MATH 1311 Syllabus

Course: MATH 1311 – Elementary Mathematical Modeling
Prerequisite: Two credits of high school algebra, one credit of geometry and satisfactory scores on the placement examination.
Course Description: Credit 3 hours (3-0). Functions, graphs, differences, and rates of change, mathematical models, mathematics of finance, optimization, and mathematics of decision making. May not be applied to a major or minor in mathematics. Students may not receive credit for both MATH 1310 and MATH 1311.

Course Requirements

Textbook: *Functions and Change: A Modeling Approach to College Algebra***,** Bruce Crauder, Benny Evans and Alan Noell, 3rd edition, Houghton Mifflin Company, 2007, ISBN-10: 0-618-64301X.

Calculator: A graphing calculator will be required. The text is designed to be used with a TI83 graphing calculator, and the calculator is an essential part of the presentation as well as the exercises. An accompanying *Student Study and Technology Guide*, ISBN-10: 0-618-64303-6, for the textbook provides TI83, TI83+, and TI84 keystrokes for creating tables, graphs, entering expressions, solving equations, and performing various types of regressions.

Course Objectives

Upon completion of this course, students will understand and appreciate some of the applications of mathematics to real-world concerns as well as become proficient with basic calculator and computer-generated spreadsheet operations. The student will meet the mandated goals and objectives of the core curriculum requirements in mathematics.

<table>
<tr><th>CH . SECTION</th><th>OBJECTIVE AND EXAMPLE</th><th>SESSION</th></tr>
<tr><td colspan="3">CHAPTER 1 – FUNCTIONS</td></tr>
<tr><td>1.1
Functions Given by Formulas</td><td>Define, evaluate, and use functions given by formulas.
Example: Evaluate $M = P(e^r - 1)/(1 - e^{-rt})$, where $r = 0.1$, $P = 8300$, and $t = 24$.</td><td>Week 1</td></tr>
<tr><td>1.2
Functions Given by Tables</td><td>Define, evaluate and use functions given by tables
Example: Gross domestic product: The following table from the 2003 Statistical Abstract of the United States shows the U.S. gross domestic product (GDP) G, in trillion of dollars, as a function of the year t.
<table>
<tr><td>t = Year</td><td>1996</td><td>2000</td><td>2002</td></tr>
<tr><td>G = GDP (trillions of dollars)</td><td>7.81</td><td>9.82</td><td>10.45</td></tr>
</table>
a. Explain in practical terms what G(1996) means, and find its value.
b. Use functional notation to express the gross domestic product in 1998, and estimate that value.
c. What is the average yearly rate of change in G from 2000 to 2002?
d. Use your answer to part c to predict the gross domestic product in the year 2010.</td><td>Week 2</td></tr>
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Ch . Section	**Objective and Example**	Session
1.3 Functions Given by Graphs	**Define, evaluate and use functions given by graphs.** Example: A stock market investment: A stock market investment of $10,000 was made in 197-. During the decade of the 1970s, the stock lost half its value. Beginning in 1980, the value increased until it reached $35,000 in 1990. After that its value has remained stable. Let $v = v(d)$ denote the value of the stock, in dollars, as a function of the date d. a. What are the values of $v(1970)$, $v(1980)$, $v(1990)$, and $v(2000)$? b. Make a graph of v against d. Label the axes appropriately. c. Estimate the time when your graph indicates that the value of the stock was most rapidly increasing.	Week 2
1.4 Functions Given by Words	**Define, evaluate, and use functions given by words.** Example: United States population growth: In 1960 the population of the United States was about 180 million. Since that time the population has increased by approximately 1.2% each year. This is a verbal description of the function $N = N(t)$, where N is the population, in millions, and t is the number of years since 1960. a. Express in functional notation the population of the United States in 1963. Calculate its value. b. Use the verbal description of N to make a table of values that shows U.S. population in millions from 1960 through 1965. c. Make a graph of U.S. population versus time. Be sure to label your graph appropriately. d. Verify that the formula 180×1.1012^t million people, where t is the number of years since 1960, gives the same values as those you found in the table in part b. e. Assuming that the population has been growing at the same percentage rate since 1960, what value does the formula above give for the population in 2000? (Note: The actual population in 2000 was about 281 million.)	Week 3

<table>
<tr><th>CH . SECTION</th><th>OBJECTIVE AND EXAMPLE</th><th>SESSION</th></tr>
<tr><td colspan="3"><u>CHAPTER 2 – GRAPHICAL AND TABULAR ANALYSIS</u></td></tr>
<tr><td>2.1
Tables and Trends</td><td>Define, construct, and analyze tables of values from given formulas.

