Instructor Notes for Chapters 1&2

Section 1.2

The notion of function is fundamental to mathematics. Goals for students for this section are:

- Determine whether a correspondence is a relation or function
- Find function values, or outputs, using a formula (emphasize)
- Vertical line test
- Find domain and range of a function (mastery not likely here)

If you decide to do a traditional lecture, you might start with an application, informally, like #82, p. 90, perhaps without using function notation right away. You might say something like "Power = " then gradually introduce $P(v)$ notation, perhaps joking that it is the "lazy way out." (less writing).

If you're more adventuresome, you might try something like this:

> Let students sit in groups and discuss everything they know/remember about functions. Distribute 1 3x5 card to each group and ask one student in each group (a "recorder") to list the groups responses. Collect the cards and use the responses as a springboard for discussion. Try to draw the main ideas from the students' comments.

Today's focus should be on function notation, which students often don't understand. Be sure (obvious to us) that given the notation *f(x)* , students understand that *f* is the name of the function, *x* is the input variable, and *f(x)* is the output. Reinforce this notion by reading function values from graphs with students. You might use #35 – 40 on p. 88.

Finding function outputs with non-numeric inputs (e.g. finding *f(x+5)*) is a good review of basic manipulative skills, which our students need. The instructor site (and the student's Blackboard course) has a sheet with extra practice. I plan to use these as a source of quiz problems. Students will need to get a score of 8 of 10 or better in order to pass the quiz and they make retake it up to 3 times.

You might introduce domain of function informally to start, perhaps with an application, again using #82 on p.90: "What values of *v* make sense in the problem?" The instructor and Blackboard sites have an activity sheet for an informal introduction to this topic. You might consider using the Tabular representation piece.

Suggested Homework: **MLP**: HW 1.2

Section 1.3/1.4

Goals for students

- Understand that linear functions are functions with a constant rate of change
- Find slope from two points and in context
- Interpret slope in context of a real-world situation
- Write linear models
- Write equations for lines

Find slope and writing equations for lines are prerequisite skills. You might do a few basic problems of each on the board (from p. 104 and p. 118), then focus on applications emphasizing slope as a constant rate of change. Be sure students can *interpret* the slope in context: e.g. in example 5 on p. 99:
$m = \frac{-49,442}{4} = \frac{-12,361}{1} = \frac{change\,in\,output}{change\,in\,input} = \frac{\Delta number\ of\ snowboards\,sold}{\Delta years}$, or in words, "Each year, the number of snowboards sold decreased on average by 12,361."

Suggested Homework:

MLP: Day 1: *Writing Equations for Lines REVIEW*

Day 2: HW 1.3/1.4

Section 2.1

Goals for students**:**

- Given the graph of a function, student can name intervals over which it is increasing or decreasing.
- Find function values of piecewise functions given the input
- Graph piecewise functions by hand, including the greatest integer function
- Given the graph of a piecewise linear function, write a function formula for it.

Finding intervals of increasing or decreasing function values is not difficult for students, though they need to understand that we're dealing with the OUTPUTS that are increasing or decreasing, yet identifying the values of the INPUTS for which this occurs. Though introducing it informally, do ask students to try to understand the more formal definition on p.158. You might ask students to study it and then explain the definition in their own words. Take a little time to review reading max or min values from a graph, again emphasizing that the OUTPUT is the max or min value.

Here's one way to introduce piecewise functions: You might let students work in small groups on the following.

The normal length L of a giant earthworm (measure in cm) is approximately a function of its age, t (measured in weeks). This function can be represented by the following piecewise function rule:

$$L(t) = \begin{cases} 1.5t, & \text{if } \quad 0 < t \le 4 \\ 0.5t + 4 & \text{if } \quad 4 < t < 6 \\ 7 & \text{if } \quad 6 \le \mathrm{t} \le 10 \end{cases}$$

a) What is the normal length of a giant earthworm that is 4 weeks old? Express this information using function notation.

b) Evaluate L(8) and interpret this value in the context of the problem.

c) What is the domain of L? What does this domain tell you about the normal life span of a giant earthworm?

Then ask students to graph this function. Follow up with more examples of graphing piecewise funcs and writing a function rule given the graph. Be sure to inform students that you will ask them to graph a piecewise linear function *by hand* on an in-class quiz. The HW 2.1 assignment on MML includes these graphing questions as multiple choice only. Also, time permitting, you might want to discuss step functions, since 2 of the questions on the HW deal with this type of function.
We'll focus on modeling later when studying section 3.3

***Suggested Homework:* MLP:** HW 2.1

Section 2.2

Goals for students

- Add, subtract, multiply and divide function values, using the a table, graph, and symbolic approach
- Find the domains of each of the above.
- Given a linear, quadratic, cubic, or rational function, find its difference quotient.

You might try some or all of Activity 1 as an introduction to multiplication of functions.

Let students try # 33-44 on pp. 177-178. In MyLabsPlus, there is a "class demo" for finding domains of sums of functions. If you're in a classroom with a computer and projector, you might want to try it. Then do the symbolic approach, beginning with specific values for the input (like the opening discussion on pp. 171-172). Please remember to discuss domains of the results of the operations.

