Linear Systems Using STELLA II

1. The train was carrying the monthly payroll on that warm summer day. Billy the Kid knew it and planned to add the payroll to his hidden mountain cache. The train had just left Las Cruces heading for Deming, New Mexico and was clipping along at 20 miles per hour. Billy was 3 miles behind the train when he started to chase it. His horse was able to run 25 miles per hour. Pat Garret was at a party in Las Cruses when a messenger told him about seeing someone riding after the train. By the time Pat Garret was able to start his pursuit he was 2 miles behind Billy. Pat's horse was only able to run 24 miles per hour, and could only run that speed for 1 hour before collapsing.

   A. 1. Do you think Pat caught up with Billy before Bill caught up with the train? _____ Why or Why not?_____
   2. Do you think that Pat was able to catch the train?_____ Why or why not? _____
   _____

   B. Set up a STELLA diagram to model the train's position, Billy's position, and Pat Garret's position. Each will have a stock and a flow. The flow will be its speed. Set Pat's starting position to 0. Choose Time Specs... from the Run menu. Set the model simulation time for 2 hours, and the DT to .1. **Print** out a graph of the three stocks with a vertical axis of 0-50 for all 3. **Print** a table for the model.

   C. Did Billy catch the train?_____ If so, at what time after the simulation started did he catch the train?_____ Did Pat catch Billy before Billy caught the train?_____ If so, at what time?_____ If not, when did Pat catch the train?_____

   D. What distance and length of time had each horse run before their riders caught the train?

	Distance	Time
Billy's Horse		
Pat's Horse		

2. The starship Enterprise must shoot a laser at a meteor on a collision path with the planet Epsilon. Both the starship and the meteor are traveling in the same direction toward Epsilon. The meteor is currently 200000 miles ahead of the Enterprise and is traveling at 200000 miles per hour. The Enterprise is traveling 219500 miles per hour. The starship has a laser that it will fire when it is within 10000 miles of the meteor. The meteor is due to strike Epsilon 10 hours from now (It is 2000000 miles away). We want to know if the Enterprise will be successful in its mission.

   A. Predict whether the Enterprise can change the meteor's direction in time?_____
   Support your prediction_____
   _____

   B. Set up a STELLA diagram for this situation. Include a stock for the planet Epsilon, as well as one for the meteor and the starship. Set up flows for the meteor and the starship. Set the Enterprise starting position to 0. Choose Time Specs... from the Run menu. Set the simulation time to 12 hours and the DT to .1. **Print** out a graph of the three stocks with a vertical axis of 0 to 2.5e6 for all three. **Print** a table for the model.

   C. If the Enterprise saved the planet, at what time was the meteor deflected? _____
   If the Enterprise did not save the planet, how much faster would it have had to travel to save the planet?_____

   D. (optional) Figure out the smallest speed that would have worked for the Enterprise to save Epsilon._____

3. You and a friend have decided to go camping. You set up a tent 50 miles north of town. Some no-account ruffians have played a trick on you by planting a (sound) bug in your gear. They are rather clever an have set up some repeaters between themselves and your camp and have camped up-stream

35 miles from your camp. After lunch you and your friend are listening to the radio and learn that you have a winning lottery ticket in your possession. You are ecstatic and both decide to canoe back to town immediately to claim your prize. The spies decide to try to intercept you and steal your ticket before you reach town. If you and your friend can paddle 5 miles per hour, traveling with the 3 mile per hour current, and the spies (with a small motor boat) can travel 10 miles per hour with the current, we want to know if they intercept you before you reach the town.

A. Prediction: Will you reach the town first? _____ Why or why not?_____
_____

B. Set up a STELLA diagram for this situation. Set a stock for the town and set it's initial value to 85. Set a stock and flow for your position, and one for the spies position. Choose Time Specs... from the Run menu. Set the simulation to run for 12 hours with a DT of .1. **Print** out a graph of the three stocks on a vertical axis of 0-100. **Print** a table for this model. Answer the following questions:

1. Did they intercept you before you reached the town?_____ How did you figure out the answer? _____
2. How long did it take you to reach the town? _____ How long did it take the spies to reach the town? _____
3. What is the mathematical equation for determining your position at any given time? _____
   From the equation determine how far you had traveled in 5 hours. _____ Does the table also give the same position for this time? _____
4. What is the mathematical equation for determining the spies position at any given time?_____
5. If the town had been 100 miles away instead of 50 determine, **mathematically**, when the spies would have overtaken your canoe. Show your work here.

   Is your answer the same as the answer in the STELLA table? _____
6. What were the winning numbers of your lottery ticket (:D) _____