Math 3B: Lecture 1

Noah White

January 9, 2017

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`
- Email
- Piazza
- CCLE (not in use)

Instructor and TAs

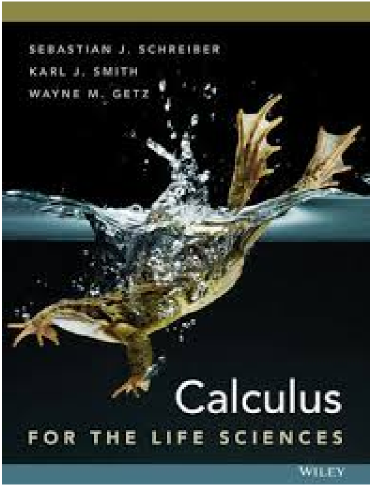
Instructor	Noah White
office hours	*MS 6304, W,F 10:30am-12pm*
TA	Max Zhou
office hours	*TBA, TBA*
	Yuejiao Sun
	TBA, TBA
	Mengyuan Ding
	TBA, TBA

Communication

- Mathematical questions should be asked on Piazza
- Administrative questions should be directed to your TA initially
- If you need to email me include `math3b-w17` in the subject

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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Quizzes

Administered every other week in discussion session. There will be 6.

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- write up your own solutions, in your own words.

Exams

There will be two midterms and a final exam

- Midterm 1 8-8:50am Monday, 30 January, 2017

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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.

10% (best 7 quizzes/hw) + 40% (midterms) + 50% (final)

or

10% (best 7 quizzes/hw) + 30% (best midterm) + 60% (final)

Schedule

See website

Where to get help

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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.

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A nonexhaustive list:

- Definitions and properties of basic functions.

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- Definitions and properties of basic functions.
- How to calculate limits.
- 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.
- 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

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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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&= e^x \sin x + e^x \cos x \\
&= e^x (\sin x + \cos x)
\end{aligned}$$

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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The quotient rule says

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

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

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

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

$$h(x) = x^{-1} \quad \text{and} \quad g(x) = \sin x$$

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$$h'(x) = -x^{-2} \quad \text{and} \quad g'(x) = \cos x$$

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

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Solution

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

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