

**Text:** A University of Oregon custom edition of *Functions Modeling Change: A Preparation for Calculus, 4<sup>th</sup> ed.*, by Connally, Hughes-Hallett, Gleason, et al.

**Technology:** If you require a graphing calculator, **use it** and recommend a TI-84, TI-83 Plus or TI-83. If you do not allow the use of a calculator, be prepared to a) not use one yourself (lest ye be accused of hypocrisy) and b) write exams so that the simplification of arithmetically complex problems does not overshadow the actual concept they are being tested on.

If you're open to it, free and/or browser-based programs like Wolfram | Alpha can be of tremendous use to you and to students (e.g. the instruction "linear best fit (1,2), (3,4), (5,10)" in Wolfram | Alpha does everything a calculator would do for section 1.6).

**Course Goals:** A student successfully completing the course should, in general, have the algebraic facility to succeed in an applied calculus or trigonometry course. The student can model the mathematical topics described among the learning outcomes in words, then solve or simplify the relevant equations and/or expressions, and finally write a summary statement of the solution. In short, all of the learning outcomes should be incorporated with skill at mathematical modeling.

**Learning Outcomes:** The student has a facility with the concept of a function, function notation, and knowledge of the defining characteristics of linear, quadratic, exponential, and logarithmic functions. He/She can describe from a graph, formula, words, or a table if the function described is exactly linear or exponential, and whether it is approximately linear or exponential. The student is able to relate functions that differ by translation, compression, reflection, or combinations thereof. He/She has a conceptual framework for composition and inverses of functions and can compute the composition of two functions or find the inverse of a function (when it exists) given a formula, table, or graph of functions. Student can model an equation relating two variables in which proportionality or inverse proportionality are defined. Given sufficient data points he/she can find a linear, quadratic, power, exponential, or logarithmic function to fit the model. Where the data does not follow a model perfectly, the student can use technology and/or discuss qualitatively the fit of a linear or exponential model to given data, and compare the effectiveness of the two models for the same data set. Student is familiar with the definition of and basic characteristics of a polynomial function.

<b>WEEK</b>	<b>SECTIONS TO COVER</b>	<b>Notes</b>
<b>1</b>	1.1, 1.2, 1.3, 1.4	<p><b>1.1</b> (1 hr) Students explicitly learn the concepts of domain, range, and of computations using formulas for functions in Chapter 2. Here the focus is on conceptualizing a function and its input and output.</p> <p><b>1.2</b> (1 hr) Discuss increasing/decreasing and ARC.</p> <p><b>1.3</b> (0.5 hr) Focus is on the form of a linear function, its constant rate of change, construction of linear functions using initial value and slope.</p> <p><b>1.4</b> (0.5 hr) More general strategies for finding formulas for linear functions (e.g. a line through two points).</p> <p><i>Readiness Quiz Friday eve. or earlier</i></p>
<b>2</b>	1.5, 1.6, 2.1	<p><b>1.5</b> (0.5-1 hr) Compare slopes of linear functions, special lines (those parallel/perpendicular to the x-axis or to another line)</p> <p><b>1.6</b> (0.5-1 hr) Consider using either a graphing calculator or Wolfram   Alpha for calculating the line of best fit and correlation coefficient.</p> <p><b>2.1</b> (1 hr) Here are more formulaic calculations and more calculations</p>

involving symbols than in 1.1.

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| <b>3</b> | 2.2, 2.3, 2.4 | <b>2.2</b> (1 hr) Make sure you think about practical domain as well as mathematical (e.g. $f(x) = 9 - 2x$ has mathematical domain of $\mathbf{R}$ , but if it represents demand at price $x$ , the domain is actually $[0,4.5]$ )<br><b>2.3</b> (1 hr)<br><b>2.4</b> (1 hr) This is a much lighter treatment than in most texts. Focus on the conceptual framework for composition and inverses, as well as the practical interpretations. |
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(Winter) *Martin Luther King Jr. Day Monday*

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| <b>4</b> | 3.1, 3.2 | <b>3.1</b> (1 hr) There are lots of great applications here (dropping/throwing objects, revenue/profit, etc.), use them. The section uses the concept of concavity, which we don't discuss explicitly. These students generally already have a good idea about concave up / down for parabolas.<br><b>3.2</b> (1 hr) Use the applications from 3.1 again, but for optimization. |
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(If you can get ahead of this schedule and cover part or all of Chapter 3 in Week 3, so much the better.)

*Review for Midterm*

*Midterm 1*

1<sup>st</sup> midterm (Chapters 1, 2, 3 exam) on Thursday/Friday

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| <b>5</b> | 4.1, 4.2, 4.3 | <b>4.1</b> (1 hr) Construct exponential functions of the form $a \cdot b^x$ using initial value and per-unit growth factor.<br><b>4.2</b> (1 hr) Find equations of exponential functions given two points (4.2 is to 4.1 for exponential functions as 1.4 is to 1.3 for linear functions, if that makes any sense); compare long-term growth of linear to exponential.<br><b>4.3</b> (1 hr) Compare graphs of exponential functions, do regression and solve exponential equations approximately (again, for both of these tasks consider a graphing calculator or Wolfram   Alpha) |
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| <b>6</b> | 4.4, 4.5, 5.1 | <b>4.4</b> (0.5-1 hr) This is a worthwhile way for students to access exponential growth, don't skip it.<br><b>4.5</b> (0.5-1 hr) Continuous growth rate is a hard topic to discuss without calculus, but it needs to be distinguished from a periodic (i.e. average rate of change) growth rate.<br><b>5.1</b> (1 hr) The text does <i>not</i> define a logarithm with an arbitrary base. Choose whether you will do this in class (and thus provide them all the tools they need) or stick with the book's approach. Be cautious of how much time you spend proving the properties vs. doing examples. |
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| <b>7</b> | 5.2, 5.3 | <b>5.2</b> (1 hr) Discuss basic qualities (domain/range, intercepts, etc.) of both exponential and logarithmic functions; explore both categories of functions with transformations<br><b>5.3</b> (1 hr) Applications involving sound, Richter scale, and apparent magnitude are worthwhile here |
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(If you can get ahead of this schedule and cover more of Chapter 5 in Week 6, so much the better.)

