Course Description:

Math 53 is a one term course in second-year Calculus at Berkeley. It's a beautiful course---I'll attempt to describe just enough of each to convince you that this is true, and to also get you to wonder about taking more.

The basic punchline is that this course is about multivariable calculus. That means, that we take what happened in one-dimensional calculus, as in, $y=f(x)$ and consider what happens when there are two or more inputs to the function f, as in $z=f(x,y)$.

Everyday life is full of functions of more than one variable (at my corner pizza store, extra avocado raises the price more than extra cheese). We'll take the ideas and questions of one-dimensional calculus, and ask them again for multi-dimensional functions:

1. What is a derivative (since there is more than one input, then what is changing with respect to what?)
2. How do we take derivatives?
3. How do we integrate?
4. How do you find maximums and minimums?

What's great about this course is that you begin to see that all things that you learned in one-dimensional calculus have meaning in higher dimensions. Better yet, it all makes even more sense in higher dimensions, and one-dimensional thinking seems dull by comparison. After all, since we all live in at least 4 dimensions (three physical ones plus time), we might as well go outside and study there!

We start out discussing parameterized equations: the reason is that it sets the stage for what happens when there is more than one output to a function, and even more than one input. We then visit vectors in 2D and 3D--those are geometric objects and people usually feel comfortable with.them.

And it opens the box of "vector functions", and then taking partial derivatives. This is where the fun starts: we get to take really complicated functions (such as, "when you buy a computer/IPAD/tablet/cell phone/intercranial implant, how much does it cost to get any particular snazzy new feature upgraded compared to another?

Of course, you can't take derivatives without wanting to optimze things--- maximizing and minimizing. This is a large hunk of the course---followed by doing integration when a function has lots of input. Now, the "area under a curve" is replaced by the "volume under a surface", and we'll figure out how to do all of those.

And then we get to the coolest part of the course: Vector Calculus. We get to finally explain why the derivative of a volume is the surface area. (as in, why is the surface area of a sphere the derivative of the formula for its volume). We get to understand why fluids flow they way they do. We get to understand the diffusion of heat. We get to understand antennas, and a whole bunch of other things.

Honestly, this course is *great fun*. Yeah, I know you are saying "sure, but he's a math professor". Well true, but take a leap of faith and believe me. Everytime:

1. You listen somebody make an argument about the economy, like "if you raise taxes, then people have less, then they spend less money, then the economy falls apart, then people don't have any money to tax..."
2. You jump on a trampoline
3. You boil some water
4. You play an instrument
5. You breathe, sing, move a muscle, twitch your eyes...

you're talking about multivariable calculus.

How This Course Works:
My job is to help you to figure out this subject. Your job is to ask questions if you are lost. That means you are supposed to ask questions, no matter how supposedly dumb. You can be assured that any question you think up, there are at least 20 people out there who are desperately glad that you asked.

Important Details:

1. Class starts at 8:00AM. Please be on time.

2. Office Hours: I cannot hold physical office hours. So instead, I will stick around on the same zoom link after class.

3. Grades/Exams There will be two midterms and one final, as well as homework and an occasional quiz in section. The grade breakdown is:

   Homework/Quizzes: 10%, Each Midterm: 30%, Final: 30%

4. It is difficult to qualify for an "Incomplete" grade. Regulations require that you have must have a compelling reason for an incomplete, plus at least a C- at the time the incomplete is granted. The C- requirement can be waived in *exceptional circumtances*, such as "Martians landed on my street and I had to choose between studying math and defending Earth."

Prerequisites: Math 1A, 1B

Book:

Stewart, Multivariable Calculus, Early Transcendentals, UC Berkeley Paperback Edition. Eighth Edition.

Note: in the below, each of our lectures is 1.5 lecture hours, since we meet for 90 minutes.

- **Chapter 10** Parameteric Equations and Polar Coordinates, 4 lecture hours
- **Chapter 12** Vectors in 2D and 3D: 4 lecture hours
- **Chapter 13** Vector Functions: 1 lecture hour
- **Chapter 14** Partial Derivatives: 9 lecture hours
- **Chapter 15** Multiple Integrals: 10 lecture hours
- **Chapter 16** Vector Calculus: 12 lecture hours

Total=40 lecture hours