Show all your work for credit. Total: 50 Points

1. (25 Points) SuperSauce produces a certain type of salad dressing. The demand for this dressing is about 400 pounds per month. To initiate production, the machines have to be thoroughly checked and cleaned and it costs the company $120 per setup. The production time is very short, so let’s assume that it’s 0 – the total production quantity is available immediately. The cost to produce this dressing is $3 per pound, and the inventory holding cost is estimated at 20% annually. If the demand for this dressing exceeds the available inventory, it is backlogged. Management estimates that the backlog cost is $1.2 per pound short per month.
   a. Find the optimal production quantity. (3pts)
   b. Find the optimal backlog quantity. (3pts)
   c. Find the number of production runs per year. (1pt)
   d. Find the average annual cost. (3pts)
   e. Assume the production rate is slow, about 2000 pounds per month. Derive the average annual cost function for this case. (10pts)
   f. Derive the optimal production quantity and the optimal backlog quantity (5pts)

2. (12 Points) LoEnd, a small computer company, buys two types of low-end CD-ROM drives. Because of the small volume of this company, the manager limits the investment in inventory to a maximum of $5000. The prices of these two drives are $50 and $80, respectively, and the annual demand for these two drives is 250 and 484 units, respectively. The company has to spend $50 to process the order of either of these two drives, and the manager uses 20% annually for financial evaluations.
   a. Formulate the constrained optimization problem for LoEnd. (3pts)
   b. Formulate the Lagrangean and write the first-order conditions. (3pts)
   c. Solve for $Q_1^*$ and $Q_2^*$ starting with the first-order conditions in part b. (6pts)

3. (13 Points) Mikel Sports uses a screen-printing textile printer to manufacture three kinds of T-shirts. There is a setup cost to start producing each type of T-shirt. Holding costs are based on a 20% annual interest rate, and the T-shirts are to be produced in sequence on a rotation cycle. Setup times can be assumed to be 0. Other relevant information is given below:

<table>
<thead>
<tr>
<th>T-shirt type</th>
<th>Annual demand</th>
<th>Setup cost</th>
<th>Unit cost</th>
<th>Annual production rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2000</td>
<td>70</td>
<td>15</td>
<td>36000</td>
</tr>
<tr>
<td>2</td>
<td>5000</td>
<td>110</td>
<td>17</td>
<td>36000</td>
</tr>
<tr>
<td>3</td>
<td>1000</td>
<td>50</td>
<td>21</td>
<td>18000</td>
</tr>
</tbody>
</table>

   a. What is the optimal time between setups for T-shirt number 3? (3pts)
   b. What is the percentage of time that the printer is idle, assuming an optimal rotation cycle policy? (3pts)
   c. What are the optimal lot sizes of each part put through the printer at an optimal solution? (3pts)
   d. What is the total annual cost of holding and setup for these items on the printer, assuming an optimal rotation cycle? (4pts)