MATH 336: Homework #9

Due: Tuesday, December 5, 2017

Solve the below problems concerning ordinary differential equations. A (possibly improper) subset of them will be graded. All calculations should be done analytically, unless marked with an (M). (M) problems require the use of MATLAB. ES denotes the online lecture notes.

1. (20 points) (ES, p.152, #3) Problem 3 in the ODE7 section of the notes (end of chapter 2). Note that s is assumed constant here, so that the differential equations obtained are **linear**, and can be solved by standard methods from your ODE course.

2. (20 points) (ES, p.152, #4) Problem 4 in the ODE7 section of the notes (end of chapter 2).

3. (20 points) (ES, p.152-153, #5) Problem 5 in the ODE7 sections of the notes (end of chapter 2). For part (c), you should use MATLAB to solve the system of ODEs, and then just plot $p(t)$ vs. t; that is, the first component of the solution as a function of time. Any of the recent HW solutions can be minimally adapted to solve this system; please see me if you have any questions.

4. (20 points) (ES, p.153, #6) Problem 6 in the ODE7 section of the notes (end of chapter 2). I only went over the Goldbeter-Koshland model briefly in class; please read Section 2.7.4 in the ES notes for more details.

5. (20 points) (ES, p.154, #2) Problem 2 in the ODE8 section of the notes (end of chapter 2).

Bonus (20 points) Read the interesting section on a simple cell differentiation model (Section 2.7.3, pages 91-97 in ES), and complete problem 2 in the ODE7 section of the notes. This model elaborates on the idea of how a sigmoidal response and bistability can be used to describe decision making mechanisms inside a cell; for instance, how a morphogen can influence whether a cell differentiates between becoming a "nose" cell or a "mouth" cell.