M636 Mathematical Modeling

Fall 2015

Instructions: SHOW ALL WORK and STAPLE ALL PAGES

Name: _____

1. In this problem, you will analyze yeast data and then fit various growth models using different techniques. The data is on my web-site under Assignments → Population Dynamics. Perform the following tasks:

   (a) Use the first ($t = 0$) and fifth point ($t = 4$) to estimate the growth rate of the yeast population. Use the first point ($t = 0$) as N_0 and the last point ($t = 18$) as the carrying capacity. Write an explicit formula for the logistic fit obtained with these parameters.

   (b) Use the first 5 data points ($t = 0, 1, 2, 3, 4$) to find the best fit of a logistic-exponential function to the data using a nonlinear square routine ("lsqcurvefit" in MATLAB). Use the values of N_0 and R_0, together with the estimated carrying capacity from (a), to write an explicit logistic-exponential formula for the fitted data.

   (c) Repeat (b) using the logarithm of the first 5 data points ($t = 0, 1, 2, 3, 4$) and fitting a straight line. Write an explicit formula to fit the data using the carrying capacity estimated in (a).

   (d) Perform a nonlinear square fit (using "lsqcurvefit" in MATLAB) of the entire data set by using the exact solution of the logistic growth model as a fitting function. Write the estimated values of initial population N_0, growth rate R_0, and carrying capacity. Write an explicit formula for the fitted data.

   (e) In one graph, plot (in a distinctive fashion) the original data set and the four fitted models (a),(b),(c), and (d). Summarize briefly your results by discussing the accuracy of the models to predict the growing culture.