

## Homework 10 – for extra credit

Construct a YASAI model for the model below, and hand in the standard printouts. (Three Excel sheets and your answer in words; see course webpage for details.) Notice that the deadline is different from the usual – **next Monday**. Make sure that you **cut your final solution**, do not print out 100 identical rows of the spreadsheet. Also, make sure that the **table headings are displayed** on the printouts!

1. (25 points) You work for a pharmaceutical subcontractor that has genetically engineered small trees to produce a medically useful protein in their sap. You plan to set up a greenhouse containing either 55, 60, 65, or 70 of the trees. Each day, each tree produces a random amount of sap, independent of the other trees, averaging 0.39 liters, with a standard deviation of 0.21 liters, with the exact distribution unknown. Each tree costs \$4.25 per day to maintain. This amount contains all the costs that arise from growing the trees, harvesting the sap, etc.

Each day you expect to receive a random number of orders for the sap from your customers. Each order is for exactly one liter of sap, and you expect the number of orders to be well-described by a Poisson random variable with a mean value of 23.5. You receive \$29.50 for each order you fill.

The protein in the sap degrades extremely quickly unless it is kept under very special conditions. Therefore, you must put the extracted sap in a special storage unit, immediately after harvesting. In the special storage units you have access to the protein degrades in 48 hours after harvesting. Outside the storage units it degrades almost immediately. (The customers take their order in their special storage units, you need not worry about that.) There are four possible kinds of storage units, holding 5, 10, or 15 liters, with respective total costs per day of \$25, \$35, and \$42.50. You can buy as many of each these units as you want, in any combination you prefer.

You start each day by harvesting sap from the trees, and storing them in the storage units early in the morning, before the orders of that day arrive. All excess sap, that does not fit in the storage unit, must be discarded. You cannot ship partial orders. Any orders that you cannot meet in full are lost and cannot be “backordered”. However, you are allowed to mix sap harvested on different days to fill an order.

**Determine which combination of storage units and number of trees would give you the highest expected average profit per day, and estimate the average amount of discarded sap per day for the optimal solution.** Simulate 100 days with each combination; make 200 experiments for each scenario. (Note, depending on how you set up the problem, the simulation might take up to a few minutes!) Assume you start with empty storage units.

Due on **Monday, December 10**, in class.