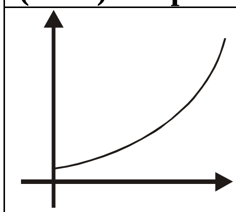
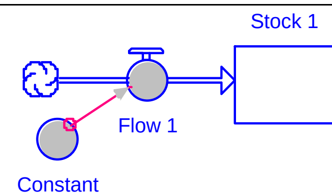
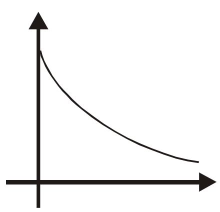
Sample Questions Modeling Test 2

A typical test would contain three of the types of questions below.

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. 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, describe the feedback for each loop.

Behavior Over Time (BOT) Graph	**Graph Description**	**Feedback Description**	**STELLA Model**
			
			
		Positive feedback on inflow, and negative feedback on outflow.	
			
	Decreasing at an increasing rate.		

2. I have just built a fish pond to keep my live fish in. I start initially with no fish. After it is built, each month I buy 10 live fish and put them in the pond. Each

month I eat 20% of the fish in the pond. Refer to the diagram, equations, and BOT graph attached as you answer the following questions.

a. If at some point in time there are 40 fish in the pond, how many fish will I eat that month? Show how you calculated this number.

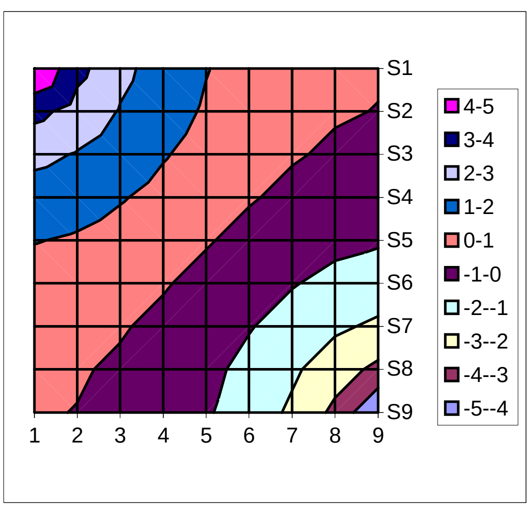
b. At what number of fish does the pond achieve a “steady state?” While you can approximate this from the graph, full credit follows if you show how you can calculate this from the initial conditions.

c. What in the model causes the number of fish in the pond to stabilize at a steady state? Explain in terms of the inflow, outflow, and feedback in the model.

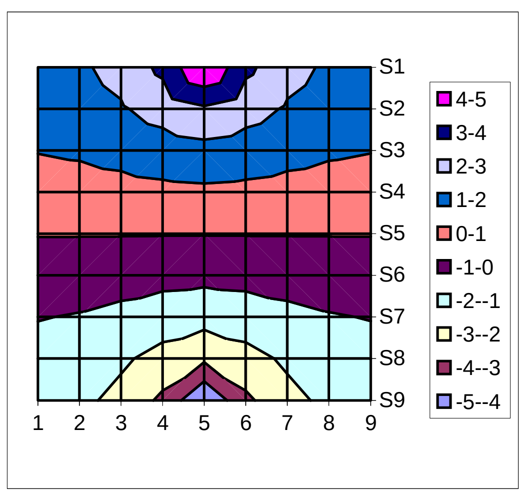
d. Suppose that my pond will actually hold 60 fish. Describe two *different* ways in which I could cause the pond to stabilize at 60 fish.

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.

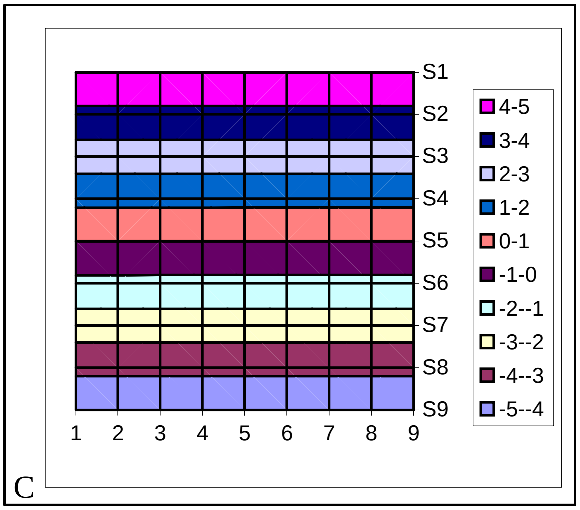
5	0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
-5	0	0	0	0	0	0	0	-5