Example: The Harvard Step Test was developed in 1943 as a physical fitness test, and modifications of it remain in use today. The candidate steps up and down on a bench 20 inches high 30 times per minute for 5 minutes. The pulse is counted three times for 30 seconds: at 1 minute, 2 minutes, and 3 minutes after the exercise is completed. If P is the sum of the three pulse counts, then the physical efficiency index E is calculated using E = 15,000/P. The following table shows how to interpret the results of the test.
<table><tr><th>Efficiency Index</th><th>Interpretation</th></tr><tr><td>Below 55</td><td>Poor condition</td></tr><tr><td>55 to 64</td><td>Low average</td></tr><tr><td>65 to 79</td><td>High average</td></tr><tr><td>80 to 89</td><td>Good</td></tr><tr><td>90 & above</td><td>Excellent</td></tr></table>a. Does the physical efficiency index increase or decrease with increasing values of P? Explain in practical terms what this means.
b. Express using functional notation the physical efficiency index of someone whose total pulse count is 200, and then calculate that value.
c. What is the physical condition of someone whose total pulse count is 2000?
d. What pulse counts will result in an excellent rating?</td><td>Week 4</td></tr>
<tr><td>2.2
Graphs</td><td>Define, construct, and analyze graphs for given functions.

Example: The resale value V, in dollars, of a certain car is a function of the number of years t since the year 2000. In the year 2000 the resale value is $18,000, and each year thereafter the resale value decreases by $1700.
a) What is the resale value in the year 20001?
b) Find a formula for V as a function of t.
c) Make a graph of V versus t covering the first 4 years since the year 2000.
d) Use functional notation to express the resale value in the year 2003, and then calculate that value.</td><td>Week 4</td></tr>
</table>

CH . SECTION	OBJECTIVE AND EXAMPLE	SESSION
2.3 Solving Linear Equations 2.4 Solving Non-linear Equations	**Solve linear and non-linear equations.** Example 1: Solve for k: $2k + m = 5k + n$. Example 2: Solve the following equation by a) the single-graph method and b) the crossing-graphs method. $-x^4/(x^2 + 1) = -1$ (*Note:* There are two solutions. Find them both.)	Week 5
2.5 Optimization	**Determine optimum values of functions from their graphs.** Example: The weekly profit P for a widget producer is a function of the number n of widgets sold. The formula is $P = -2 + 2.9n - 0.3n^2$. Here P is measured in thousands of dollars, n is measured in thousands of widgets, and the formula is valid up to a level of 7 thousand widgets sold. a. Make a graph of P versus n. b. Calculate $P(0)$ and explain in practical terms what your answer means. c. At what sales level I the profit as large as possible (maximized)?	Week 5
CHAPTER 3 – STRAIGHT LINES AND LINEAR FUNCTIONS		
3.1 The Geometry of Lines	**Determine, analyze, and use the slope of a line.** Example: If a building is 100 feet tall and is viewed from a spot on the ground 70 feet away from the base of the building, what is the slope of a line from the spot on the ground to the top of the building?	Week 6
3.2 Linear Functions	**Define and use functions of lines with a constant slope.** Example: An elementary school is taking a busload of children to a science fair. It costs $130.00 to drive the bus to the fair and back, and the school pays each student's $2.00 admission fee. a) Use a formula to express the total cost C, in dollars, of the science fair trip as a linear function of the number n of children who make the trip. b) Identify the slope and the initial value of C, and explain in practical terms what they mean. c) Explain in practical terms what $C(5)$ means, and then calculate that value. d) Solve the equation $C(n) = 146$ for n. Explain what the answer you get represents.	Week 6

<table>
<tr><th>CH . SECTION</th><th>OBJECTIVE AND EXAMPLE</th><th>SESSION</th></tr>
<tr><td>3.3
Modeling Data with Linear Functions</td><td>Determine linear data, define models and evaluate resulting functions.

