Guided Study Program in System Dynamics

System Dynamics in Education Project
System Dynamics Group
MIT Sloan School of Management[1]

Assignment #9

Assigned on: Friday, November 6, 1998

Due by: Monday, November 16, 1998
12:00 PM (Noon)[2]
WE WILL REVIEW THE RESPONSES ON MONDAY AFTERNOONS, BOSTON TIME.
LATE SUBMISSIONS WILL NOT RECEIVE FULL ATTENTION.

Please email assignment solutions, questions, or comments to:

gsp@sysdyn.mit.edu

Save solutions with the filename XYZ-S09.doc
(where XYZ are your initials)

Reading Assignment:

Please refer to Road Maps 4: A Guide to Learning System Dynamics (D-4504-4) and read the following papers from Road Maps 4:

- Beginner Modeling Exercises Section 4, Mental Simulation: Adding Constant Flows, by Alan Coronado (D-4546)

- Problems with Causal Loop Diagrams, by George Richardson (D-3312-1)

Please refer to Road Maps 5: A Guide to Learning System Dynamics (D-4505-4) and read the following paper from Road Maps 5:

- Graphical Integration Exercises Part 3: Combining Flows, by Kevin Agatstein and Lucia Breierova (D-4596)

[2] The deadline is in United States Eastern Time, equivalent to Greenwich Mean Time minus 4 hours during US daylight savings time, and Greenwich Mean Time minus 5 hours for the rest of the year.

Exercises:

1. Beginner Modeling Exercises: Adding Constant Flows

After reading this paper and doing all the included exercises, please answer the following questions by using mental simulation:

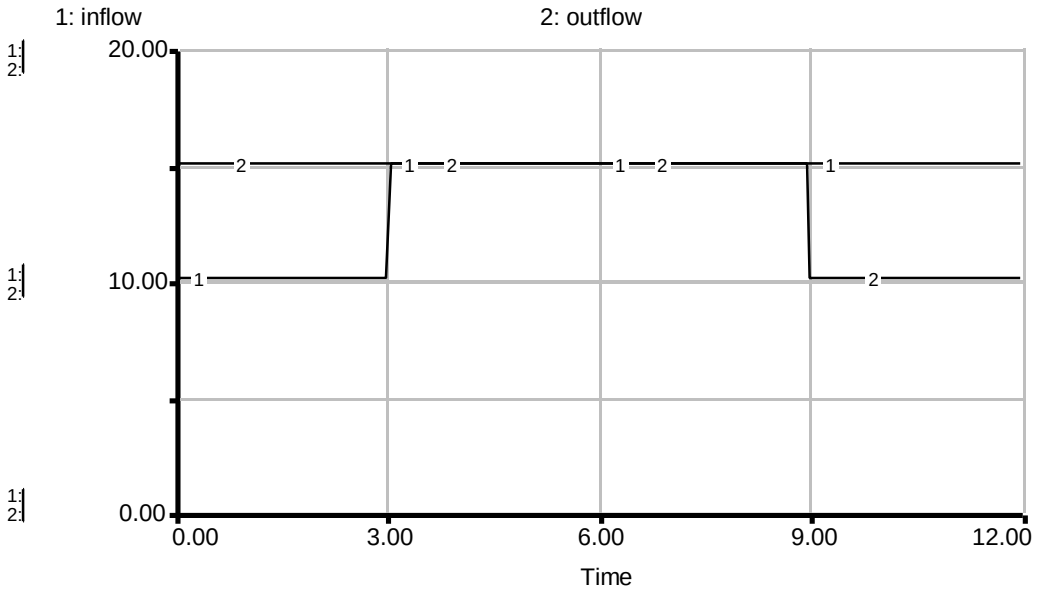
A. Refer back to the scenario in exercise 2 of assignment 8. Imagine that Donald Trump vows to make a quarterly donation of $5,000 (he owns a building on the southwest corner of the park, and hopes that a new botanical garden will attract residents to his building) until the park raises enough money. How does this constant inflow of funds affect the equilibrium time and value of the system?

B. Imagine that, despite Trump's donation, you must pay the architecture firm $10,000 per quarter to retain its services. Such an expense would make sure that the firm does not take on any other major projects that would interfere with the botanical garden, so that construction can commence as soon as you gather all necessary funding. How does this constant outflow of funds affect the equilibrium time and value of the system? Explain the behavior that you observe.

