Lesson 2: Average Rate of Change & Intro. to Linear Functions

(Cover 1.2, Start 1.3)	**Read:** Section 1.4
Announce: Quiz on Student Guide next class	**Do:** WebWork (as usual)
Remind: Online Student Data Form	**Watch:** Team Homework Tutorial

The most important points and skills for §1.2

- The definition of the average rate of change of a function over an interval (see pages 11, 14)
- The symbolic expression for rate of change expressed using function notation: For $Q = f(t)$ over the interval $[a, b]$, students should recognize both of the following expressions for the average rate of change over the interval: $\dfrac{f(b) - f(a)}{b - a}$ and $\dfrac{\Delta Q}{\Delta t}$.
- Students should know that the average rate of change of $f(x)$ over the interval $[a, b]$ can be represented *graphically* by the slope of the secant line joining the points $(a, f(a))$ and $(b, f(b))$.
- The definitions of "increasing" and "decreasing" function behavior and how to recognize this behavior using graphs, tables, formulas, and verbal descriptions

The most important points and skills for today's portion of §1.3

- Given a table of data, students should be able to determine whether or not the relationship could be perfectly linear by calculating the average rate of change between each pair of points from the table of data to determine whether they always get the same value for the average rate of change.
- Students should know why the formula of a linear function is of the form: $y = b + mx$.

Suggested Lesson Plan:

00-15 If there are students coming for the first time, give them the handouts from last class and tell them to fill in the online Student Data Form.

Put your class into their team homework groups based on where they live (North Campus, Central Campus, "The Hill", Off Campus). It is up to you if you want students to sit in their Team HW groups every day, but they should stay together today.

Give them a few moments to introduce themselves to the others at their table. Have each team give you a list of the names of each person at that table. Explain that you will be assigning the first team homework and would like to talk about the procedures for Team Homework. As you circulate, **make sure all groups have established their first meeting time.** Have them write down their names and first meeting time on a piece of paper for you. (Encourage them to come up with a team name and include this on the paper that they give you.)

Pass out the **Reporter page**. Take a few moments to go over the different roles and responsibilities of the team members (found in the Student Guide) and discuss what you are looking for in team homework write-ups. (Make sure YOU have read "Doing Team Homework" and watched "Team Hwk Tutorial" so that you can make the expectations clear.)

The first team assignment should be due at the *beginning* of the last day of class next week (or, if you prefer to let them have until Friday afternoon (especially if you do not teach on Fridays), you can have it due to you by a specific time (such as 5 pm) on Friday). Make sure that you are clear about the deadline, and then stick to it. Do *NOT* accept late assignments. If you do it even once, it will cause problems.

15-25 Review material from last time. Give an outline of what you intend to cover today.

25-35 Tell students that the idea of rate of change (in particular *average* rate of change, since this is not yet calculus) will be addressed throughout the text. Discuss the average rate of change as a change in output over change in input over an interval. The text provides a nice explanation of this and how it can be interpreted. (This is a good opportunity to remind students of the importance of reading the text.)

Make sure to show symbolic *and* graphical ways of defining the average rate of change. **Section 1.2 #16 on page 17** is a nice problem to do here to demonstrate these.

35-45 The previous example mentions a *rate of decrease*. Use this to segue into a mini-lecture on the terms *increasing* and *decreasing*. It is fine to point out that if a function is increasing over an entire interval, then the average rate of change on that interval is positive (or if the function is decreasing on an interval, then the average rate of change is negative), but DON'T fall into the trap of stating the converse. (Note Example 4 on page 14, the part finding the average rate of change between x= -2 and x = 1.) Use $f(x) = 16 - x^2$ (just used in #16 on page 17) as an example to demonstrate when the function is increasing and decreasing. Stress the fact that the terminology refers to the behavior of the function *as x moves from left to right*. Students have sometimes seen arrows on both ends of a graph of things like $y = x^2$ and tend to confuse long-term behavior with increasing or decreasing behavior. For this reason, I would definitely *discourage arrows on graphs* students' or yours.

45-55 Follow up with an example involving tables. Have the students work on **Section 1.R #8 on page 51** with their group members. Circulate the room and ask student volunteers to present their answers. Insist that answers include *units*. Make sure to emphasize the interpretation of these answers as in part (b), and be sure students point out which is increasing or decreasing (based on table data).

55-70 Next introduce students to our first family of functions linear functions. Point out that a linear function is one in which the average rate of change is *constant*. (Note: Students are familiar with the general formula for linear functions ($y = b + mx$) but often have not explored this family by considering its presentation by tables and verbal descriptions or thought a lot about the *interpretations* of m and b within the context of a problem. The challenge for us is to present the material as fresh and to keep students from thinking that this material is just a rehash of what they have had before.)

Put up the following table on the board:

x	-4	-1	0	2
$f(x)$	2	5	8	11
$g(x)$	8	2	0	-4

In their groups, have students determine if either of these functions could be linear. If they do believe the function is linear, have them find a formula for the function.

Wrap up the example by discussing solutions. It is also important at this time to point out that tables give discrete data and we do not know what is going on between the data points. As a result, we can only note that a function *could be* linear based on the data given.

70-80 Point out that in the next class, we will focus more on linear modeling problems and on the interpretations of the slope and vertical intercept in these problems. For now, have the students work on **Section 1.3 #13 on page 25** or **Section 1.3 #17 on page 26** in their groups. Be sure to leave time for closure.

Before you dismiss your class for the day, remind them about

- reading "Doing Team Homework"
- watching "Team Hwk Tutorial"
- quiz on the student guide (next class)
- the Gateway
- online student data form