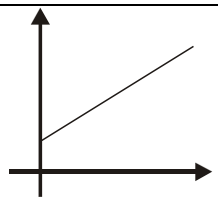
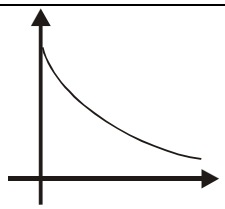
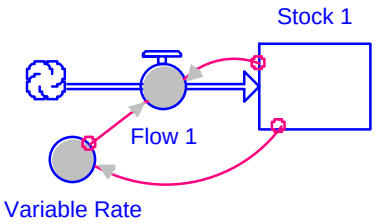
Name_____

MA 261/419/519 **Test #2** **April 13, 2006**

Answer the questions below on this test form. Use the reverse side of a sheet, if needed for a longer answer. Points per question are given in brackets thusly [45].

1. For each line below, match a BOT graph with the appropriate graph description, feedback description(s), and simple Stella model which could produce the BOT graph. Refer to pages 5 and 6 for choices. Note that there are more choices in each category than matches. Make the single best choice in each category, except if there is more than one feedback loop in the model, choose an appropriate feedback description for each loop. [45]

Behavior Over Time (BOT) Graph	**Graph Description**	**Feedback Description**	**STELLA Model**
			
	Increasing at an increasing rate.		
			
		Positive feedback on inflow, and no feedback on outflow.	
			

2. A bakery bakes cookies and only cookies. Each baker on the staff of 12 bakers bakes 120 cookies every day. The cookies pile up in their shop. However, fortunately they are able to sell 85% of their stock of cookies every day. The chief baker constructs the Stella model below to help determine what backlog of unsold cookies will build up in the shop. The model diagram, equations, and a sensitivity analysis for several different initial backlogs of cookies are below on page 7. Answer the following questions about the model. [32]

    a. How many cookies are baked each day? Show how you calculated this number.

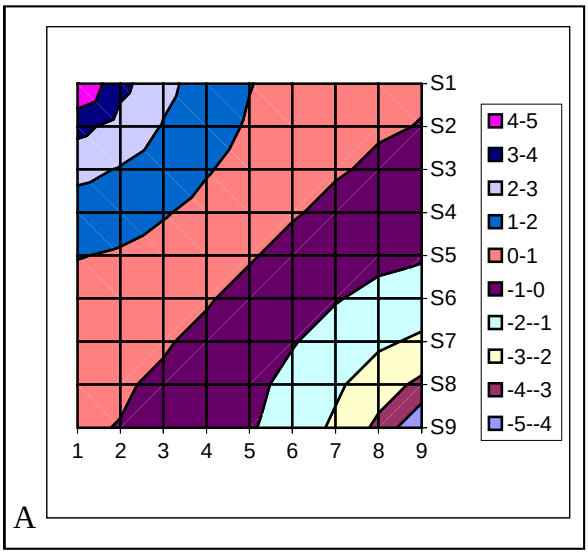
    b. Assuming there are 1000 cookies in the shop to be sold, how many will be sold on that day?

    c. At what number of cookies in the shop does the model tend to stabilize? Show how you calculated this from the initial conditions. Explain in terms of the inflow, outflow, and feedback in the model.

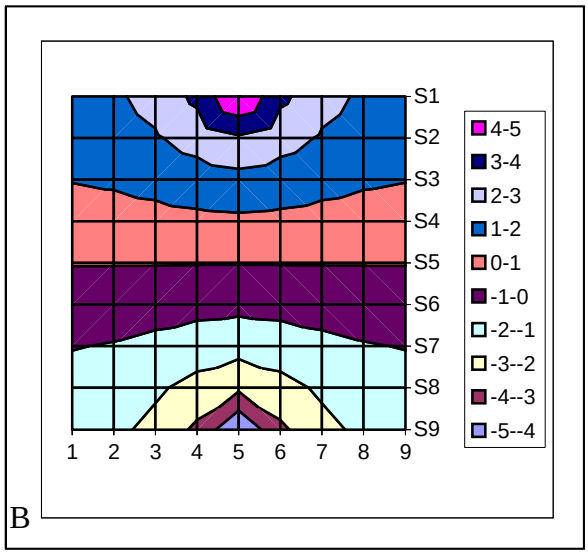
    d. Describe how you could get the model to stabilize at a lower number of cookies in stock. At a higher number.

