Applied Math Modeling Takehome, Exam 2 (Spring 2020)

Name:

Directions: **All work should be your own**. Any cooperation or collusion between students will result in a grade of F for the exam and an F for the course. This exam is due Sunday, 4/19/2020, at 11:59pm.

1. This problem refers to an InsightMaker model (available at this link; clone the insight).

   You should

   a. Explain how the parts of this model – stocks, flows, variables – work together to create the interations of Newton's method, for the four built-in functions.

   b. Simulate the model for the four functions, subject to their initial conditions. Capture only one (the best) of the three displays to illustrate what is going on in each case, and explain why the results make sense for that function and that initial condition. You might want to graph the functions to point out what's going on.

   c. Choose a function of your own, with a known root, and choose an appropriate initial condition so that Newton's method requires at least five (but no more than 50) iterations to converge. Make the necessary alterations to the InsightMaker model to incorporate your chosen function as a fifth choice to a user. Show an image of Newton's method operating on your function, using your preferred display.

   Send me a link to your insight when you're done.

2. This second problem concerns non-linear regression.

   An experiment on the relation between the velocity of an enzymatic reaction and the substrate concentration was conducted. The concentrations and observed reaction velocities for an experiment in which the enzyme was treated with puromycin are given by

   $$concentration = \{.02, .02, .06, .06, .11, .11, .22, .22, .56, .56, 1.1, 1.1\}$$

   $$velocity = \{76, 47, 97, 107, 123, 139, 159, 152, 191, 201, 207, 200\}$$

   a. Fit a Michaelis-Menton model to this data,

   $$v(c) = \frac{\alpha c}{\beta + c}$$

   b. **Evaluate the fit**. Include a plot of the data with the fitted model, residuals, and confidence intervals for the parameters.

   c. Interpret α.

Good luck!