Math 3B: Lecture 1

Noah White

September 29, 2017

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 (only for recordings)

Instructor and TAs

Instructor	Noah White
office hours	*MS 6304, Thursday 10-11:30am, Friday 9:30-11am*
TA	Bohyun Kim
office hours	*TBA, TBA*
	Kevin Miller
	TBA, TBA
	Ryan Wallace
	TBA, TBA

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections
- Your TA will guide discussion in small groups

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections
- Your TA will guide discussion in small groups
- These will be your opportunity to actively discuss mathematics, this should be active, not passive, learning.

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections
- Your TA will guide discussion in small groups
- These will be your opportunity to actively discuss mathematics, this should be active, not passive, learning.
- Learning assistants will be available on Piazza

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections
- Your TA will guide discussion in small groups
- These will be your opportunity to actively discuss mathematics, this should be active, not passive, learning.
- Learning assistants will be available on Piazza
- They will also host study sessions

Discussions and Learning assistants

- Undergraduate students assisting in discussion sections
- Your TA will guide discussion in small groups
- These will be your opportunity to actively discuss mathematics, this should be active, not passive, learning.
- Learning assistants will be available on Piazza
- They will also host study sessions
- Connie, Jayesh, Jennifer, Kelsey, and Nick will be a fantastic resource for you this quarter.

BruinCast

- The lectures will be recorded.

BruinCast

- The lectures will be recorded.
- The recordings will be available on CCLE

BruinCast

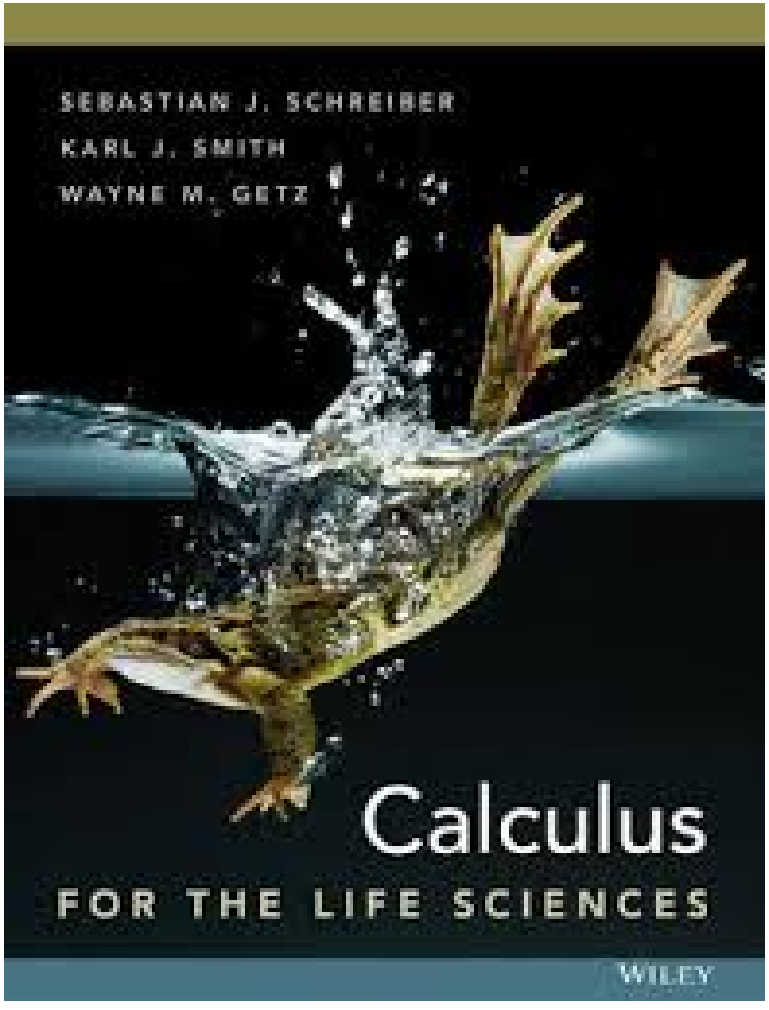
- The lectures will be recorded.
- The recordings will be available on CCLE
- Study tip: doing problems is much better than watching a video!

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` in the subject

Textbook

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



Problem sets, homework, and quizzes

Problem sets

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

Problem sets, homework, and quizzes

Problem sets

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

Homework

Due in weeks 2, 5, 9. A small number of questions drawn from the problem sets.

Problem sets, homework, and quizzes

Problem sets

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

Homework

Due in weeks 2, 5, 9. A small number of questions drawn from the problem sets.

Quizzes

Administered in discussion session in weeks 3, 6, 10. More on the format to come.

Homework; collection and collaboration

- Homework will be collected at the start of the lecture on the dues date.

Homework; collection and collaboration

- Homework will be collected at the start of the lecture on the dues date.
- Late homework will not be accepted.

