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

Assignment #8

Assigned on: Friday, October 30, 1998

Due by: Monday, November 9, 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-S08.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:

- Generic Structures: First-Order Positive Feedback, by Stephanie Albin and Mark Choudhari (D-4474-1)
- Generic Structures: First-Order Negative Feedback, by Stephanie Albin (D-4475-1)

Please download and read the following paper from http://sysdyn.mit.edu/gsp98/

- Mistakes and Misunderstandings: Time Constants, by Kevin Stange (D-4768)

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[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. Generic Structures: First-Order Positive Feedback

After reading this paper and doing all the included exercises, read the following system descriptions and answer questions below:

You are a drug rehabilitation counselor who is given the choice of two school districts to work in. Both districts show initial stages of drug abuse in the student body. Being a concerned and brave soul, you would like to work for the district that will have the greater number of drug-abusers in ten years if you are not present. The two districts you are presented with are Adams and Barton. Through interviews with school administrators, you have identified the following data:

Adams estimates that about 200 high-school students are active drug users. The number of drug users steadily increases because each drug user tends to influence his or her friends to try drugs. Because the student body as a whole comes from wealthy families, cash is not a problem. As a result, every drug user influences approximately 0.2 students to become drug users per year. Without you, the rehabilitation counselor, the school does not expect the number of drug users to decrease.

Barton estimates that about 400 students are currently using drugs in the four grades. Fortunately, because the district is comprised mostly of students from lower-income families with budget constraints, every drug user influences only 0.1 additional drug users. Again, the school does not expect the number of drug users to decrease without your aid.

Both school districts are extremely large, so you can assume that there is no market saturation effect.

A. Calculate by hand which high school you expect to have more drug users in ten years. Explain your calculations in your assignment solutions document.
Hint: Think about the doubling time of each system.

B. Build a model of the system and use the different parameter values to study the number of drug users in each school district. In your assignment solutions document, include the model diagram, documented equations, and graphs of model behavior. Did the model generate results that you expected? Why or why not?

C. In addition to your work, the school administration at Adams is considering inviting a speaker to address the students on the dangers of drug abuse once a year. Administrators predict that the speaker will be able to really reach out to a small percentage of the students and be able to decrease influence to about 0.15 - 0.18 new drug users per current drug user. How does this proposal affect your decision of where to work? Please submit graphs for all relevant simulations you used in attempting to answer this question.

2. Generic Structures: First-Order Negative Feedback

After reading this paper and doing all the included exercises, read the following system description and answer the questions below:

You are the fund-raising director of Central Park in New York City. Whenever you have a particular project in mind, you submit a quarterly funding request to the city Office of Management and Budget, and usually, about 50% of your request is granted (the city is tight-fisted!). You have just received an excellent architectural proposal for a botanical garden and green house in the middle of the park that will cost about $1 million to build. Remember, when you submit a request you must attach the architect's estimated cost statement and request only the difference between the total cost and the amount already granted, so you cannot make requests for absurd amounts of money. For this problem, you should not take interest rates or discounting into consideration.

A. Build and simulate a model to study how much funding you will request in each quarter for building the garden. In your assignment solutions document, include the model diagram, documented equations, and graphs of model behavior.

B. How many fiscal quarters will pass before you are granted 95% of the funds needed for the park (assume you can raise the remaining 5% from private donors once you have the other 95%)?

C. Before you submit your first funding request, you suddenly receive an anonymous gift of $500,000 to be used for the botanical garden project. Model this event into the model from part A. How does this gift affect the number of quarters that will pass before you are granted 95% of the funds needed for the park?

3. Mistakes and Misunderstandings: Time Constants

Please read this paper carefully. You do not have to answer any questions for this paper, but if you can think of an instance when you made the same mistake, feel free to share with us the lesson you learned.