When discussing difference quotients, please do an intuitive (as well as symbolic) approach here, noting that the difference quotient is the slope of a secant line. Students have a hard time understanding that this manipulation on a function results in another function that is a *formula* for slope of a secant line for different values of *x* and *h*. The Instructor site (and Vista site) has a sheet on this…I've tried it in class with moderate success. Your suggestions are welcome.

***Suggested Homework:* MLP:** HW 2.2

Section 2.3

Goals for students:

- Find the composition of two functions
- Find the domain of the composition of two functions
- Decompose a function as a composition of two functions

Composition of functions is a new concept for most students. Introducing a real world scenario is one way to motivate the topic:

> *Suppose you want to buy a car for $18,000. The manufacturer will give a $500 rebate and the dealer will give a 10% discount. Which is the better deal: should you take the rebate first, then the discount, or vice versa?*

Then you might introduce composition: "do one function first, then the second on the result of the first." I ask students to **write out** the definition each time $f \circ g = f(g(x))$, then "take out $g(x)$ and put in its rule." You might want to do these with specific input values first, as in the above examples. Be sure to discuss domains of the result.

Another option is to use the Activity sheet on the Instructor and Blackboard websites entitled *Composition of Functions.*

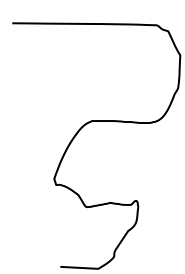
***Suggested Homework:* MLP** HW 2.3

Section 2.4, Day 1: Symmetry of Graphs; Even and Odd functions

Goals for students:

- Determine whether a graph is symmetric with respect to the x-axis, y-axis, and the origin
- Determine whether a function is even, odd, or neither

Discuss symmetry as it appears in our world and ask students for examples (human body, for one). As a possible introductory activity, you might give students an arbitrary squiggle, something like this:



add in a line perhaps to the left of the sketch and ask students to sketch in the reflection of the sketch. Extend this concept to the coordinate plan and assume the *y*-axis is the line of symmetry. You might as students such questions as:

- *If the point (-5, 4) is on the graph, what point is on its reflection through the y-axis?*

You might do several of these, then generalize:

- *If the point (x,y) is on the graph, what point is on its reflection through the y-axis?*

Ask students if they can come up with a formula for which this would be true. Guide them to realize that any even power function has this symmetry.

- *If* $y = x^2$ *has y-axis symmetry, does,* $y = x^2 + 2x$ *? Why or why not?*

Then see if students can derive an algebraic test for symmetry. My guess is they will choose polynomials with only even powers. What a perfect segue to the definition of even function. Point out, however, that there are non-polynomial functions that are even.

Try similar questioning for symmetry with respect to the *x*-axis and odd functions.

Be sure to give examples of functions that are neither even nor odd.

Finish up with symmetry to the origin.

Suggested Homework: **MLP**: HW 2.4A

Section 2.4, Day 2: Vertical and Horizontal Translations of Graphs

The graphing calculator is an ideal tool here for studying translations of graphs. See the Instructor course website for activity sheets for this topic. Students can discover the patterns and the reasons for them.

I always start with the old-fashioned approach, however, letting students create and compare a table of values for $y = x^2$ with one for $y = x^2 + 1$

- *How do you think the graph of the second function will differ from that of the first?*
- *So what about* $y = x^2 + 5$? $y = x^2 + 2$? $y = x^2 - 3$? etc.

You can then do several examples (or let students do them) on the graphing calculator and ask them to predict the shift of the graph. Be sure they understand *why* the graph is shifting as it is. After they seem comfortable with the vertical shifts of a parabola, try doing these translations with other functions (absolute value, cubic, square root). You can use the YVARS menu on the calculator to minimize button pushing on your calculator. Ask me if you're not sure how to do this.

When discussing horizontal translations, be sure to have students note the fact that a subtraction sign indicates a shift to the right, which one might think of as a positive shift (unlike the vertical shift downward resulting from a subtraction sign). I ask them to check the table on their grapher to see where the *y*-coordinate is 0.

Now that students have seen horizontal and vertical translations, you can do several combinations on the grapher, asking them either to guess the graph (given the function rule) or guess the function rule (given the graph). Great fun!

Discuss reflections through *x* and *y* axis.

Again, you might remind students that you will ask them to graph *by hand without access to a graphing calculator* during a quiz.

Suggested Homework: **MLP**: HW 2.4B

Section 2.4, Day 3 Vertical and Horizontal Stretching and Shrinking

Goal for students:

- *Given the graph of a function, graph its transformation under translations, reflections, stretchings, and shrinkings.*

Be sure to do a numeric approach with plenty of examples, encouraging students to note the pattern and why it works. Many students think that the graph of the function $y = 3x^2$ will be wider (i.e. larger) than the graph of $y = x^2$. I usually joke about "algebra by democracy" and ask for a show of hands of those students who think this is the case. We then look at some numeric examples, and plot a few points by hand. So much for democracy.

The Translation inquiry sheet entitled "All Combined" on the course website offers an activity for vertical stretches and shrinks. The sheets entitled Transformations I and Transformations II are alternate activities.

Suggested Homework: **MLP**: HW 2.4C

Exam Ch1

There is a set of review problems and a practice exam on MLP for Exam 1.

All in-class exams are paper and pencil exams and a sample is available for you. Please see Bev for access.