Example: Determine if the following data given in the table below is linear. Plot the data from the table and determine the linear function, if applicable, that the data models.
<table><tr><td>x</td><td>2</td><td>4</td><td>6</td><td>8</td></tr><tr><td>y</td><td>12</td><td>17</td><td>22</td><td>27</td></tr></table></td><td>Week 7</td></tr>
<tr><td>3.4
Linear Regression</td><td>Use linear regression to approximate linear functions.

Example: For the following data set: (a) Plot the data. (b) Find the equation of the regression line. (c) Add the graph of the regression line to the plot of the data points.
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>2.3</td><td>2</td><td>1.8</td><td>1.4</td><td>1.3</td></tr></table></td><td>Week 7</td></tr>
<tr><td>3.5
Systems of Equations</td><td>Solve systems of two equations in two unknowns.

Example: Solve the following system of equations by a) the hand calculation method and b) the crossing-graphs method. $-6.6x - 26.5y = 17.1$
$6.9x + 5.5y = 8.4$</td><td>Week 8</td></tr>
<tr><td colspan="3"><u>CHAPTER 4 – EXPONENTIAL FUNCTIONS</u></td></tr>
<tr><td>4.1
Exponential Growth and Decay</td><td>Define, evaluate and interpret exponential functions.

Example: Suppose that f is an exponential function with growth factor 2.4 and that $f(0) = 3$. Find $f(2)$. Find a formula for $f(x)$.</td><td>Week 9</td></tr>
<tr><td>4.2
Modeling Exponential Data

4.3
Modeling Nearly Exponential Data</td><td>Determine exponential and nearly exponential data, define models, apply exponential regression and evaluate resulting functions.

Example 1: Determine whether the following table shows exponential data. If the data is exponential, make an exponential model for the data.
<table><tr><td>x</td><td>0</td><td>2</td><td>4</td><td>6</td></tr><tr><td>y</td><td>5</td><td>10</td><td>20</td><td>40</td></tr></table>
Example 2: Use exponential regression to fit the following data set. Give the exponential model, and plot the data along with the model.
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>y</td><td>3.7</td><td>4.3</td><td>6.1</td><td>9.1</td><td>13.6</td></tr></table></td><td>Week 9</td></tr>
</table>

<table>
<tr><th>CH . SECTION</th><th>OBJECTIVE AND EXAMPLE</th><th>SESSION</th></tr>
<tr><td>4.4
Logarithmic Functions</td><td>Understand and apply common logarithmic functions.

Example: The largest recorded earthquake centered in Idaho measured 7.2 on the Richter scale.
a) The largest recorded earthquake centered in Montana was 3.16 times as powerful as the Idaho earthquake. What was the Richter scale reading for the Montana earthquake?
b) The largest recorded earthquake centered in Arizona measured 5.6 on the Richter scale. How did the power of the Idaho quake compare with that of the Arizona quake?</td><td>Week 10</td></tr>
<tr><td>4.5
Connecting Exponential and Linear Functions</td><td>Establish and understand the connection between linear and exponential data.

Example: The following table, taken from the U.S. Industrial Outlook, shows the average hourly wages for American auto parts production workers from 1987 through 1994.

<table><tr><th>Date</th><th>Hourly Wage</th><th>Date</th><th>Hourly Wage</th></tr><tr><td>1987</td><td>$13.79</td><td>1991</td><td>$15.70</td></tr><tr><td>1988</td><td>$14.72</td><td>1992</td><td>$16.15</td></tr><tr><td>1989</td><td>$14.99</td><td>1993</td><td>$16.50</td></tr><tr><td>1990</td><td>$15.35</td><td>1994</td><td>$16.85</td></tr></table>a) Plot the natural logarithm of the data. Does it appear that it is reasonable to model auto parts worker wages using an exponential model?
b) Find the equation of the regression line for the natural logarithm of the data.
c) Make an exponential model for auto parts worker wages using the logarithm as a link.</td><td>Week 10</td></tr>
<tr><td colspan="3"><u>CHAPTER 5 – A SURVEY OF OTHER COMMON FUNCTIONS</u></td></tr>
<tr><td>5.1
Power Functions</td><td>Define, evaluate and interpret power functions.