3. Below is the grid of initial data for a Nearest-Neighbor Averaging Automaton. From the four possible surface graphs, choose the one that best represents the state at which the automaton will stabilize after iteration. Explain your choice. Describe simple initial data for the other three choices. [23]

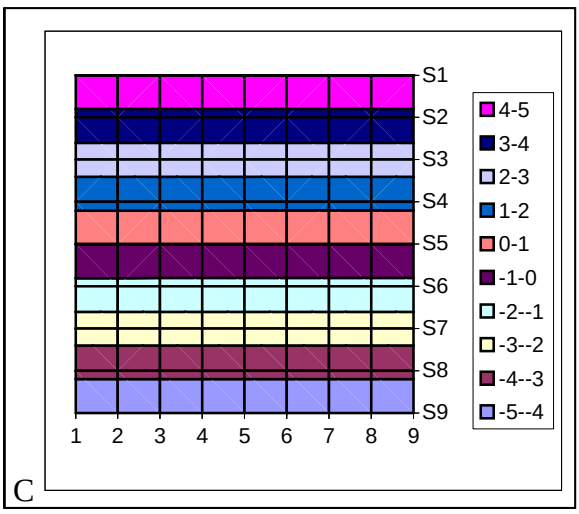
0	0	0	0	5	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	-5	0	0	0	0



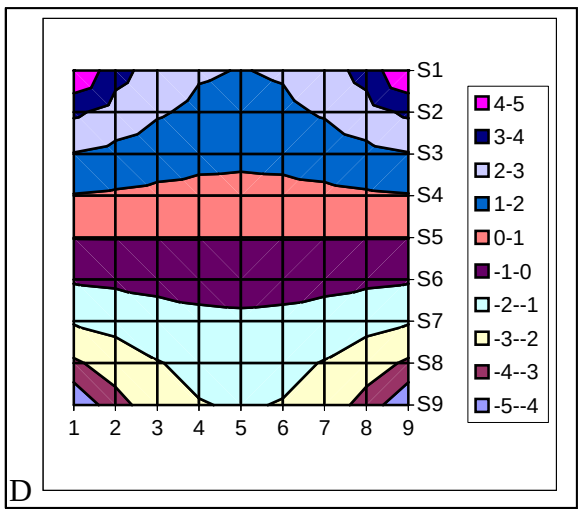
A



B



C

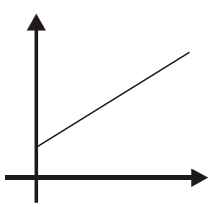


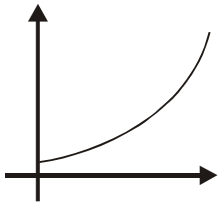
D

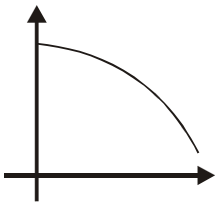
Write your answer for Problem 3 here:

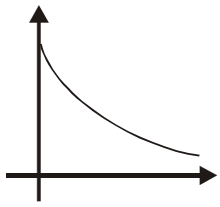
For Problem 1: You need only put the **number(s)** of your choice(s) in the spaces provided above in Problem 1.

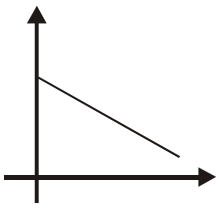
Graph Choices

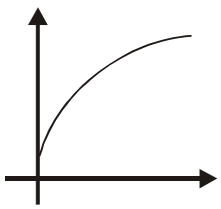

(1)

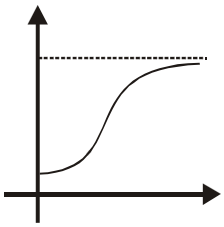

(2)

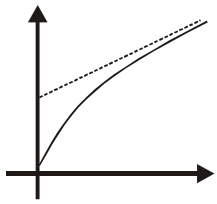

(3)

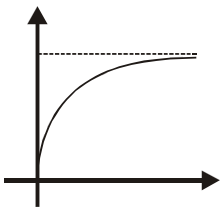

(4)

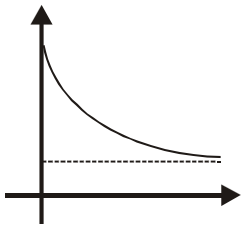

(5)


(6)


(7)


(8)


(9)


(10)

Graph Description Choices

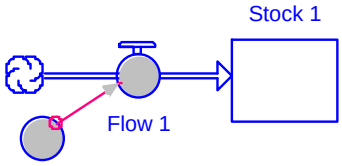
(1) Constant.
(2) Increasing at a constant rate.
(3) Decreasing at a constant rate.
(4) Increasing at an increasing rate.
(5) Increasing at a decreasing rate.
(6) Decreasing at an increasing rate.
(7) Decreasing at a decreasing rate.
(8) Increasing at a decreasing rate, converging upward toward a limit.
(9) Increasing at an increasing rate, and then at a decreasing rate, converging upward toward a limit.
(10) Decreasing at a decreasing rate, converging downward toward a limit.
(11) Increasing at a decreasing rate, converging to a constant rate of increase.

Feedback Description Choices

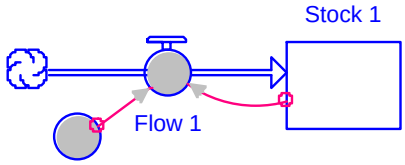
(Note that more than one choice may apply to a given model.)

(1) No feedback on inflow.
(2) No feedback on outflow.
(3) Positive feedback on inflow.
(4) Positive feedback on outflow.
(5) Negative feedback on inflow.
(6) Negative feedback on outflow.

