Warning: This is a long homework assignment, but you should be able to start most of the problems (especially those on pages 2) immediately. I recommend that you read the Glu-Lam case and organize your teams very soon, but wait until after the lecture on 9/13 before you start to work on it seriously.

0. Prepare the Glu-Lam case (which appears in the course reader) in small groups (about 4 students). DO NOT ANSWER THE QUESTIONS AT THE END OF THE CASE. Instead, do enough “back of the envelope” analysis to help you decide on an overall procurement and shipping strategy. (In other words, roughly how should the system operate?) Then, for that strategy, determine appropriate operating parameters. (For example, if you decide to use a (s,S) policy for each beam size, determine “good” s and S values. These values need not be exactly optimal, but should be close enough for practical purposes.) Also, provide an estimate of the cost of the system.

In your case write-up, you should provide the following:
(a) a one-paragraph description of the main issues facing the company.
(b) a list of all assumptions, with a brief justification for each.
(c) an explanation of why you chose your selected strategy.
(d) your analysis, with enough detail so that the instructor or TA can understand it.
(e) your recommendations and an estimate of the annual cost of your system (within 5%).

The write-up should be legible, logically organized, and clearly written. If you include figures or tables, your write-up should include references to these figures and tables and brief explanations of them.

To conduct your analysis, you may find it helpful to develop a spreadsheet model.

Hint: The expected number of units short if demand has a Normal distribution with mean 0 and standard deviation 1, assuming that safety stock is set to z standard deviations above the mean is

\[ L(z) = z\Phi(z) + \phi(z) - z \]
\[ L(-z) = L(z) + z \]

where \( \Phi(z) \) is the cumulative distribution of the standard Normal and \( \phi(z) \) is the probability density function of the standard Normal. From the above formulas, you can compute \( L(z) \) using Excel. Your approach to the problem may not require these formulas, but I have provided them just in case.
1. A professional services business (for example, a law firm or accounting firm) uses promotional brochures at a fairly constant rate during the year. The marketing manager at the accounting firm of Fastow and Sullivan is trying to revive business while the two partners are on leave due to “governmental commitments.” She has identified two potential suppliers for the firm’s main brochure, for which the annual demand is expected to be about 6,000.

The Big Batches Printing Company offers the following all units discounted price schedule:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2999</td>
<td>$5.00</td>
</tr>
<tr>
<td>3000-5999</td>
<td>$4.75</td>
</tr>
<tr>
<td>6000+</td>
<td>$4.50</td>
</tr>
</tbody>
</table>

The As-You-Like-It Company offers the following incremental units discounted price schedule:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1500</td>
<td>$5.00</td>
</tr>
<tr>
<td>1501-3000</td>
<td>$4.75</td>
</tr>
<tr>
<td>3001+</td>
<td>$4.50</td>
</tr>
</tbody>
</table>

The price per unit includes delivery. The purchasing manager estimates the administrative cost of processing an order to be approximately $25, and the firm uses an annual inventory holding cost rate of 50% because of the chance of obsolescence. What should the office manager do?

2. A well-known “warehouse” store has a contract with a manufacturer for its “store-brand” 33-gallon trash bags. The warehouse store pays $8 per package and sells a package for $10. Daily demand averages about 300 packages and has a standard deviation of 60. The store is open 350 days per year. The manufacturer is in another state and charges $750 per truck for each delivery. Each truck can hold up to 5000 packages and takes 2 days to travel from the factory to the warehouse store. According to the terms of the contract with the manufacturer, the order quantity is restricted to be a multiple of 100. The store uses an annual holding cost rate of 80% for paper and plastic goods.

(a) Suppose the manager wants to maintain a 2% chance of not stocking out during the lead time. What order quantity and reorder point would you recommend?

(b) The customer service department is concerned that many customers are complaining about shortages of trash bags, which is one of the most popular products. This department would like to have a fill-rate of 99.9%. What inventory control policy would they implement?

(c) The manager is thinking about offering more expensive “name-brand” trash bags to customers for the same price as the “store-brand” if the “store-brand” is out of stock. A package of the “name-brand” trash bags costs $9 and sells for $12. Under this policy, what should the inventory control parameters be?

Note: You will find it educational to also solve parts (b) and (c) without restrictions on the order quantity.

3. The warehouse store in Problem #2 has a lot of market power. It has convinced its supplier to build a warehouse nearby and to provide vendor-managed-inventory (VMI) services—including delivery—free, with inventory being delivered on consignment. Under a vendor managed inventory system, the warehouse store no longer sends orders to the supplier. Instead the supplier
is responsible for managing the inventory according to some rules that are mutually agreed upon by the buyer and supplier. Under a consignment system, the buyer does not pay the supplier for the goods until the buyer has sold the product. Thus, the supplier owns the inventory and incurs the financial cost of holding it until it is sold.

It costs approximately $50 for the supplier to make a delivery, and $6.00 for the supplier to manufacture a package of trash bags. The supplier uses an annual inventory holding cost rate of 80%. The supplier plans to check the inventory status at the end of each day, and expects to be able to make a delivery by the end of the following day.

The warehouse store has asked for a 98% probability of no stockout during the order cycle, but the supplier also recognizes that each shortage will result in a lost sale, and it will therefore lose its profit if a shortage occurs.

For simplicity, you may assume that a year has 50 weeks, and each week has 7 working days. (That is, deliveries can be made on any day of the week.)

(a) How often should the supplier send a truck to the warehouse store?

(b) Use the Newsvendor model to estimate the economically optimal probability of no stockout during the order cycle.

(c) How should the supplier operate the VMI system?

Note: You will find it educational to also solve part (c) without restrictions on the order quantity.
4. A local stationary store is well-known for its excellent selection of products, and is one of the only stationary stores in the area to stock A4 paper, which is a paper size that is commonly used in Europe, Asia, and other parts of the world. But the demand for A4 paper is quite small. The purchasing manager has observed that during a typical week, the demand for white A4 paper is zero with probability 0.3, 1 ream (package of 500 sheets) with probability 0.5, and 2 reams with probability 0.2. A ream costs $3.00 and sells for $8.00. Because there are so few sources, customers will return if the product is out of stock. However, the store has a policy of giving customers a certificate for a $2.00 discount if the store is out of stock and the customer returns to purchase the product later. The store uses an inventory holding cost rate of 100% (2% per week) for all paper products.

The stationary store’s main supplier is willing to supply A4 paper overnight, along with the stationary store’s regular order, but charges a $5.00 handling fee for orders of paper that are not in multiples of 10 reams. (There are 10 reams in a box.) The manager doesn’t think it is sensible to order so many reams at the same time.

(a) What is the Markov transition matrix if the store uses a periodic review policy with $s = 1$ and $S = 4$?

(b) On Tuesday morning, immediately after a delivery has arrived and the goods have been placed onto the shelves, one of the employees notices there is 1 ream of A4 paper on the shelf. What is the expected cost that the store will incur during the upcoming week, considering the cost of ordering, inventory, and shortage penalties if $s = 1$ and $S = 4$?

(c) Do you think a policy with $s = 1$ and $S = 4$ is a good policy? (Note: there are many different ways to answer this question.) Please state your assumptions and provide analysis to support your recommendation.