Study guide for the second exam

Math 1241, Fall 2012

The second exam is based on textbook chapter 2, sections 3.1-3.3 and Math Insight parts 8-17. Given that this material includes more on discrete dynamical systems, the material from the first exam is also implicitly relevant. Using the book sections as a guide, the following highlights what is and what is not good potential material for the second exam.

1. Introduction to derivative (section 2.1)

   The slope of the secant line as average rate of the change, and the slope of the tangent line as instantaneous rate of change.

   The tangent line as the limit of a secant line with the two points approaching each other.

   The derivative is the slope of the tangent line.

   The limit as the idea of getting as close as possible with actually going all the way.

2. Limits and continuity (sections 2.2 and 2.3)

   We didn't cover these sections.

3. Derivatives of polynomials (sections 2.4 and 2.5)

   Be able to calculate the derivative of polynomials.

   Be able to calculate critical points: points where the derivative is zero or the function is not differentiable.

   The sign of the derivative tells where the function is increasing and decreasing.

4. Derivatives of products and quotient (section 2.6)

   Be able to calculate the derivative of the product and quotient of two functions.

5. The second derivative, curvature, and acceleration (section 2.7)

   Be able to calculate the second derivative of a function.

   The second derivative gives inflections points and tells where the function is concave up or down.

   Although it's good to know that the second derivative of a function specifying position is acceleration, this won't show up on the exam.

6. Derivatives of exponential and logarithmic functions (section 2.8)

   Be able to calculate the derivative of the exponential function and the logarithm.

7. The chain rule (section 2.9)

   Be able to calculate the derivative of simple compositions.

   Derivatives of inverse functions or implicit differentiation will not be on the exam.

8. Derivatives of trigonometric functions (section 2.10)

   Derivatives of trigonometric functions will not be on the exam.

9. Partial derivatives (Math Insight, part 14)

   The partial derivative is just like the ordinary derivative, where you hold all but one variables constant.

   Be able to describe what a partial derivative means in the context of an example.

10. Stability of equilibria in discrete dynamical systems (sections 3.1 and 3.2)

    To calculate the stability of an equilibrium, put the system in function iteration form: $x_{t+1} = f(x_t)$. Then, an equilibrium $x_n = E$ is stable if $|f'(E)| < 1$ and is unstable if $|f'(E)| > 1$.

    Be able to calculate equilibria and stability of dynamical systems that include parameters. This is where the derivative method for stability shines, as we cannot determine stability graphically if we don't have numbers for all the parameters. Be able able to determine the values of a parameter that make an equilibrium stable.

11. Maximization (section 3.3)

    Be able to identify local and global minima and maxima but checking the critical points and the endpoints.

    Be able to identify local minima and maxima by checking the second derivative at critical points.