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## MATH 114-01, Math for the Life Sciences, Fall 2012

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*Instructor:* Professor Erin Bodine

*Email:* [bodinee@rhodes.edu](mailto:bodinee@rhodes.edu)

*Office:* Ohlendorf 422

*Office Hours:* MWThF 2-4 pm, and by appointment

If not in office, check MSC (Ohlendorf 2<sup>nd</sup> Floor)

*Course Website:* This course has a Moodle website.

**Section 114-01** meets MWF 1:00 – 1:50 pm in Ohlendorf 225

*You will be required to meet with your Supplemental Instructor (SI) for one hour a week, time TBA.*

**Course Description:** Mathematics for the Life Sciences provides an introduction to a variety of mathematical topics used in analyzing problems arising in the biological sciences, without using calculus. The mathematics covered in this course includes descriptive statistics, linear and exponential regressions, matrix algebra, matrix modeling, basic probability theory, and discrete difference equations. Some of the biological applications we will explore include modeling the population sizes of various species over time, describing how the concentration of a drug in the body changes over time, modeling the process of ecological succession, predicting the likelihood of a false-positive or false negative in medical testing, and modeling the frequency of a certain allele in a population over time.

In addition to lecture, this course has a lab component where students will learn to utilize the software Matlab (a popular piece of software used in the sciences) to analyze data, investigate mathematical models and provide some exposure to programming.

The goals of this course are for the students to

- Develop their ability to quantitatively analyze problems that arise from the study of biological systems.
- Experience the great utility of mathematical models as a means of providing answers to key biological problems.
- Gain fluency in using computer software and some programming skills to analyze data and investigate mathematical models.

**Prerequisites:** None

**Course Materials:**

- *Textbook:* The textbook we will be using is currently in development (by your instructor), and thus will be available to you for free as a PDF. This book is under contract with Princeton University Press, and thus I must ask that you do not distribute or share copies of this PDF in any way. To do so will be a violation of the Honor Code.
- *Supplemental Materials:* You are responsible for all handouts given in class and materials posted on Moodle.
- *Calculator:* For some computations it will be advantageous to have a calculator. If you do not already have one, please acquire a scientific calculator (NOT a graphing calculator!). I recommend TI-30X IIS (\$13.24 on Amazon) or TI-36X Pro (\$20.53 Amazon). You will NOT be allowed to use a scientific calculator app on your phone.
- *MATLAB:* All lab projects in this course will be completed using Matlab. Copies of this software are available on computers on campus. If you wish to have your own copy on your own compute, student copies are \$99 and available through [www.mathworks.com](http://www.mathworks.com).

**Supplemental Instruction:** In addition to time spent in lecture, you will be required to spend one hour a week with your Supplemental Instructor (SI). The class will be broken up into 4 groups. Each group will get to choose (within reason) when they would like to meet with their SI. During the meetings with the SI, you will work through Matlab tutorials and exercises with the aid of the SI. Additionally, you may use your time with your SI to obtain guidance and additional direction on the projects or homework questions which require Matlab.

You may also request additional time to meet with your SI, but they may decline at their discretion (please respect the SI's time, they are students with heavy work loads, too!). If you cannot meet with your SI and have questions, you can also ask questions of Prof Bodine either at office hours or via email.

**Course Grading:**

Component	Frequency	% of Grade
Homework	each section collected 2 days after section is completed	10 %
Quizzes	weekly	20 %
Lab Participation	weekly	10 %
Projects	3 total (worth 8% each)	24 %
Exams	3 total (worth 8% each)	24 %
Final Exam	Friday, May 4, 2012 @ 8:30 am	12 %

*Homework:* There will be one homework set for each section of the text we cover. The problems are to be done a blank 8.5" × 11" white paper. See sheets at the end of this syllabus for an example (copies are posted on Moodle). Your name, the homework section, and the date will be given at the top of each page, and the page number in the bottom right of each page. The remainder of the page will be divided in to two columns. In the left column, work the assigned exercise. After you have worked the problem, check your answer in the answer key (posted on Moodle). If your answer is correct, indicate this in the right column. If your answer is incorrect, identify where you went wrong, and record this in the right column. Being able to identify where an error occurred is a very important skill! The grading for practice problems will be based on completion, so do not worry about getting every problem completely correct. In each homework set, each attempted problem is worth 2 points (1 point for attempting the problem and 1 point for indicating if it is correct or indicating where the mistake was made).

*Quizzes:* Quizzes will be given weekly (on Wednesdays) and be designed to take approximately 10-15 minutes.

*Lab Participation:* During the weekly meetings with your SI you will need to complete Matlab tutorials. Upon demonstration of completion of the week's Matlab tutorial, your SI will award you your lab participation points for the week. If you are unable to attend the meeting with your SI on a given week you must provide advanced notice to Prof Bodine and your SI instructor. You may make up the lab participation points for that week by working through the tutorial on your own time and then taking Matlab quiz given by Prof Bodine.