Example: The speed at which certain animals run is a power function of their stride length, and the power is $k = 1.7$. If one animal has a stride length three times as long as another, how much faster does it run?</td><td>Week 11</td></tr>
</table>

<table>
<tr><th>CH . SECTION</th><th>OBJECTIVE AND EXAMPLE</th><th>SESSION</th></tr>
<tr><td>5.2
Modeling Data with Power Functions</td><td>Define and construct power function models from given data.

Example: The following data table was generated by a power function f. Find a formula for f and plot the data points along with the graph of the function.

<table><tr><th>x</th><th>f</th></tr><tr><td>1</td><td>3.6</td></tr><tr><td>2</td><td>8.86</td></tr><tr><td>3</td><td>15.02</td></tr><tr><td>4</td><td>21.83</td></tr><tr><td>5</td><td>29.17</td></tr></table></td><td>Week 11</td></tr>
<tr><td>5.3
Combining and Decomposing Functions</td><td>Combine and decompose functions.

Example 1: The radius r of a circle is given as a function of time t by the formula $r = 1 + 2t$. The area A of the circle is given as a function of the radius r by the formula $A = \pi r^2$. Find a formula giving the area A as a function of the time t.</td><td>Week 12</td></tr>
<tr><td>5.4
Quadratic Functions and Parabolas</td><td>Define, analyze, and evaluate quadratic functions and their graphs.

Example: Test the following data to see whether the data are quadratic. If the data is quadratic, use quadratic regression to find a model for the following data set. Plot the data and the model on the same graph.

<table><tr><th>x</th><th>f</th></tr><tr><td>1</td><td>-4</td></tr><tr><td>2</td><td>-5</td></tr><tr><td>3</td><td>-8</td></tr><tr><td>4</td><td>-13</td></tr><tr><td>5</td><td>-20</td></tr></table></td><td>Week 13</td></tr>
<tr><td>5.5
Higher-degree Polynomials and Rational Functions</td><td>Define, analyze, and evaluate quadratic functions and their graphs.

Example: Use cubic regression to find a model for the following data set. Plot the data and the model on the same graph.

<table><tr><th>x</th><th>f</th></tr><tr><td>1</td><td>1</td></tr><tr><td>3</td><td>3</td></tr><tr><td>4</td><td>5</td></tr><tr><td>6</td><td>2</td></tr><tr><td>7</td><td>1</td></tr></table></td><td>Week 13</td></tr>
</table>

CHAPTER 6 – RATES OF CHANGE		
6.1 Velocity	**Describe and analyze velocity and directed distance.** Example: A rock is tossed upward and reaches its peak 2 seconds after the toss. Its location is determined by its distance up from the ground. What is the sign of velocity at 1 second after the toss, 2 seconds after the toss, and 3 seconds after the toss?	Week 14
6.2 Rates of Change for Other Functions	**Utilize the fundamental properties of rates of change.** Example: Estimating rates of change-Use your calculator to make a graph of $f(x) = x^3 - 5x$. Is df/dx positive or negative at $x = 2$? Identify a point on the graph of f where df/dx is negative.	Week 14
6.3 Estimating Rates of Change	**Estimate rates of change.** Example: Make a graph of $x^3 - x^2$ and use the calculator to estimate is rate of change at $x = 3$.	Week 15
6.4 Equations of Change: Linear and Exponential Functions	**Analyze equations of change: Linear and Exponential Functions** Example: You open an account by investing $250 with a financial institution that advertises an APR of 5.25%, with continuous compounding. What account balance would you expect 1 year after making your initial investment?	Week 15

Where to find help: There are several different ways to find help in the course.
(1) **Instructor:** During his/her office hours or CASA Tutoring hours.
(2) **CASA Tutoring:** 222 GARRISON GYM (2nd Floor) for homework exercises.
(3) **LEARNING SUPPORT SERVICES:** 321 SOCIAL WORK BUILDING (3rd Floor) for one-on-one free tutoring over concepts, examples, and homework. See link through your instructor's website for more information.
(4) **Online Study Center:** Provided by Houghton Mifflin publishing that provides extra proofs, quizzes, and discovery exercises. See textbook's website at http://college.hmco.com/PIC/crauder3e.

