ISyE 3104: Introduction to Supply Chain Modeling:
Manufacturing and Warehousing
Instructor: Spyros Reveliotis
Spring 2013
Homework #3
Due Date: 3/7/13

Reading Assignment:
This homework covers the statistical inventory control theory that we have discussed in class. In your textbook, statistical inventory control theory is covered in Sections 6.2. But a treatment of this topic that is closer to the material that was presented in class, is provided in the excerpt from the book *Factory Physics*, by Hopp and Spearman, that I have posted at the course electronic reserves. Remember that in order to access the electronic reserves for our course, you will need the following password: he4mo45g

Problem Set:
1. Solve Problem 6.38 from your textbook.

2. Tammi's Truck Stop sells Seat-o-Nails cushions, which are specially designed to keep drivers awake on the road. Her accessories supplier makes deliveries every Tuesday, at which times she can get as many cushions as she wants (the supplier's truck carries a large number of cushions). The cushions cost $40 wholesale, and Tammi sells them for $65. She also uses 35 percent interest rate to evaluate the cost of holding inventory. Today it is Tuesday, Tammi has 12 cushions in stock, and the supplier has just arrived. Assuming that the weekly demand is normally distributed with mean 35 and st. deviation 10, answer the following questions:
   a. How many cushions should Tammi buy if sales are lost when see runs out of stock during the week?
   b. What is the fill rate that results from your response in part (a)?
   c. Reconsider part (a) if unmet demand is not lost but it is backordered, and it costs Tammi $12 to mail the cushion to the customer.

3. Enginola, Inc., assembles amplifiers on a two-stage production line. The first stage makes a chassis and the second stage does the custom assembly. The chassis stage consists of 20 parallel stations, each staffed by an operator; the amplifier stage consists of 15 parallel stations, each also staffed by a single operator. Because all chassis are identical, the time for an operator to build one is almost constant, at 15 minutes. But, because there are many different amplifiers assembled from the standard chassis, the time for an operator to assemble an amplifier is highly variable, with a mean of 20 minutes (more specifically, here it is assumed that at each of the 15 stations of the amplifier stage, the next amplifier to be built by the station operator can belong to any of the available types).
   From the above description it is evident that the chassis stage has more capacity than the amplifier stage. This excess capacity is utilized by having the chassis operators perform additional tasks, whenever they are not needed to build chassis. Also, Enginola has implemented a KANBAN system to ensure that the inventory of completed chassis waiting at the amplifier stage does not become excessive. This system makes use of paper cards, which are attached to the finished chassis. Whenever an amplifier operator takes a chassis out of stock, s/he removes the card and hands it upstream to the chassis

stage. The card is given to a chassis operator as a signal to build another chassis. When the operator completes the chassis, s/he attaches the card to it and delivers the chassis to the stockpoint at the amplifier stage. Since chassis operators are not allowed to build chassis without a card, and there are only m cards in the system, the total amount of chassis inventory at the amplifier stage can never exceed m.
Assuming that the 15 stations at the amplifier stage operate independently from each other, and that the time to build an amplifier at that stage can be approximated by an exponential distribution (this assumption is justified on the basis of the high variety of the amplifiers that are built at that stage), determine a value for the number of cards m so that the probability that an amplifier operator will find a chassis in stock when s/he needs one is at least 99 percent.

Hints: Refer the above operation to one of the stochastic inventory models discussed in class, by looking at the KANBAN mechanism described above as an order generating mechanism. What is the replenishment lead time in this inventory model? To answer the problem question, you will need to characterize the demand during a replenishment lead time interval. For this, remember the connection between the exponential and the Poisson distribution, and also some key properties of the Poisson distribution, from your 3232 class. This problem sets the stage for discussing KANBAN production systems as we move to the next part of the course.

4. Harvey Gold, the owner of Harvey's Specialty Shop, orders an unusual olive from the island of Santorini, in Greece. Over the years, Harvey has noticed considerable variability in the time it takes to receive orders of these olives. On average, the order lead time is four months and the st. deviation six weeks (1.5 months). Monthly demand for the olives is normally distributed with mean 15 jars and st. deviation 6. If Harvey's replenishment orders are at the level of 100 jars, how should he set his reorder point in order to guarantee a fill rate of 90 percent?

5. Continuous review inventory control is being applied to purchase motors for an electric fan manufacturer. Demand is uniformly distributed between 500 and 600 units per week. Each order costs $250 to prepare, place and receive. Motors cost $2.75 and the holding cost is evaluated based on an annual interest rate of 8%. The order lead time is equal to one week. Management proposes using the EOQ order quantity and setting the reorder point to ensure a fill rate of 97%. Compute the order size Q for this company and the corresponding reorder point r.