Study guide for the first exam

Math 1241, Fall 2012

The first exam is based on textbook chapter 1 and Math Insight parts 1-7. Using the book sections as a guide, the following highlights what is and what is not good potential material for the first exam.

1. Biology and dynamics (section 1.1)

   Good background material, but nothing that can go on an exam.

2. Functions, variables, and parameters (section 1.2, Math Insight, Part 1)

   (a) Be comfortable with variables, parameters, and functions. Manipulating them is a key basic skill for this course.

   (b) Of particular importance is being able to work with parameters that don't have a specific numerical value.

   (c) Exam problems are likely to be more involved than a simple calculation from section 1.2, but the ability to do such calculations is assumed.

3. Units and dimensions (section 1.3)

   We didn't explicitly cover section 1.3 of the textbook in this course. It's good stuff, but we'll discuss it more later if we need to. It won't show up on the first exam.

4. Linear functions (section 1.4)

   Linear functions are particularly important as we'll use them to obtain a derivative. Our main use of them now, and the way they would show up on the first exam, is in the context of linear discrete dynamical systems.

5. Discrete-time dynamical systems (sections 1.5, 1.6, Math Insight, parts 2-7)

   Discrete-time dynamical systems will be the core of exam 1.

   Key points are

   (a) Calculating the first few points of a trajectory from an initial condition.

   (b) Solving the system if it is linear without a constant term. In this case, one obtains exponential growth or decay.

   (c) Estimating a solution with cobwebbing using the graph of the updating function.

   (d) Finding equilibria analytically and graphically.

   (e) Determining the stability of an equilibrium via cobwebbing or by observing trajectories near the equilibrium.

   (f) Analyzing the influence of parameters on the behavior of the system.

   (g) Setting up a dynamical system from a verbal description of a system. This process includes

i. carefully defining the notation used.

ii. possibly introducing parameters to describe quantities whose numerical value is unknown or whose value may change between experiments.

iii. possibly estimating parameters of the system from data.

The dynamical systems you would be asked to set up will be linear (possibly with a constant term) unless any nonlinear component is clearly specified. (Sorry, no rabbit control challenges on the exam.)

6. Exponential functions (section 1.7, Math Insight parts 4 and 6)

   You should be able to

   (a) calculate the solution of a linear dynamical system to obtain exponential growth or decay.

   (b) determine the doubling time or the half-life of a linear dynamical system.

   (c) manipulate exponential functions and logarithms.

7. Oscillations and Trigonometry (section 1.8)

   We aren't covering this section for now, and the material will not appear on exam 1.

8. Gas exhange in the lungs (section 1.9)

   You wouldn't be asked to come up with such a model in an exam. But, this is a good example you could review if you want to see another linear dynamical system. It will give you more exposure to working with a sytem that has parameters. You can view it as another nicely outlined example.

9. Nonlinear example (section 1.10)

   We won't cover sections 1.10.1 and 1.10.2 in this course.

   The one part of this section that is relevant to the exam is section 1.10.3, which is where the book defines stable and unstable equilibria.

10. The heart example (section 1.11)

    We won't cover section 1.11 in this course.