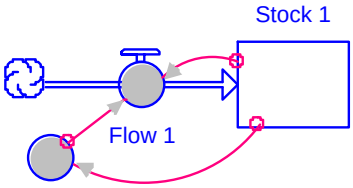
Model Diagram Choices



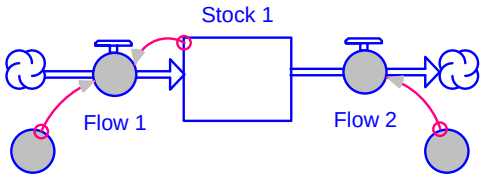
(1) Constant



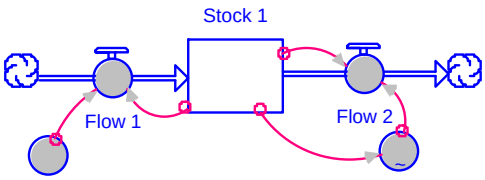
(2) Constant Rate



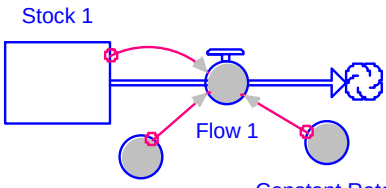
(3) Variable Rate



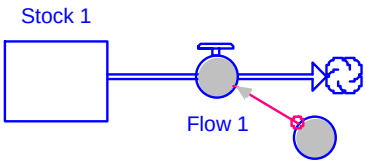
(4) Constant Rate Constant



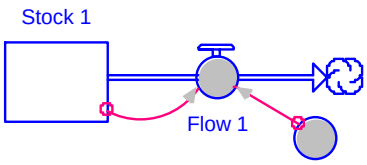
(5) Constant Rate Variable Rate



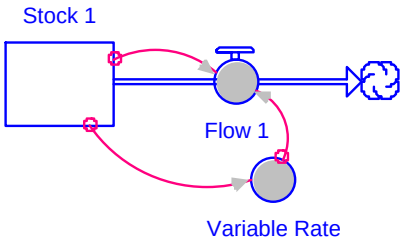
(6) Target Constant Rate



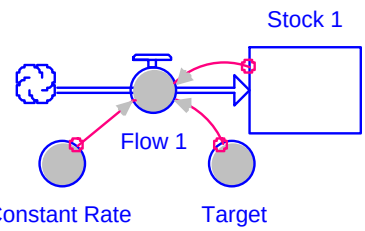
(7) Constant



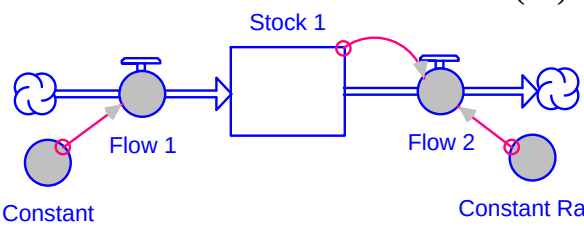
(8) Constant Rate



(9) Variable Rate



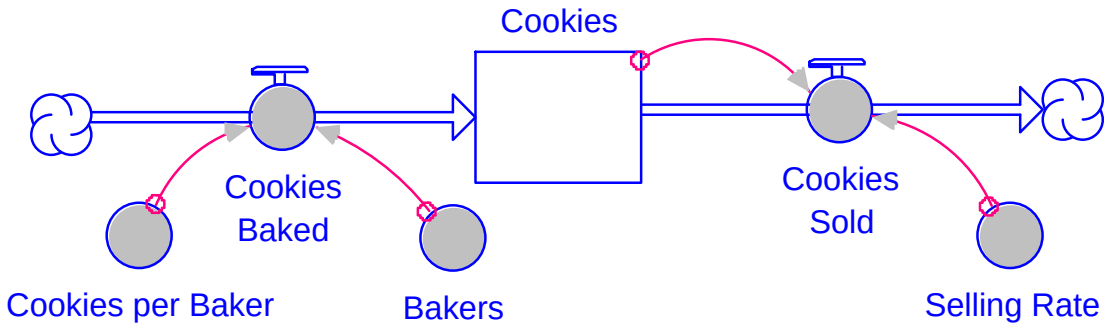
(10) Constant Rate Target



(11) Constant Constant Rate

For Problem 2:

DIAGRAM



EQUATIONS

Cookies(t) = Cookies(t - dt) + (Cookies_Baked - Cookies_Sold) * dt
INIT Cookies = 1000 {cookies}

INFLOWS:
Cookies_Baked = Cookies_per_Baker*Bakers {cookies/day}

OUTFLOWS:
Cookies_Sold = Selling_Rate*Cookies {cookies/day}
Bakers = 12 {bakers}
Cookies_per_Baker = 120 {cookies/baker/day}
Selling_Rate = .85 {cookies/cookie/day}

BOT GRAPH