Elementary Modeling and the Olympics

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In January, 2000, Elon University offered a special Winter Term with classes mainly addressing the challenge of the next millennium. That term I taught a freshman modeling class, with a major component devoted to trying to extrapolate Olympic athletic performance. This talk will address the benefits of such an approach as well as some of the pitfalls.

In January, 2000 I taught a section of Elon's *Applied Mathematics with Calculus* class as part of our Winter Term. This term lasts for three weeks, with classes meeting three hours a day. It is challenging to engage the students at such a rapid pace, and to see that the students retain the content of the class after the end of the term.

The course is aimed at non-majors who are likely to go into fields that use applied mathematics, primarily in business-related majors. The class that term had nineteen students.

In the past this course has focused on a review of algebraic manipulation, an introduction to differentiation, rates of change, optimization, and optionally some systems of linear equations. In recent years with the advances in graphic calculator technology I have tried to use a modeling approach as a source for examples, rather than arbitrary formulae.

I had been using business data but for a change of pace I focused in this term on data from track and field Olympic data. This ensured a good deal of interest in the data, as well as some good sanity checks on the results.

We focused on some of the simpler models provided on the TI-83 (required for our non-major classes): linear, quadratic, cubic, exponential, and logistic. The first part of the class focused on qualitative aspects of these models: convexity, inflection points, and horizontal asymptotes. We also spent a good deal of time on the differences between interpolation and extrapolation.

After a good deal of computational practice with data sets from our text (*Calculus Concepts* by LaTorre et al), I assigned the second of three weekly projects, which required the students to analyze historical data on athletic performance and to construct models to predict future performance. (The first project dealt with modeling in general; the third with educational expenditures in the students' home states.)

First day of project: the students were organized in groups of three or four. Each group selected one Olympic track and field event and provided me with the name of the event, so that I could ensure that no two groups examined the same event. Each group selected a coordinator, a writer, and a presenter.

I asked the students to obtain their data from the following web site, run by the *Information Please Almanac*:

`http://www.infoplease.com/almancs.html`

The students were asked to focus on a specific event over a period of years.

Third day of project: the students turned in to me a summary of the data, the model chosen, an explanation of their choice, a scatter plot, and predictions of performance in the Olympic years from 2004 to 2048.

Fourth day of project: the students visited *The Olympic Challenge of the Next Millennium*, a class taught by Joyce Davis of our Physical Education program. The students from our class presented on their mathematical analysis.

Fifth day of project: students from Joyce Davis' class visited and presented responses to our class' work in terms of what could be expected on a physiological level.

Sixth day of project: the students turned in a written report that incorporated and responded to the feedback from the students in the other class. (Each student also submitted a one-page description of the contributions of each member of the group.)

Problems with the student models:

- Negative results for time and distance in the near future.

- Distance results that leave Earth's orbit

It was hard for the students to spot these as problems, until they began to explain them to people outside of their groups. When they saw their audience's reaction to their graphs, they quickly realized their error.

Benefits from assignment:

- Working in group
- Communication (oral and written)
- Working with students in another discipline
- Identify modeling with tangible results, as opposed to homework problems.

Minor disadvantages to assignment:

- Not all students interested in sports (although most were interested in Olympics)

- Logistics of working with another class