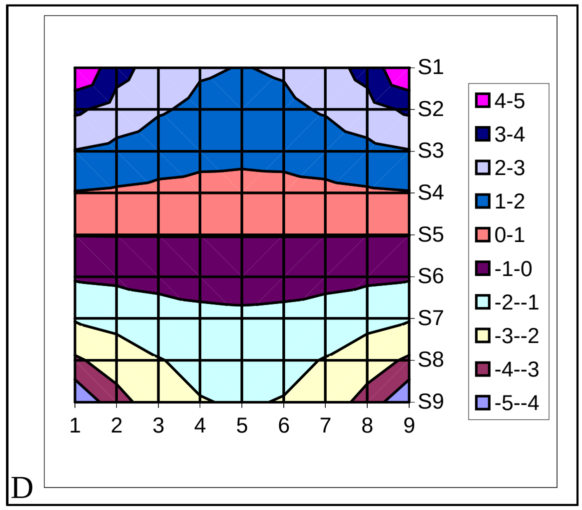


A



B





4. A barrel has a capacity of 50 gallons. Water flows out of it through a drain at the rate of 0.2 gallons/gallon/minute. Assume the barrel initially has 50 gallons of water in it. We set DT = 1, and Stella simulates the barrel draining and reports that the volume of water in the barrel after 1 minute is 40.00 gallons. We set DT = 0.25, and Stella simulates the barrel draining and reports that the volume of water in the barrel after 1 minute is 40.73 gallons. Explain the discrepancy.

5. I hate grading math problems! But I have a class of 24 students and I assign each of them 10 problems each week to do. They always do them all. I stack up the un-graded problems on my desk. I promise myself that I will grade 75% of the problems on my desk each week. I construct a Stella model of this situation in order to determine what kind of backlog of un-graded problems will build up on my desk. That model diagram, its equations, and a sensitivity analysis of different initial backlogs of un-graded problems are below. Answer the questions below about the model.

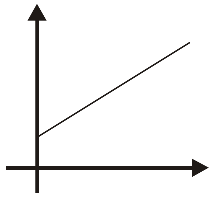
    a. How many problems are added to the stack on my desk each week by the students? Show how you calculated this number.

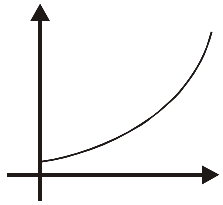
    b. Assuming there are 300 un-graded problems on my desk, how many will I grade in one week? Show how you calculated this number.

    c. At what number of problems does the stack of un-graded problems on my desk tend to stabilize? Show how you calculated this from the initial conditions.

    d. What in the model causes the number of un-graded problems to stabilize? Explain in terms of the inflow, outflow, and feedback in the model.

Graph Choices


(1)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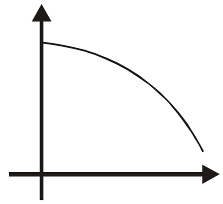
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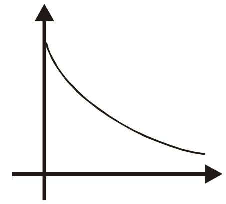
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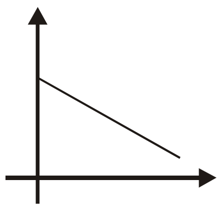
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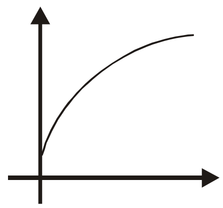
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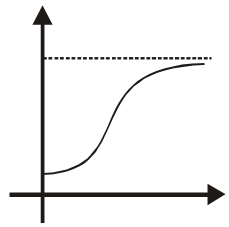
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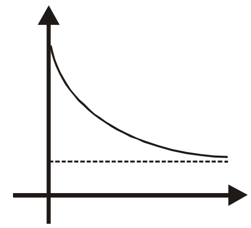

(8)

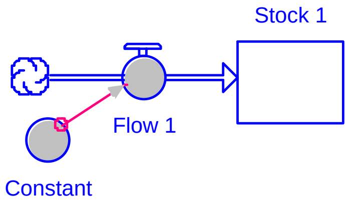
Graph Description Choices

(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.

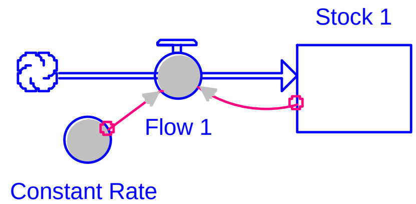
Feedback Description Choices
(Note that more than one choice may apply to a given model.)

