Math 3B: Lecture 1

Noah White

September 23, 2016

Syllabus

Take a copy of the syllabus as you walk in

or

find it online at `math.ucla.edu/~noah`

Class website

There are a few places where you will find/receive information about Math 3B:

- The class website: `www.math.ucla.edu/~noah`
- CCLE
- Email
- Piazza

Instructor and TAs

Instructor	Noah White
office hours	MS 6304, M 3:30pm-5pm, R 9-10:30am
TA	Kyung Ha
office hours	*MS 6943, W 4-5pm*
	Robert Houseden
	MS 3915B, T 3-4pm
	Dustan Levenstein
	MS 3965, R 3-4

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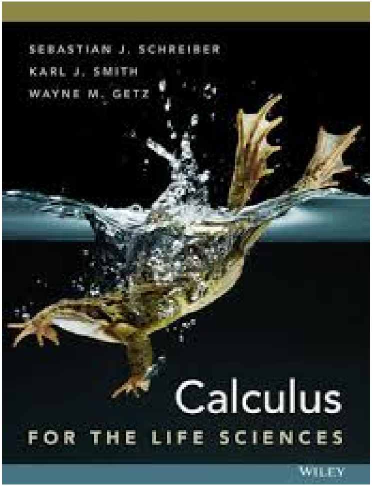
Note!

Change of room for Dicussion Section 2D (Thurdsay with Dustan). You are now in Boelter 5419.

Textbook

S. J. Schreiber, *Calculus for the Life Sciences*, Wiley



Problem sets, homework, and quizzes

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Assigned every week. Long list of problems. Not graded, but recommended!

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Due every second week. A small number of questions drawn from the problem sets. There will be 5.

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Quizzes

Administerd every other week in discussion session. There will be 4.

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- You may collaborate in small groups if:
  - you aknowledge your collaborators,
  - write up your own solutions, in your own words.

Exams

There will be two midterms and a final exam

- Midterm 1 2-2:50pm Monday, 17 October, 2016

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- Midterm 2 2-2:50pm Monday, 21 November, 2016

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Cheatsheets and calculators

You will be allowed a small cheatsheet in each exam. Must be self-written and one side, half a letter size piece of paper. You are also allowed to use non-programmable, non-graphing calculators.

Grading

Your final grade will be calculated using the maximum of the following two grading schemes.

15% (best 7 quizzes/hw) + 40% (midterms) + 45% (final)

or

15% (best 7 quizzes/hw) + 30% (best midterm) + 55% (final)

Schedule

	Dates	Monday	Tuesday	Wednesday	Thursday	Friday
0	9/19-23	No classes				*Intro/4.1*
1	9/26-30	*4.1*	Quiz 1	*4.2*	Quiz 1	*4.3-4.4*
2	10/3-7	*Review*		*5.1*		HW 1 due/*5.2*
3	10/10-14	*5.2 (cont.)*	Quiz 2	*5.3*	Quiz 2	*Review*
4	10/17-21	Midterm 1		*5.4*		HW 2 due/*5.5*
5	10/24-28	*5.6*	Quiz 3	*5.6 (cont.)*	Quiz 3	*5.8*
6	10/31-11/4	*Review*		*6.1*		HW 3 due/*6.2*
7	11/7-11	*6.2 (cont.)*	Quiz 4	*6.3*	Quiz 4	Vet's day
8	11/14-18	*6.4*		*6.4-6.5*		HW 4 due/*6.5*
9	11/21-25	Midterm 2		*6.6*	Thanksgiving	
10	11/28-12/2	HW 5 due		*Review*		*Review*

Where to get help

Piazza

Here you can ask questions and answer others' questions. Lets take a look. . .

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Use them wisely! Prepare and seek information first. If you learn something, post it to Piazza!

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Student Math Center (SMC)

Location: MS 3974, times: M-R 9am-3pm.
The SMC offers free, individual and group tutoring for all lower division math courses. This service is available on a walk-in basis; no appointment is necessary. Students may ask any of the TAs in attendance for assistance with math problems.