*Exams:* There will be three exams given (one after the completion of each Unit 1, 2, and 3). Each exam will be given at least one week after we finish the corresponding unit, on a Thursday evening. Material from Unit 4 will be included on the final. In order to remove the pressure of a time constraint, these exams will be given in the evening with a wide window of time (4-5 hours). You may take the exam for as little or as much of that time as needed. However, the exams will not be designed to take the full length of time. A make-up exam will only be given if both of the following two conditions are satisfied:

1. You contact Prof Bodine prior to the test being given (at least one week in the case of absence due to the attendance of an official school function).
2. You provide the proper documentation.

*Final Exam:* The final exam will cover all materials in this course. Unless otherwise notified, the exam will be closed book and closed notes.

**Section 114-01:** Final Exam on Friday, May 4, 2012 @ 8:30 am (Ohlendorf 225)

**Final letter grades** are determined as follows:

A	93 – 100 %	C	73 – 76.9 %
A -	90 – 92.9 %	C -	70 – 72.9 %
B +	87 – 89.9 %	D +	67 – 69.9 %
B	83 – 86.9 %	D	63 – 66.9 %
B -	80 – 82.9 %	D -	60 – 62.9 %
C +	77 – 79.9 %	F	0 – 59.9 %

**Disability Services:** If you need course adaptations or accommodations due to a documented disability, please contact the Office of Disability Services at Burrow Student Center, Fourth Floor, 901-843-3885. Hours: M-F, 8:30 am – 5:00 pm. See <http://www.rhodes.edu/disabilityservices/default.asp> for details.

**Classroom Etiquette:** Please be considerate of the instructor and your classmates around you. Come to class on time and stay the entire period. Turn off cell phones or any beeping/ringing devices during class (this means no sending text messages during class).

**The Honor Statement:** You are expected to conduct yourself within the guidelines of the College's Honor Code. If you have any questions about what is or is not allowed, please ask.

*The note that this syllabus is a guide and not a contract, and thus is subject to change at the discretion of the instructor.*

## List of Topics Covered

<b>Descriptive Statistics</b>
Introduction to Descriptive Statistics
Summarizing data numerically - Measures of Central Tendency and Variability
Bivariate Data - Scatter Plots, Regression Lines, and Correlation
Inverse Functions
Exponential and Logarithm Functions
Scaling Functions: Semilog and Log-Log Plots
<b>Probability</b>
Introduction to Discrete Probability
Probability Lab
Compound Events & the Laws of Probability
Conditional Probability & Independence
Sequential Experiments & Bayes' Theorem
Probability Models in Population Genetics
<b>Matrix Modeling</b>
Introduction to Matrix Algebra
Solving Systems of Equations
Age Structured Population Models & Leslie Matrices + Harvesting
Eigenvalues & Eigenvectors
Discrete Compartmental Models & Transfer Matrices
Examples of Matrix Models
<b>Difference Equation Models</b>
Sequences & Limits
First Order Difference Equations
Second Order Difference Equations
<b>Using Matlab as a Virtual Laboratory</b>
<i>This material will be throughout the semester and concurrent with the above material</i>
Introduction to Matlab
Plotting Data and Creating Histograms
Generating Regression Lines
Generating Random Numbers
Using Matlab to "Sample a Population"
Matrix Algebra in Matlab
Using Matlab to find Eigenvalues & Eigenvectors
Matrix Modeling in Matlab
Difference Equations in Matlab

Name \_\_\_\_\_ Section \_\_\_\_\_ Date \_\_\_\_\_

#1 Find the average of

906 1320 711 1170

$$\text{average} = \frac{906 + 1320 + 711 + 1170}{4} = \frac{4107}{4}$$

$$= 1026.75$$

Correct

#2 Use MATLAB to find the average

of 906 1320 711 1170

SEE ATTACHED MATLAB PRINTOUT

Whoops! Entered  
4<sup>th</sup> data point  
incorrectly.

#3 Compute the standard deviation

of 906 1320 711 1170

Know mean from #1,  $\bar{x} = 1026.75$

$$s^2 = \frac{1}{4} \left[ (906 - \bar{x})^2 + (1320 - \bar{x})^2 + \dots + (1170 - \bar{x})^2 \right]$$

$$= 55198.6875$$

$$s = \sqrt{55198.6875} \approx 234.9$$

Need to divide by  
 $n-1$ , not  $n$   
so this  
needs to be  
 $4-1=3$

## Scheduling Meetings with Supplemental Instructors

Please indicate (with an X) which times are you available on a regular basis to meet with the SI.

Times	Sunday	Monday	Tuesday	Wednesday	Thursday
6 – 7 PM					
7 – 8 PM					
8 – 9 PM					
9 – 10 PM					

Once you have indicated the times you are available, you are ready to form your SI group.

*Step 1:* Find 3-4 other students in this class with whom you have three available times in common.

*Step 2:* Have one member fill out the form on the bottom of this page and turn it into Prof Bodine by **Friday, January 13** (spooky!)



----- tear here -----

Names of students in your group

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

Indicate **at least** three common available times for the group to meet with the SI. These times must be regularly available.

Times	Sunday	Monday	Tuesday	Wednesday	Thursday
6 – 7 PM					
7 – 8 PM					
8 – 9 PM					
9 – 10 PM					