(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)



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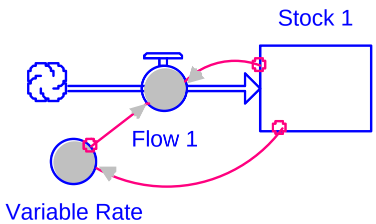

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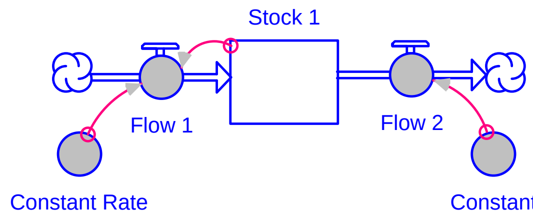
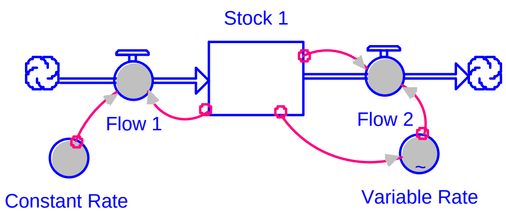


(4)



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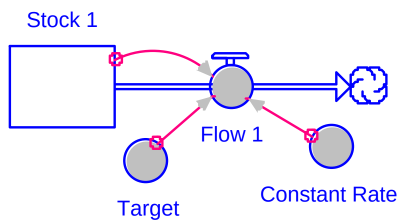

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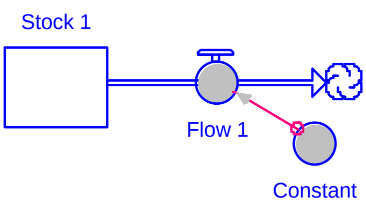

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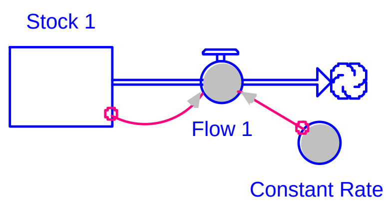

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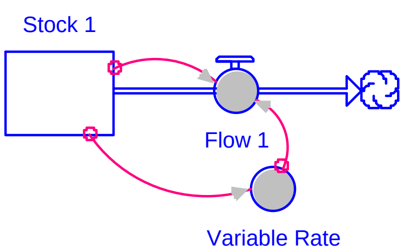

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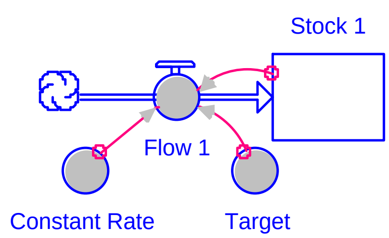
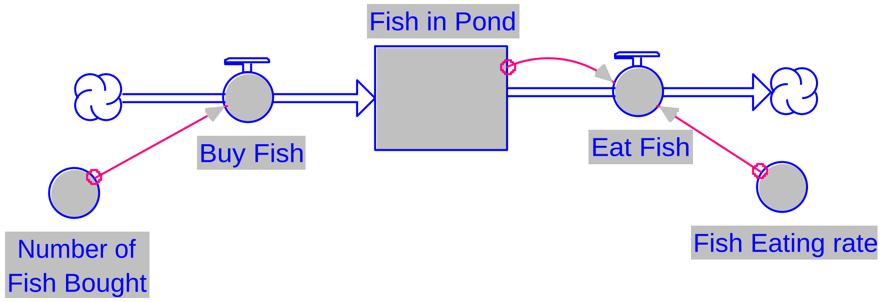


(10)

For Problem 2:

DIAGRAM:



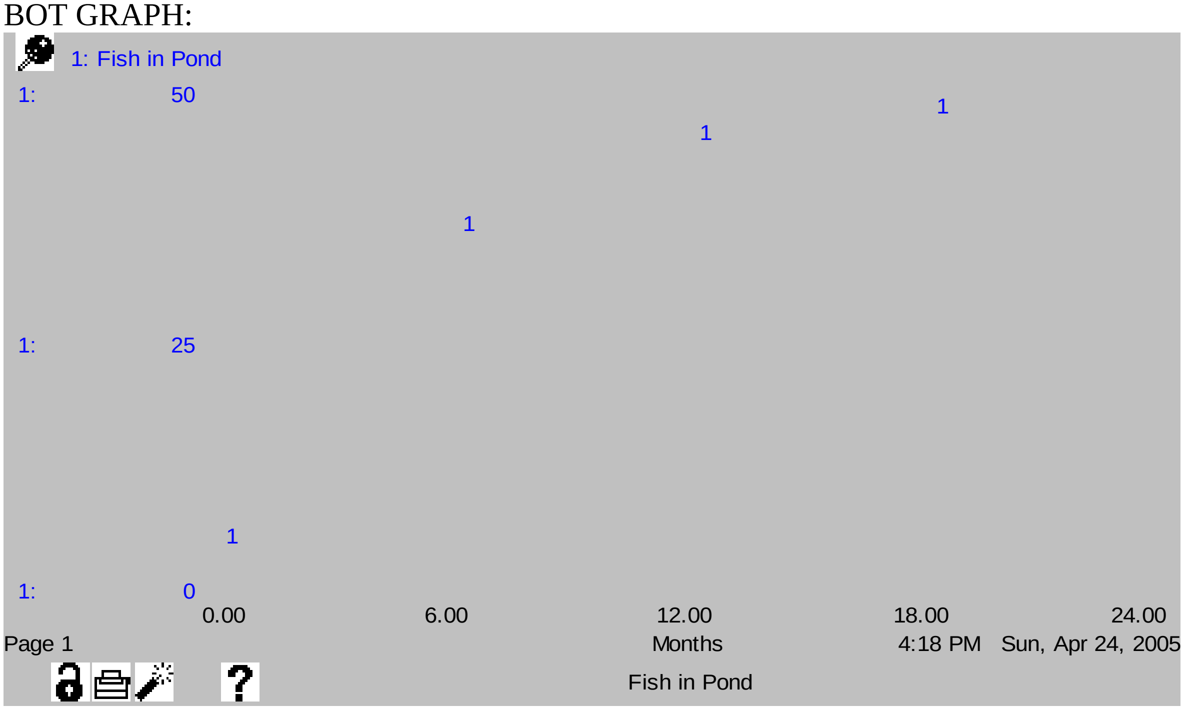
EQUATIONS:

Fish_in_Pond(t) = Fish_in_Pond(t - dt) + (Buy_Fish - Eat_Fish) * dt
INIT Fish_in_Pond = 0 {fish}

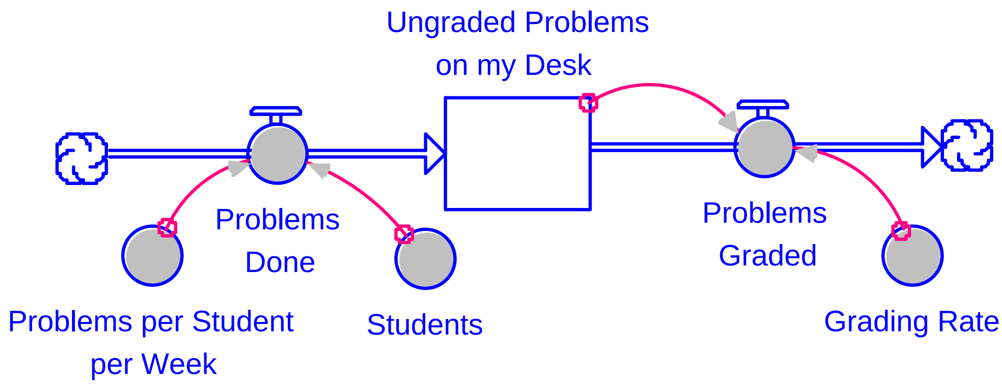
INFLOWS:
Buy_Fish = Number_of__Fish_Bought {fish/month}

OUTFLOWS:
Eat_Fish = Fish_Eating_rate*Fish_in_Pond {fish/month}
Fish_Eating_rate = 0.2 {fish/fish/month}
Number_of__Fish_Bought = 10 {fish/month}

BOT GRAPH:



For Problem 5:



EQUATIONS:
Ungraded_Problems__on_my_Desk(t) = Ungraded_Problems__on_my_Desk(t - dt) + (Problems_Done - Problems_Graded) * dt
INIT Ungraded_Problems__on_my_Desk = 250 {problems}
INFLOWS:
Problems_Done = Problems_per_Student_per_Week*Students {problems/week}
OUTFLOWS:
Problems_Graded = Grading_Rate*Ungraded_Problems__on_my_Desk
Grading_Rate = .75 {problems/problem/week}
Problems_per_Student_per_Week = 10 {problems/student/week}
Students = 24 {students}