Differentiation

You should have a good feel for what the derivative means. I.e. derivative at a point = tangent slope. You need to understand differentiation algebraically as well as geometrically.

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You should also know the definition of the derivative

$$\frac{\mathrm{d}}{\mathrm{d}x} f(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Differentiation

You should be able to differentiate many of the standard functions we will see in this course. This includes:

- polynomials/power functions

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(x^n\right) = nx^{n-1}$$

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$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\ln x\right) = \frac{1}{x}$$

- trig functions

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\sin x\right) = \cos x$$

Product rule

The product rule lets us differential functions of the form $f(x) = g(x)h(x)$. It says

$$\frac{\mathrm{d}}{\mathrm{d}x} f(x) = g'(x)h(x) + g(x)h'(x)$$

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Example

Let's differentiate the function $f(x) = e^x \sin x$.

$$\frac{\mathrm{d}}{\mathrm{d}x} f(x) = \left(\frac{\mathrm{d}}{\mathrm{d}x} e^x\right) \sin x + e^x \left(\frac{\mathrm{d}}{\mathrm{d}x} \sin x\right)$$

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The chain rule

The chain rule is very important! It allows us to differentiate functions of the form $f(x) = g(h(x))$. It says

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so

$$f'(x) = e^x \cos(e^x)$$

The quotient rule is stupid

The quotient rule says

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{g(x)}{h(x)}\right) = \frac{g'(x)h(x) - g(x)h'(x)}{h(x)^2}$$

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$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{g(x)}{h(x)}\right) = \frac{g'(x)h(x) - g(x)h'(x)}{h(x)^2}$$

This is annoying to remember (where does that minus sign go again?). Luckily we can notice

$$\frac{g(x)}{h(x)} = g(x)k(x) \quad \text{where} \quad k(x) = (h(x))^{-1}$$

So we can just use the product rule!

Example

Question

Differentiate

$$f(x) = \sin \frac{1}{x}$$

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Solution

We should use the chain rule. Notice $f(x) = g(h(x))$ where

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so

$$\begin{aligned} f'(x) &= h'(x)g'(h(x)) \\ &= -\frac{1}{x^2}\cos(x^{-1}) \end{aligned}$$

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$$f(x) = \frac{x-1}{x+1}$$

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$$f(x) = \frac{x-1}{x+1} = (x-1)(x+1)^{-1}$$

Solution

We should use the product/quotient rule. Notice $f(x) = g(x)h(x)$ where

$$h(x) = (x+1)^{-1} \quad \text{and} \quad g(x) = x - 1$$
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$$\begin{aligned} f'(x) &= g'(x)h(x) + g(x)h'(x) \\ &= \frac{1}{x+1} - \frac{x-1}{(x+1)^2} = \frac{2}{(x+1)^2} \end{aligned}$$

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Differentiate

$$F(x) = \frac{\sin x^2 - 1}{\sin x^2 + 1}$$

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Solution

We should notice that F(x) = f(g(x)) so we can use the chain rule!

$$f(x) = \frac{x-1}{x+1} \quad \text{and} \quad g(x) = \sin x^2$$

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$$\begin{aligned} f'(x) &= g'(x) f'(g(x)) \\ &= 2x \cos x^2 \frac{2}{(\sin x^2 + 1)^2} \end{aligned}$$

Example

Question

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$$P(t) = \frac{24t + 10}{t^2 + 1}$$

and t is the number of hours after a toxin is introduced.

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and t is the number of hours after a toxin is introduced.

1. At what rate is the population changing when $t = 1$?
2. Is the rate increasing or decreasing at this time?
3. At what time does the population begin to decrease?

Example (cont.)

1. At what rate is the population changing when $t = 1$?

We want to know how many individuals are being added per hour at $t = 1$. We need to find the derivative:

$$P(t) = (24t + 10)(t^2 + 1)^{-1}$$

Example (cont.)

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Example (cont.)

1. Is the rate increasing or decreasing at this time?

We need to figure out when the derivative $P'(t)$ goes from being positive to negative. First let's ask when does

$$P'(t) = 0$$

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$$t = \frac{2}{3} \quad \text{or} \quad -\frac{3}{2}$$