Courseware: Each student MUST establish a Courseware student account via the internet by the END OF THE SECOND WEEK. Your instructor has a link to Courseware from his/her website. For more information visit http://CASA.uh.edu. Students failing to establish a Courseware account will NOT have access to grades or instructor emails.

Grading System: The University standard grade system will be used. If x is your semester numerical score:

A	$x > 93$	**B-**	$80 \leq x < 83$	**D+**	$67 \leq x < 70$
A-	$90 \leq x < 93$	**C+**	$77 \leq x < 80$	**D**	$63 \leq x < 67$
B+	$87 \leq x < 90$	**C**	$73 \leq x < 77$	**D-**	$50 \leq x < 63$
B	$83 \leq x < 87$	**C-**	$70 \leq x < 73$	**F**	*Below* 50

The course grade will be computed as follows:

Homework	10%
Quizzes	10%
Chapter Projects	10%
Tests (3-20% each)	60%
Final Exam	10%

Homework: Each section covered will have two types of homework assigned. The first type is the "Skill Building Exercises" which is NOT to be turned in—each section's assignment will be the all the odd-numbered exercises from this type. The second type comes from the "Exercises". The "Exercises" homework consists of approximately 10 exercises from each section covered in the textbook. There are approximately 4-5 sections per chapter in the textbook. Homework will be turned in by "chapter", meaning all the chapter's "section exercises" will be turned in together upon completion of that chapter. Thus the homework will be due the first day of class of the week following the completion of that chapter (i.e. if a chapter is completed on Wednesday, then all of the homework assigned in each section of that chapter will be due the following Monday). Selected exercise(s) from each section will be graded based on completeness and correctness. We will have SIX homework assignments; ONLY ONE homework assignment will be dropped. No late or early homework will be accepted. Homework MUST be STAPLED TOGETHER with the CORRECT COVERSHEET for each chapter or it will NOT BE GRADED! (For an example of the homework coversheet see your instructor's website.)

Quizzes: There will be given during the semester as determined by your instructor. The quizzes will consist of one question chosen from each section's assigned homework exercises. Each quiz will be worth a total of 10 points with partial credit possible. Quiz scores will be posted on Courseware once a week. The actual quiz will NOT be returned to the student. Solutions for each quiz will be posted online through your instructor's website.

Chapter Projects: Several projects will be assigned from selected chapters. These projects must have documented research and resources. The projects will be completed using a computer-based spreadsheet software program. The projects will not be accepted handwritten; projects must be printed from a computer software package like Excel or Lotus 1-2-3. Your name, HA number, class, section, semester and project title

must be on the top coversheet. The research project as well as all supporting documentation must be attached to the top coversheet. No late projects will be accepted. No projects will be dropped. (For an example of the project coversheet see your instructor's website.)

Tests: There will be in-class tests during the semester as announced by your instructor. The dates of these tests are given in the course calendar provided by your instructor. You MUST bring your student ID to every exam! If it is necessary for you to miss an in-class test, please contact your instructor immediately and in advance whenever possible. There will be NO makeup tests; your final exam score will also serve to replace any ONE missed test.

Extra Bonus Points for Each Test: Each of the above three tests will have a selected number of "end of the chapter review exercises" assigned. This optional "test review" may be turned in at the beginning of class on the day of the respective test. The review assignment will be given a grade between 0-10 points, inclusive, and this grade will then be added at the end of the semester to each respective test. This will be the only way to add extra bonus points on the in-class tests.