*Review for Midterm, Midterm 2*

2<sup>nd</sup> midterm (Chapter 4, 5 exam) on Friday

Have exam grades available by Sunday before the drop deadline

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| <b>8</b> | 6.1, 6.2, 6.3, 6.4 | <b>6.1</b> (0.5 hr) If you haven't thought carefully about horizontal transformations, do so before arriving at class. Getting them right is |
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mildly tricky, explaining it to students convincingly is a challenge.

**6.2** (0.5 hr)

**6.3** (0.5 hr)

**6.4** (0.5 hr) See comment on 6.1.

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- 9** 6.5, 11.1, 11.2 **6.5** (1 hr) Make sure you either agree with the horizontal transformation ordering on pg 259 or have a plan for an alternative (e.g.  $y = f(\mathbf{Bx} - h)$  is first a shift by  $h$  units right *then* a horizontal stretch by a factor of  $1/|\mathbf{B}|$ )
- 11.1** (1 hr) This and 11.2 could be done directly after 3.1. If so, that might mess up the exam schedule, or at least change the content of the second midterm exam.
- 11.2** (1 hr) Try not to get carried away with the Fundamental Theorem of Algebra (over  $\mathbf{R}$ ), it really is worthwhile for them to get a sense of approximation strategies and an argument for the existence of roots based on a graph.

(Fall) *Thanksgiving holiday Thursday/Friday.*

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- 10** This week is most responsibly dedicated to (1) finishing up content if necessary, and then (2) in-class individual or small-group review with students.

*Catch-up, review*

(Spring) *Memorial Day holiday Monday*

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## **11 Final exam during scheduled time**

[http://registrar.uoregon.edu/calendars/final\\_exam#2012-2013](http://registrar.uoregon.edu/calendars/final_exam#2012-2013)

### **Additional Notes**

- It is extremely important that the students know that Math 111 is a pre-calculus course. It is designed for students who have a basic algebraic understanding that is to be built upon in order to prepare them for calculus. Not all students fit this description, but nevertheless it is the assumption.
- The content of this class may be different than you've experienced in a precalculus course (either taking one or if you've taught it elsewhere). There are fewer topics than in many other college algebra curricula, with the goal of the topics being covered in depth and with lots of varying applications. Keep in mind that probably less than 5% of the students will go on to degrees in mathematics, and that the majority enrolled need a solid conceptual understanding of the topics in a scientific context.
- Common areas of difficulty: Basic algebra (factoring, simplifying and operations on fractions), horizontal transformations, completing the square, applications of any sort. Be conscious of these facts when you approach each topic so that you can be ready for the confused looks, frustrated sighs, and eye rolling. Combat them with detailed examples and ample opportunities for practice. Basic algebra review is most effective when integrated into new concepts, so do it on an as-needed basis. Students complain about the abstract problems because they aren't relatable. Students complain about word problems because they're hard. It's difficult to win, but a responsible math class involves both abstract mathematics and applications.
- Word problems should be a main feature of the course. Consider introducing new topics in a non-mathematical context (there is lots of evidence that this helps students learn the material to begin with, but also to retain it longer). E.g. A function from the perspective of a machine like a wood-chipper or microwave oven; exponential functions from the notion of the thickness of paper after  $n$  foldings, and so on.

- A common complaint about this textbook from *students* is that it doesn't provide enough foundation for the student to do the problems. This is largely because the book makes a concerted effort to have many and varied applications, which are just hard, period. We can combat this with effective discussion of strategies for translating English into mathematics and providing them with lots of good examples of our own. Also, practice makes perfect.
- A common complaint about this textbook from *mathematicians* is that it's not rigorous enough (or doesn't provide complicated enough calculations). Students who are not math majors benefit from having applications and mathematical modeling used at every step (I've talked to most of the science departments to get their opinions about this). Our math majors, I'd argue, also benefit from having a conceptual and practical understanding of these concepts, and not as much from extraordinarily complex computations.
- There are no sections listed as optional – it is your responsibility to your students to cover the material listed. To further that end, please use this syllabus when preparing your class lecture schedule, and keep it to refer to during the term. Ask if you have questions!
- Mike has lecture guides (or in-class worksheets, if you aren't lecturing), quizzes, exams, practice packets, and word problems available upon request.

**Other Important Dates (<http://registrar.uoregon.edu/calendars/academic#fall2012>):**

Monday of 2 <sup>nd</sup> week	Last day to drop without a “W” (but only 75% tuition refund)
Wednesday of 2 <sup>nd</sup> week	Last day to add a class
Sunday after 7 <sup>th</sup> week	Last day to drop --- period!