15.762.
ESD.267J,1.273J
Spring 2005
Problem Set – due on February 16, 2005.

Please do this in groups, and submit one answer set per group. You should use the (approximate) models that were covered in class, Feb. 7. For some questions you will need to use material beyond what we did in class, such as models from your introductory class.

Please do 6 of the 8 problems.

1. Problem 17 from page 74 in text book (Designing and & Managing the Supply Chain)

2. (adapted from Nahmias book) Cassorla's Clothes sells a large number of white dress shirts. The shirts are shipped from a manufacturer in New York City. Hi Cassorla, the proprietor, says, "I want to be sure that I never run out of dress shirts. I always try to keep at least two months supply in stock. When my inventory drops below that level I order another two-month supply. I've been using that method for 20 years and it works." The shirts cost $9 each and sell for $20 each. The cost of processing an order and receiving new goods amounts to $100, and it takes three weeks to receive a shipment. Monthly demand is approximately normally distributed with mean 75 and standard deviation 15. Assume a 20 percent annual interest rate.

   a. What values of Q and R is Hi Cassorla using to control the inventory of white dress shirts? How much inventory is there on average?
   b. What service level is provided by this policy? How many stock outs per year might you expect?
   c. Suppose Hi changes her tune to "I want to be sure that I don't stock out of dress shirts any more often than twice in five years." Assume she sticks to her current value for Q. What will R be? What is the average inventory level? What is the cost (inventory holding cost plus order cost) of this policy? (assume four weeks per month)
   d. If Hi assumes that the cost of each stock-out is $11 per unit ($20 - $9), what stock-out probability would you suggest? (Think of this in terms of a newsboy problem)
   e. Suppose Hi also recognizes that her order quantity, equal to two months demand, may be out-dated. What order quantity would you recommend to reduce costs? And how might your reorder point change, so as to satisfy service requirement of part c? What is the cost (inventory holding cost plus order cost) of this policy?

3. Consider an item whose inventory is controlled by a periodic review, base-stock policy. Suppose the review period is 1 week (7 days), the replenishment lead-time is

3 days, and the daily demand is normally distributed with mean 20 and standard deviation 4.

a. What is the base stock B to assure that the coverage probability (Type I service) is 0.98? What is the average inventory level? How many stock-outs might you expect per year? (Assume 50 weeks per year)
b. Suppose the holding cost for the inventory is $2 per unit per year, the cost for every order is $100, and the cost of every stock-out occurrence is $10. Find the policy (r, B) that minimizes cost. You should consider writing a mathematical expression of the average costs, including stock-outs, and building a simple spreadsheet to model this cost function (approximately). You can then perform a search to find the best policy, and/or use the Solver..

4. Consider an item whose inventory is controlled by a *periodic review*, base-stock policy. Suppose the review period is 1 day, the replenishment lead-time is 5 days, and the daily demand is normally distributed with mean 100 and standard deviation 30.

a. What is the base stock B to assure that the coverage probability is 0.90? What is the average inventory level? How many stock-outs might you expect per year? (Assume 250 days per year)
b. Suppose customers permit a grace period or service time of 2 days. That is, a customer demand on day t can be satisfied on day t + 2. How would you modify the base stock in light of this relaxation of service expectations? By how much does the average inventory change?

5. Consider an item whose inventory is controlled by a periodic review, base-stock policy. Suppose the review period is 7 days, the replenishment lead-time is 3 days, and the daily demand is normally distributed with mean 10 and standard deviation 4.

a. Suppose we set B = 130. What is the coverage probability? What is the average inventory level? How many stock-outs might you expect per year? (Assume 350 days per year)
b. Suppose we have two categories of customers – gold and silver. We promise a higher level of service to the gold customers (e. g., 99% of demand is satisfied from stock); for silver customers, the service level would be lower, e. g., 85% of demand satisfied from stock. Describe how you might manage the inventory to serve the two demand classes? (We don't expect you to find a specific policy, but you should attempt to describe conceptually how you might structure a policy and then operate with this policy).

6. Consider an item whose inventory is controlled by a continuous review, Q R policy. Suppose the lead time is 5 days, Q = 100, and daily demand is normally distributed with mean 10 and standard deviation 2. The desired service target is 0.98 (the coverage probability).

a. Suppose the lead time is primarily transportation time, and you have an alternative option to use premium transportation that would reduce the lead time to 2 days. Suppose you can use only one option – either the premium transportation or the slow transportation mode. How would you decide what to choose? Outline an analysis to help you make the choice.
b. Suppose you could use both options, e. g., ship part of your order by the slow mode and part by the fast mode. Would you ever want to do this? How would you decide how to split the order?

7. Consider a semiconductor device that is produced in a wafer fabrication facility. The input into the facility is wafers that are released into the facility in lots of 25 wafers. The output from the fabrication facility goes to a testing operation that determines which die on the wafer are good and which are bad. The good die go into an inventory to serve customer demand, and the bad die are discarded. The production lead-time through fabrication and test is 50 days on average with a standard deviation of 3. The daily demand for die is 300 per day with a standard deviation of 30. The yield of good die from each wafer is 20 good die on average with a standard deviation of 8. Suppose we want to have a 95% fill rate from the die inventory. Describe an inventory policy to achieve this (You can assume all uncertainty follows a normal distribution and you probably want to make some assumptions of independence, as well as some simplifications and approximations). In particular, you should decide how to determine when to release a lot of wafers into the wafer fabrication facility. If it is helpful, you might consider a particular instance: suppose the number of batches in progress is 30 and the current position of the finished goods inventory is 1500 die. Then the question is whether or not we should launch any new batches into production, and if so how many?

8. (adapted from Nahmias book) The daily demand for a spare engine part is a random variable whose distribution, based on past experience, is given below:

Number of demands per day	Probability
0	0.21
1	0.38
2	0.19
3	0.14
4	0.08

The part is expected to be obsolete after 400 days. Assume demands from one day to the next are independent. The parts cost $1500 each when acquired in advance of the 400 day period and $5000 each when purchased on an emergency basis during the 400-day period. Holding costs for unused parts are based on a daily interest rate of 0.08%. Unused parts can be scrapped for 10% of their purchase price. How many parts should be acquired in advance of the 400-day period?