Time Scale Summer REU

The derivative of x^2 is $2x$ ... or is it? Well, if we think about calculus where we do all the calculations on the real numbers, then it is. But what if we think about doing calculations on the integers $\{\dots, -2, -1, 0, 1, 2, \dots\}$? Go back to thinking about the derivative as a slope. Then the slope of x^2 on the points we care about is

$$\frac{\text{function value at the next point} - \text{function value at this point}}{\text{distance between the points}}$$
$$= \frac{(x+1)^2 - x^2}{1} = 2x + 1.$$

This is close to $2x$, but it isn't quite the same. So the set we care about does make a difference. This means that our first task is to look at lots of different sets and learn the notation for writing derivatives on those sets (the sets are also called time scales).

But in the integer example, what was to stop us from taking (function value at this point) - (function value at the previous point) instead? Who decided that we have to do a forward difference? We could even do an average of the two! It turns out that we get a different answer depending on how we decide to define the derivative. Now we have a second task: look at different ways of defining the derivative and decide which one is best. However what is best? We get to decide that too. We are going to do that based on calculations and models using Maple.

In fact a typical day will consist of a morning session, lunch together, and an afternoon session. The morning (9 am -11:30 am) will consist of worksheets, lectures, presentations by you and some graduate students, and general discussion. Lunch (11:30 am - 1:00 pm) will be together. Some days we may go to a restaurant, some days stay on campus. Either way you can bring your own if you like, but it is amazing how often good ideas happen over food. The afternoon session (1:00 pm - 4:00 pm) will be in the computer lab. At first there will be worksheets on using Maple, then after we have it down we will split into groups, each doing a different problem. That way we can combine our results and try to see patterns.

There is also an opportunity to go to the 2 week session on time scales at the University of Wyoming from July 8-19 for an in depth look at derivatives on different sets (also called dynamic equations on time scales). See http://math.uwyo.edu/RMMC/rmmc.html for lots more info, including applications where time scales are actually used. We may even be able to make a presentation of our work there!

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