Notes and Announcements

• First Lab tomorrow!

• Lab Assistants:
  05 Chengyu Du
  06 Chengyu Du
  07 Keyvan Yaghmayi and You-Cheng Chou
  08 Keyvan Yaghmayi and You-Cheng Chou
  09 Donald Chacon-Taylor

• Will update syllabus with data on office hours and location.

• These notes are available online. You can download them before class. They contain significant gaps that we will fill in together during class. The filled in notes will replace the initial set after class. An asterisk will indicated that the replacement has taken place. Click in the calendar on our home page:

  \url{http://www.math.utah.edu/~pa/1210/}

• There are weekly WeBWorK (ww) home works. You should have received a message with login information from me.

• It is essential that ww has a valid email address for you, and that you monitor that email. You can change your email address after logging into ww. The initial email is your U of U address

  uxxxxxxx@utah.edu
• If you have not heard from me check your spam filter. If you can’t find my message email me at

pa@math.utah.edu

• Homeworaks open Friday mornings and close 11 days later on Tuesdays, one minute before midnight.

• You should finish each hw before the next one opens.

• Home work 1 is open and due August 29. You should finish it by Thursday evening, but it is open until the next Tuesday.

• You do need to have easy access to the textbook, but you don’t need to bring it to class. (I don’t bring it myself.)
What is Calculus?

And what can it be used for?

- We will introduce the concepts with an example:

  **Velocity — Location**

  - Your car has a **speedometer** (showing current velocity) and an **odometer** (showing distance covered, or location along a highway).

  - Speed versus velocity: velocity has a direction, in this semester just forward and backward, or up and down, distinguished by a plus or minus sign.

  - **Profound Fact:** Velocity and Location are related. One determines the other

  - Think of both as functions of time $t$:

    - $v(t)$ is velocity at time $t$
    - $d(t)$ is location (distance) at time $t$

  - If we know our location function $d$ we should be able to compute our velocity function $v$, and if we know our velocity function $v$ (and our location at time $t - 0$, say) we should be able to compute our location function.

  - Note: we do not just compute location or velocity at a specific time. We know one function for all (relevant) time and compute the other for all (relevant) time.

  - This is what Calculus is all about!

    - $v \rightarrow d$: integration
    - $d \rightarrow v$: differentiation
Falling Objects

- simple physical example: falling object, ignore air resistance, consider gravity constant. (It actually does depend on altitude and location on earth.)

- Observation: Velocity increases by 32 ft/sec every second. We say that the acceleration is 32 feet per second squared.

- Let $v(t)$ be the downward velocity, and assume

  $$v(0) = 0.$$  

- Then clearly

  $$v(t) = 32t$$

- How far does the object fall in $t$ seconds?

  - In other words, what is $d(t)$? (Think of $d$ as distance or depth.)

  - Let’s figure it out.

![Graph showing falling objects](image)
$v(t)$ is constant $= v_0$

d$(t) = v_0 t$

spherical and identical
Going the other way

- Suppose we know the distance. How can we figure out the velocity?

- Let’s apply the ideas to a situation where we already know the answer!

- Suppose

\[ d(t) = 16t^2 \]

- What is \( v(t) \). Of course we should get \( v(t) = 32t \) but suppose we don’t know that yet.
\[ d(t) = 16t^2 \]

\[ \frac{d(t+h) - d(t)}{h} = \text{avg vel.} \]

\[ h \neq 0 \]

\[ \frac{16(t+h)^2 - 16t^2}{h} = \frac{16(t^2 + 2th + h^2) - 16t^2}{h} \]

\[ = \frac{16t^2 + 32th + 16h^2 - 16t^2}{h} \]

\[ = \frac{h(32t + 16h)}{h} \]
\[
\begin{align*}
\text{velocity} & = \frac{32t + 164}{1} \\
& = 32t + 164 \\
& \quad \downarrow \\
& \quad \uparrow \\
& \quad \text{as} \quad h \to 0 \\
\Rightarrow & \quad \text{limit} \\
v(t) & = 32t
\end{align*}
\]
The Fundamental Theorem of Calculus
The Plan (for both Math 1210 and 1220)

- Make the idea $h \to 0$ precise. (This will give rise to the concept of limits.)
- Make the limit of the quotient

$$\frac{d(t+h) - d(t)}{h}$$

precise. (This will give rise to the concept of a derivative.)

- The process of computing a derivative is called differentiation. The opposite process is integration. The result of integration is an integral.
- Find formulas for computing derivatives and integrals.
- See lots and lots of applications.
- Math 2210 (Calc III) covers the Calculus of several (dependent or independent variables.)
- Before we start let’s review some prerequisites so we are all on the same page.