Math 463: Introduction to Mathematical Biology

Computer Lab Assignment #1

Based on the data in Table 1, we came up with the following simple model for the growth of a bacterial culture:

$$p_{n+1} = p_n + \Delta p_n$$

where p_n is the biomass of the bacteria after n time steps and Δp_n is the change in biomass.

Table 1:

Time (hours) n	Yeast biomass p_n	Change in biomass $\Delta p_n = p_{n+1} - p_n$
0	9.6	8.7
1	18.3	10.7
2	29.0	18.2
3	47.2	23.9
4	71.1	48.0
5	119.1	55.5
6	174.6	82.7

1) Input the data in Table 1 (taken from the yeast culture experiment discussed in Wednesday's lecture) into MATLAB. Plot the change in biomass vs. biomass with circles (plot(x,y,'o')) and do a linear regression for the data. What is the predicted slope and y-intercept? Graph the straight line that fits the data together with the data on the same set of axes. What information does this provide about our model? Use this to simplify the model. Plot the solution of your simplified model together with the experimental data on the same set of axes.

Based on the data in Table 2, we revised our model to be:

$$p_{n+1} = p_n + k(665 - p_n)p_n$$

2) Input the data from Table 2 into MATLAB. Repeat #1, this time plotting the change in biomass vs. $p_n(665 - p_n)$. What is the proportionality constant, k? Plot the observed and predicted yeast biomass as a function of time on the same set of axes.

Table 2:

Time (hours) n	Yeast biomass p_n	Change in biomass $\Delta p_n = p_{n+1} - p_n$
0	9.6	8.7
1	18.3	10.7
2	29.0	18.2
3	47.2	23.9
4	71.1	48.0
5	119.1	55.5
6	174.6	82.7
7	257.3	93.4
8	350.7	90.3
9	441.0	72.3
10	513.3	46.4
11	559.7	35.1
12	594.8	34.6
13	629.4	11.5
14	640.8	10.3
15	651.1	4.8
16	655.9	3.7
17	659.6	2.2