GX2796

OLLSCOIL NA hÉIREANN
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II, SUMMER 2001 EXAMINATION

Masters in Information Technology (NUI,G / IMI Programme)

Algorithms (Problem Solving) CT510

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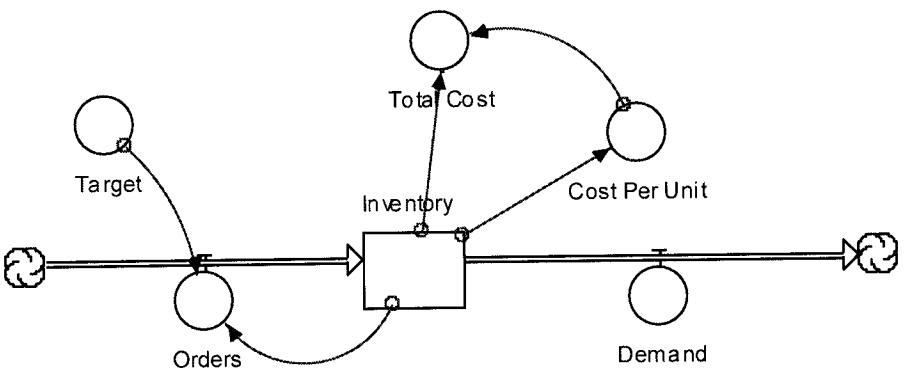
Time Allowed: 2 hours
Answer any THREE Questions.

1. With a value of DT = .25 and SIMULATION LENGTH = 2, generate equations and a paper-based simulation based from the diagram shown below.



Assume that:

- Demand is constant at 1000 units
- The initial inventory is 0
- The Target Inventory is 500
- The orders are the target minus the current inventory level.
- The cost per unit is £0.50 if the inventory is positive, and £2.00 if the inventory is negative.
- The total cost is the current inventory level x cost per unit

2. For the following problem descriptions: (1) generate causal loop diagrams; (2) identify feedback loops; and (3) speculate on system behaviour.

   - An increase in the Price of Oil leads to an increase in Profits. As Profits decrease, the amount of Oil Produced increases. As the amount of Oil Produced decreases, the Price of Oil gets higher.

   - An increase in Goods Produced increases Stock. An increase in Demand reduces Stock. As Stock increases, Goods Produced decreases.

   - An increase in Buying Rate reduces Market Inventory. An increase in Harvest Rate increases Market Inventory. As Market Inventory increases, the Price decreases. An increase in Price leads to an increase in Planting Rate. An increase in Planting Rate leads to an increase in Harvest Rate.

3. Based on an analysis of course completion rates in a University, it was found that these rates could be accurately modeled using a first order exponential delay. Given that the average duration of a course is four years, develop:

   - A system dynamics diagram (assuming that the number of graduates is also modeled)

   - A set of system dynamics equations

   - A graph of Numbers Entering vs Numbers Completing, assuming that we have a once off entry of 1000 students at the start of the simulation. Assume DT = 1 and the simulation length is 5.

4. (a) Explain the difference between:

   - A *feedback loop* and a *feedback system*
   - *Positive feedback* and *negative feedback*

   (b) Develop a causal loop diagram for the following model of the internet. Identify any feedback loops and speculate on the overall system behaviour.

   As Network Bandwidth increases so too does Quality of Service. When Quality of Service goes down, so too does Consumer Demand. As Consumer Demand increases, Quality of Service falls. An increase in Consumer Demand leads to an increase in Investment. Further Investment, in turn, leads to an increase in Network Bandwidth.

5. For the Air Conditioning System (ACS), draw a system dynamics diagram and write a set of equations.

   The ACS reacts to increases in room temperature to produce more cool air, and reducing the accumulation of heat in the room. Heat is gained in the room based on the following equation:

   Heat Gained = (Outside Temperature – Room Temperature) / Time Constant

   The Time Constant is a measure of the room's insulation: the higher the value, the longer it takes for the room to gain heat.

   The amount of cool air produced by the climate control system depends on the target value (i.e. the desired room temperature), and the current room temperature:

   Cool Air Produced = Room Temperature – Target Value