Non-Linear Systems Using STELLA II

Note: See review STELLA II diagrams at the end of this document before starting.

1. The train was leaving the station. It was accelerating at 20 miles per hour per hour. Jason was .4 mil behind the rear car of the train, talking to his girlfriend, when he realized it was moving. The train was moving at 5 miles per hour already. He took off sprinting. He was running a constant 10 miles per hour but could only run that fast for 10 minutes. (He wasn't in shape.)

   a. Prediction:
   Do you think Jason will catch the train?_____
   Support your answer._____
   _____

   b. Modeling:
   Design two STELLA II diagrams for this situation.
   1. Jason is running at a CONSTANT speed. So his position over time is changing at a (linear/quadratic) rate.
   2. Set Jason's initial position to 0. Place an appropriate value in the flow converter.
   3. The train is ACCELERATING at a uniform rate so its position over time will be changing at a (linear/quadratic) rate.
   4. Start the train position at .4. Start the velocity of the train at 5. Set speed = velocity. Set an appropriate value for the acceleration flow.

   c. Set up a graph.
   Place only Jason's position and the train's position (stocks) in the selected box. Set the vertical scale for both variables from 0 to 8. Set DT = .1 and end of simulation to 1, under the run/time specs menu. Set Run/Simulation Specs to Runge-Kutta 4. Run the simulation.
   Does Jason ever catch the train?_____

   d. Go back to the diagram and set Jason's speed to 8 miles per hour. (Assume he can maintain this speed for only 15 minutes.)
   (You may need to set up a table to answer these questions. Include the train's position and Jason's position in the table.
   1. Does Jason catch the train?_____
   2. If so, when does he catch the train?_____
      If not, how close did he get to the train?_____

   e. 1. If Jason had been .6 miles behind the train and ran at 10 miles per hour, could he have caught the train? _____Why or why not?_____
      _____
      Print out the graph to support your answer.
      2. If Jason was .4 mile behind the train and running at 10 miles per hour, but the train was accelerating at 40 miles per hour per hour, could Jason catch the train?_____ Why or why not?_____
      _____

2. Alexandria and Minh are financial advisors. You want to make an investment so you can have extra money when you retire. Alexandria suggests depositing 2000 in the bank and let the bank compound the interest at 10% per year. (nice bank) Minh suggests placing $2000 in your personal safe and depositing an additional 2000 every year.

a. Prediction:
At the end of 30 years which plan do you think will have more money?_____
Do you think the difference will be a lot of money or a little?_____
Do you think the two plans will ever have the same amount of money saved?_____

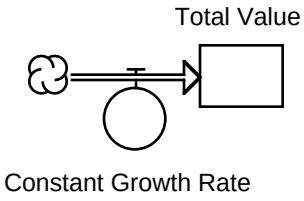
b. Modeling:
Set up two STELLA II diagrams for this situation.
1. Alexandria's plan will have your money grow at a (linear/quadratic/exponential) rate.
2. Set Alexandria's initial money to 2000. Place an appropriate value in the growth flow.
3. Minh's plan will have your money grow at a (linear/quadratic/exponential) rate.
4. Set Minh's initial money to 2000. Place an appropriate value in the growth flow.

c. Set up a graph including only Alexandria's and Minh's money plan. Set the vertical scale for both variables 0 to 300000. Set DT = 1 under Run/Time Specs. Set the end of the simulation time to 50.
1. Whose plan had more money at the end of 30 years?_____ How much more?_____ _____
2. Suppose you decided to invest for 50 years instead of 30. Whose plan had more money? _____ How much more?_____
3. Were the amounts ever the same?_____ If so, at what time were they the same?_____ (You might want to set up a table to answer this question.)

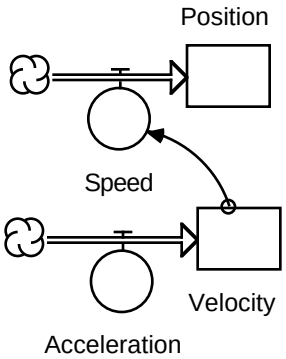
d. Banks do not have uniform interest rates over time. Whose plan is better after 50 years if the interest rates average 8% instead of 10%?_____

e. Whose plan do you think you would adopt? _____
Why?_____
_____

Linear Growth



Quadratic Growth



Exponential Growth