Homework; collection and collaboration

- Homework will be collected at the start of the lecture on the dues date.
- Late homework will not be accepted.
- You may collaborate in small groups if:

Homework; collection and collaboration

- Homework will be collected at the start of the lecture on the dues date.
- Late homework will not be accepted.
- You may collaborate in small groups if:
- you aknowledge your collaborators,

Homework; collection and collaboration

- Homework will be collected at the start of the lecture on the dues date.
- Late homework will not be accepted.
- 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 8-8:50am Monday, 23 October, 2017

Exams

There will be two midterms and a final exam

- Midterm 1 8-8:50am Monday, 23 October, 2017
- Midterm 2 8-8:50am Monday, 20 November, 2017

Exams

There will be two midterms and a final exam

- Midterm 1 8-8:50am Monday, 23 October, 2017
- Midterm 2 8-8:50am Monday, 20 November, 2017
- Final 8-11am Wednesday, 13 December, 2017

Exams

There will be two midterms and a final exam

- Midterm 1 8-8:50am Monday, 23 October, 2017
- Midterm 2 8-8:50am Monday, 20 November, 2017
- Final 8-11am Wednesday, 13 December, 2017

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 4 quizzes/hw) + 40% (midterms) + 50% (final)

or

10% (best 4 quizzes/hw) + 30% (best midterm) + 60% (final)

Schedule

See website

Where to get help

Piazza

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

Where to get help

Piazza

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

Office hours

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

Where to get help

Piazza

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

Office hours

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

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.

What should you know?

A nonexhaustive list:

- Definitions and properties of basic functions.

What should you know?

A nonexhaustive list:

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

What should you know?

A nonexhaustive list:

- 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.

What should you know?

A nonexhaustive list:

- 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.

What should you know?

A nonexhaustive list:

- 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

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

Differentiation

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

- polynomials/power functions

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

Differentiation

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

- polynomials/power functions

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

- exponentials

$$\frac{d}{dx}\left(e^x\right) = e^x$$

Differentiation

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

- polynomials/power functions

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

- exponentials

$$\frac{d}{dx}\left(e^x\right) = e^x$$

- logarithms

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

Differentiation

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

- polynomials/power functions

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

- exponentials

$$\frac{d}{dx}\left(e^x\right) = e^x$$

- logarithms

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

- trig functions

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

Product rule

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

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

Product rule

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

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

Example

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

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

Product rule

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

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

Example

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

$$\begin{aligned} \frac{d}{dx} f(x) &= \left(\frac{d}{dx} e^x \right) \sin x + e^x \left(\frac{d}{dx} \sin x \right) \\ &= e^x \sin x + e^x \cos x \end{aligned}$$

Product rule

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

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

Example

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

$$\begin{aligned}
\frac{d}{dx} f(x) &= \left(\frac{d}{dx} e^x\right) \sin x + e^x \left(\frac{d}{dx} \sin x\right) \\
&= e^x \sin x + e^x \cos x \\
&= e^x (\sin x + \cos x)
\end{aligned}$$

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

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

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

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

Example

Let's differentiate $f(x) = \sin(e^x)$. In this example

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

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

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

Example

Let's differentiate $f(x) = \sin(e^x)$. In this example

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

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

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

Example

Let's differentiate $f(x) = \sin(e^x)$. In this example

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

so

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

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

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

Example

Let's differentiate $f(x) = \sin(e^x)$. In this example

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

so

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

so

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

The quotient rule sucks

The quotient rule says

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

The quotient rule sucks

The quotient rule says

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

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

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

Example

Question

Differentiate

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

Solution

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

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

Example

Question

Differentiate

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

Solution

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

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

Example

Question

Differentiate

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

Solution

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

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

so

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

Example

Question

Differentiate

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

Solution

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

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

so

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

so

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

Example

Question

Differentiate

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

Example

Question

Differentiate

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

Solution

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

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

$$h'(x) = -(x+1)^{-2} \quad \text{and} \quad g'(x) = 1$$

Example

Question

Differentiate

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

Solution

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

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

$$h'(x) = -(x+1)^{-2} \quad \text{and} \quad g'(x) = 1$$

Example

Question

Differentiate

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

Solution

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

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

$$h'(x) = -(x+1)^{-2} \quad \text{and} \quad g'(x) = 1$$

so

$$f'(x) = g'(x)h(x) + g(x)h'(x)$$

Example

Question

Differentiate

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

Solution

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

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

$$h'(x) = -(x+1)^{-2} \quad \text{and} \quad g'(x) = 1$$

so

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

Example

Question

Differentiate

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

Example

Question

Differentiate

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

Solution

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

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

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

Example

Question

Differentiate

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

Solution

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

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

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

Example

Question

Differentiate

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

Solution

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

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

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

so

$$F'(x) = g'(x) f'(g(x))$$

Example

Question

Differentiate

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

Solution

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

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

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

so

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