics Education). I was inspired by a Sten's SpaceMath lab presented illustrating the modeling process using the Keeling CO2 Data: I downloaded his lab, and used it in a calculus course I was teaching at the time.

So I decided to create some labs of my own, based (primarily) on the data of Global Climate Change.

Lab Topics

- Some labs concerned Global Climate Change only peripherally, or not at all:
  - Leaf energy under different fertilizations
  - BP Oil spill
- Others had a very explicit connection:
  - Mass of the atmosphere
  - Global Surface Temperatures
  - Milankovitch cycles and Earth's climate
- Students worked in groups for ~40 minutes

More About Labs

- The Labs used real data (hard to scrounge!):
  - NOAA, NASA, NCAR, IPCC, etc.
  - Some data was digitized from graphs
- Labs are very modeling focused: we discussed linear models, quadratic models, exponential models, logarithmic models, etc.
- Students kept notebooks with their work in them. These were collected mid-term and given preliminary grades, then graded at the end.
- Labs are available at

http://www.nku.edu/~longa/classes/calculus_resources/labs/

Conclusions

- Real data (especially time-series) are valuable because they are perfect for approximate integrals and derivatives.
- Data help our students realize that it's not all "f(x)" out there; sometimes we discover f(x)!
- Modeling is a skill we need to emphasize
- All that being said, my students weren't particularly happy:
  - They didn't get excited about climate change
  - They wanted robotic and joyless, not hard thinking
  - They still struggle with skills (no skills for free!)

Thank You

Andy Long
longa@nku.edu

Contact me for more information, or to get involved!