# IEOR 150 Midterm Examination
## Fall, 2014, Prof. Leachman
## Open Book and Notes. No Internet access. Work all problems. 60 points total.

1. The sales of a particular item are characterized by a linear growth trend. It is desired to forecast monthly sales. Sales of the item occur only on working days, i.e., there are no sales on holidays and no sales on weekends.

(a) (5 points) Months are awkward time units in that they are not all of the same length in terms of working days. Compared to directly forecasting monthly sales without accounting for differences in the lengths of the months, what can be done to improve the accuracy of monthly forecasts for this item?

(b) (10 points) What forecasting model would you recommend? You may assume the numbers of working days in each past month and in each future month are known. Please define any notation you use.

(c) (5 points) The forecasts will be used to support inventory control of the item using a base stock policy with monthly orders. The lead time for replenishment of the item is two months. It is desired that there should be 98% probability of no shortage associated with each order. What should be the base stock level? Please provide a formula and relate it to forecasts and tracking of the forecast errors.

2. Suppose Intel offers the following pricing schedule for an advanced microprocessor:

\$400 each for orders of less than 100
\$300 each for orders of at least 100 and less than 1,000
\$250 each for orders of more than 1,000

Suppose the fixed ordering cost is \$100 and the interest rate is 15 percent per year.

(a) (5 points) Let $EOQ_i$ denote the economic order quantity assuming price $i$ is in effect, where $p_1 = \$400$, $p_2 = \$300$ and $p_3 = \$250$. Show that for $D = 19$ per year, the total relevant cost rate for an order quantity equal to $EOQ_1$ is slightly more than the total relevant cost rate for an order quantity equal to 100.

(b) (5 points) Show that for $D > 19$, it is never optimal to order $EOQ_1$. (*Hint*: Examine the partial derivative with respect to $D$ of the total relevant cost rate for $Q = EOQ_1$ and for $Q = 100$.)

(c) (10 points) Show that there is no demand rate for which $EOQ_2$ is the optimal order quantity.

3. A retailer stocks a line of refrigerators. There are 4 product types (items) in this line. Item forecast and cost information are as follows:

| Item | Forecast demand per week | MAD | Item wholesale cost |
|---|---|---|---|
| 1 | 30 | 5.0 | $400 |
| 2 | 12 | 2.9 | $400 |
| 3 | 5 | 2.1 | $400 |
| 4 | 1 | 1.3 | $400 |

For the purposes of inventory analysis, the retailer's interest rate is 20 percent per year. The refrigerator supplier charges $1,000 for a railcar delivery plus $50 for each item type included in the replenishment. These charges are independent of how many refrigerators are included in the replenishment order. The railcar capacity is 150 refrigerators. The mean transit time is 3.5 weeks, and the standard deviation of transit time is 1.2 weeks. (This transit time includes the time for the supplier to order a railcar from the railroad, load the railcar, plus the time for the railroad to haul and deliver the railcar to the retailer.) The railroad service operates once per week, i.e., replenishment shipments from the supplier are only possible on Thursdays and not on other days of the week. The supplier must be informed at beginning of the workday on Monday if a railcar is to be shipped to the retailer on the Thursday of the same week.

(a) (7 points) Suppose the items are jointly replenished in a simple common replenishment cycle. Ignoring the railcar capacity, but considering the constraint that replenishment can only occur on one day of the week, what is the best frequency for replenishment?

(b) (5 points) Now considering the railcar capacity, what is the best replenishment frequency? What are the corresponding order quantities of each type of refrigerator?

(c) (8 points) A Type I service level of 98% is desired. What safety stock level do you recommend for each item?