

Guided Study Program in System Dynamics

System Dynamics in Education Project

System Dynamics Group

MIT Sloan School of Management¹

Assignment #15

Assigned on: Friday, January 22, 1999

Due by: Monday, February 1, 1999
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-S15.doc

(where XYZ are your initials)

Reading Assignment:

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

- Dynamic Simulation Models: How Valid are They? by Ray Shreckengost (D-4463)

Please refer to Road Maps 6: A Guide to Learning System Dynamics (D-4506-4) and read the following paper from Road Maps 6:

- Exploring S-shaped Growth, by Leslie Martin (D-4476)

Please refer to Road Maps 9: A Guide to Learning System Dynamics (D-4509) and read the following papers from Road Maps 9:

- Mistakes and Misunderstandings: Table Functions, by Leslie A. Martin (D-4653)
- Graphical Integration Exercises Part Five: Qualitative Graphical Integration, by Manas Ratha (D-4675)

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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. Dynamic Simulation Models: How Valid are They?

Please read this paper carefully. This is a short paper, but very important in developing your modeling skills. You do not need to turn in anything for this paper but you will be asked to use the tests in this paper throughout the GSP.

2. Exploring S-shaped Growth

Please read this paper carefully. It covers fundamentals of the S-shaped growth structure that are vital to your understanding of system dynamics. Pay particular attention to the behavior of the net flow in a system generating S-shaped behavior.

A. How does a stock behave if its net flow is:

- positive and increasing in magnitude
- positive and decreasing in magnitude
- negative and increasing in magnitude
- negative and decreasing in magnitude
- positive throughout, first increasing then decreasing in magnitude
- negative throughout, first increasing then decreasing in magnitude

B. Find a way to improve the healthy Immune Response model.³

Hint: the formulation for the “destruction” of “Foreign Cells” is flimsy. The time for white blood cells to destroy a foreign cell is not constant, but changes with the density of foreign cells. The correct formulation should not use an IF THEN ELSE statement.

3. Mistakes and Misunderstandings: Table Functions

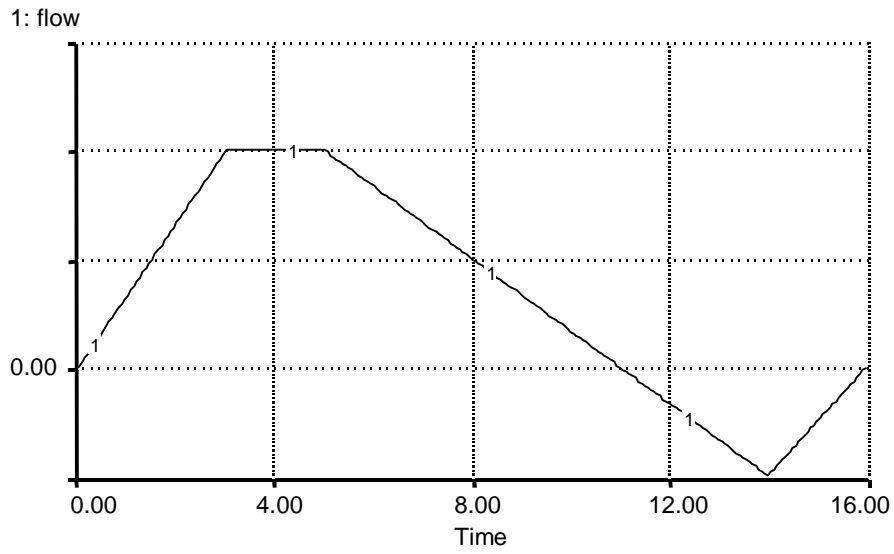
Please read this paper carefully. You do not have to answer any questions for this paper, but please let us know if you have any questions or comments about it.

4. Graphical Integration Exercises Part Five: Qualitative Graphical Integration

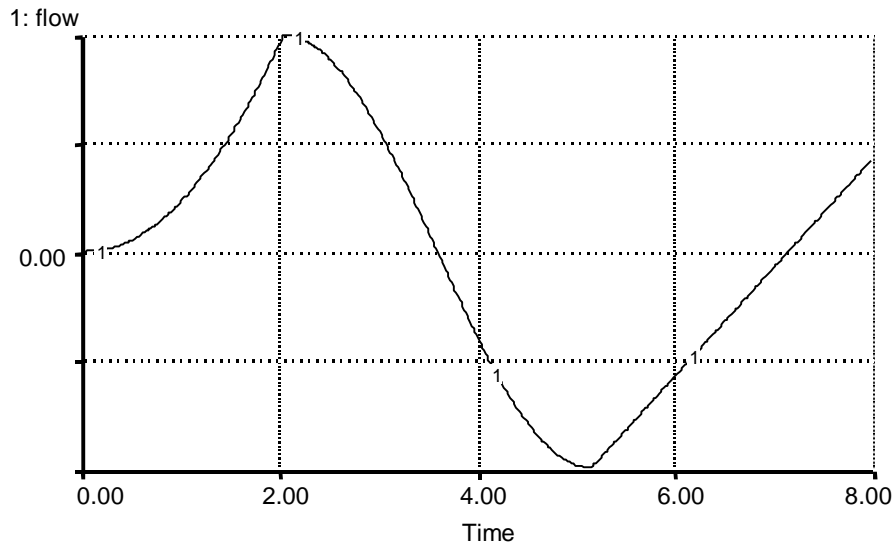
Please read this paper and do all the included exercises. Based on the skills that you acquired from this paper, integrate the following flows.⁴ Assume that the initial values of the stocks are zero.

³ The model in “Exploring S-shaped Growth” contains a unit error in the formulation of “strength of proliferation.” “Antigens” has units of antigens, and both “strength of immune response” and “strength of proliferation” are dimensionless. The “strength of immune response” should have units of 1/antigens. We apologize for the confusion.

A.



B.



⁴ Use a graphics application to create a graph of the stock behavior and then paste the graph into your assignment solutions document. You can also draw the stock behavior by hand and fax it to us at (617) 258-9405, or you can provide a detailed verbal description of the stock behavior.