2. Graphical Integration Exercises Part Three: Combining Flows

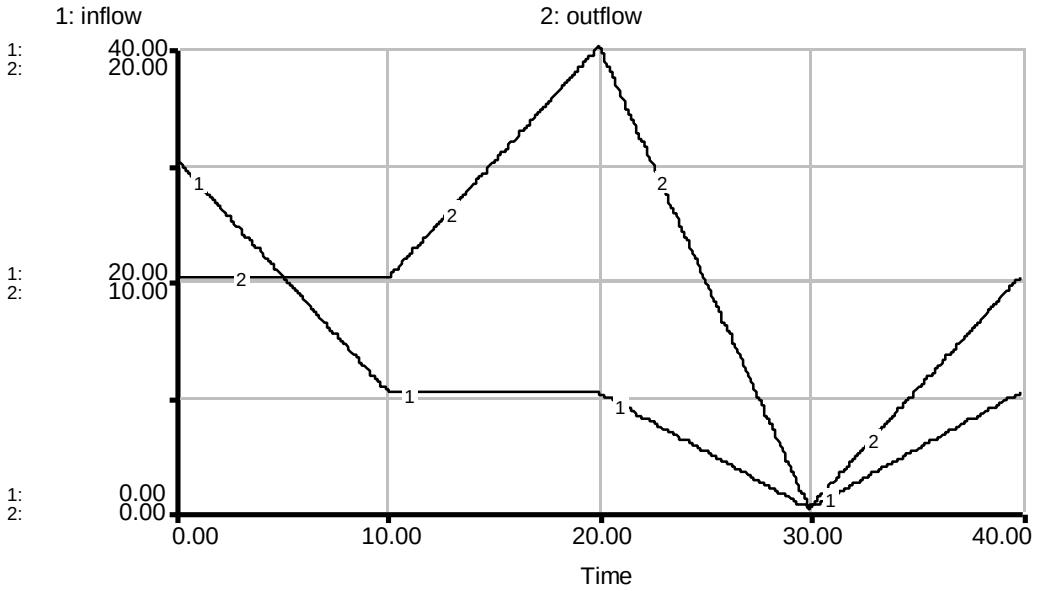
Using the skills you acquired in "Graphical Integration Exercises Part Three," complete the following exercises. For each exercise, first calculate the net flow, and then integrate the net flow. Use a graphics application to create the graphs of the net flow and stock behaviors, and then paste the graphs into your assignment solutions document.

A. Assume that the initial value of the stock is 0.



From time = 0 to time = 3, the inflow is constant at 10. At time = 3, the inflow steps up to 15 and remains at 15 until time = 12.
The outflow is constant at 15 from time = 0 to time = 9. At time = 9, the outflow steps down to 10 and remains at 10 until time = 12.

B. Again assume that the initial value of the stock is 0.



The inflow starts at 30. From time = 0 to time = 10, the inflow decreases linearly with slope of –2. From time = 10 to time = 20, the inflow remains constant at 10. From time = 20 to time = 30, the inflow decreases linearly with slope of –1. From time = 30 to time = 40, the inflow increases linearly with slope of +1.
From time = 0 to time = 10, the outflow is constant at 10. From time = 10 to time = 20, the outflow increases linearly with slope of +1. From time = 20 to time = 30, the outflow decreases linearly with slope of –2. From time = 30 to time = 40, the outflow increases linearly with slope of +1.

3. Problems with Causal Loop Diagrams

Please read this paper carefully. You do not need to answer any questions about the paper, but if you can think of an instance when you had similar problems with causal-loop diagrams, feel free to share the experience with us.

4. Independent Modeling Exercise: Eroding Goals

In assignment 7, you were asked to give examples of systems in which goals are constantly readjusted to match actual performance, creating behavior known as "eroding goals." This exercise will develop a model of such systems.

A. I want to improve my fitness by running every day. I would like to be able to run three miles every day, but right now, I can only run one mile. Therefore, I decided that over a period of two weeks, I should increase the number of miles I can run to make my current running ability equal to my running goal.
Start building the model with a simple goal-gap structure. In your assignment solutions document, include the model diagram, documented equations, and a graph of model behavior. Explain the behavior that you observe.

B. Soon enough, however, I realize that I don't like to lag behind my goal for so long. Hence, I change my goal for running, based on the difference between my current running ability and my current goal, over a period of four weeks.
Modify the model from part A to represent this "eroding goal," and simulate the model. In your assignment solutions document, include the new model diagram, documented equations, and a graph of model behavior. Explain the behavior that you observe.
Hint: What kind of feedback is there between my current running ability and the goal?