Final Exam: There will be a mandatory, comprehensive multiple choice final exam. The date and time of the final exam is given in the course calendar provided to you by your instructor. The final exam will be in the normal classroom at the date and time specified by the university. If you score a 70% or better on the final exam, you will be given a course grade of at least a D- (minimum passing grade). **However, you must have a raw score of at least 50% on the final exam to be ELIGIBLE to pass this course. NO exceptions will be given to this rule!**

Dropping the Course: You are responsible for dropping this course and other registration issues. Do not depend on your instructor to drop you for any reason, and do not assume that your drop paperwork will be processed for you. Pay attention to drop deadlines and check VIP for your course status. If you want to be dropped let your instructor know in a timely fashion. Never assume that your drop will be processed automatically. Note that your paperwork must be turned in to the registrar's office on or before the last day to drop; it is not sufficient to have your teacher sign by the deadline, you must turn in the signed paperwork to the appropriate office by the deadline.

Accommodations for testing will be handled appropriately. Please talk with your instructor privately and have the documentation for testing accommodations available at the beginning of the semester. Retroactive testing accommodations will not be made.

Cell phones must be turned off or put on silent/vibrate mode before class begins.

Cheating will not be tolerated. See the UH Student Handbook for details and consequences.

Online Help/Support is available from the textbook publisher. For more info, see "Where to find help" above.

Attendance is important. Regular attendance in class is required if you are to pass this class. This course is highly dependent on previously covered material. If you miss class, you may miss important key concepts that are required and used in future material. The student has the responsibility of obtaining any missed lecture material or class notes from fellow classmates.

Announcements will be made at the beginning of the lecture, and/or on your instructor's website, and/or by email through your Courseware account. Your instructor reserves the right to make changes to the syllabus/policies of the course and to announce such information as needed. You are responsible for knowing the content of any announcements and/or changes.

HOMEWORK: SUGGESTED "Skill Building Exercises" (S) & REQUIRED "Exercises" (R)

Section	*Exercises*	
1.1	S # 1-13 odd, R # 1-15 all	
1.2	S # 1-15 odd, R # 1-10 all	
1.3	S # 1-11 odd, R # 1-7 all, 9, 11, 12	
1.4	S # 1-11 odd, R # 1, 3-7 all, 11-14 all	*Prepare Chapter 1 Homework Assignment #1*
2.1	S # 1-11 odd, R # 1, 2, 3, 5,7, 8, 12, 14, 15, 19	
2.2	S # 1-11 odd, R # 1-7 all	
2.3	S # 1-11 odd, R # 1-6 all, 13, 15, 17, 18	
2.4	S # 1-11 odd, R # 1, 2, 4, 5, 6, 8, 16	
2.5	S # 1-11 odd, R # 1-5 all, 18, 19	*Prepare Chapter 2 Homework Assignment #2*
3.1	S # 1-11 odd, R # 1-10 all	
3.2	S # 1-13 odd, R # 1-9 all	
3.3	S # 1-11 odd, R # 1-10 all	
3.4	S # 1-11 odd, R # 1-10 all	
3.5	S # 1-11 odd, R # 1-6 all, 11, 12, 14, 15, 16, 17	*Prepare Chapter 3 Homework Assignment #3*
4.1	S # 1-11 odd, R # 1-7 all, 16, 17, 20	
4.2	S # 1-11 odd, R # 1-9 all, 16	
4.3	S # 1-11 odd, R # 1-5 all, 9, 15, 19	
4.4	S # 1-11 odd, R # 1-5 all, 13	
4.5	S # 1-11 odd, R # 1-10 all	*Prepare Chapter 4 Homework Assignment #4*
5.1	S # 1-11 odd, R # 1-7 all	
5.2	S # 1-11 odd, R # 1-5 all	
5.3	S # 1-11 odd, R # 1-5 all, 13	
5.4	S # 1-11 odd, R # 1-11 odd	
5.5	S # 1-11 odd, R # 1, 2, 3, 19	*Prepare Chapter 5 Homework Assignment #5*
6.1	S # 1-11 odd, R # 1-7 all	
6.2	S # 1-11 odd, R # 1-7 all	
6.3	S # 1-11 odd, R # 1, 4, 5, 7	
6.4	S # 1-9 odd, R # 1-5 all	*Prepare Chapter 6 Homework Assignment #6*