IEOR 150 Production Systems Analysis
Midterm Examination, Fall, 2015, Prof. Leachman
Open Notes, Open Book, but not Open Computer.
Work all problems.

1. The famous Ernie of the *Sesame Street* television program is tired of making many trips to the store to replenish the cookie supply devoured by the Cookie Monster. The cookies cost $10 per pack of 50 and the Cookie Monster gobbles them up at the rate of 100 cookies per day.

(a) (4 points) Suppose the shelf life of cookies is 5 days (i.e., 5 days after purchase, cookies become no good to eat). To avoid spoiled cookies, what is the maximum number of packs of cookies Ernie can buy on a visit to the store? 10 packs

(b) (6 points) At present, Ernie goes to the store to buy four packs of cookies every other day. If Ernie is implicitly following an *EOQ* policy, what can you say about the values of the missing parameters? $EOQ = \sqrt{\frac{2AD}{(0.2)I}} \rightarrow \frac{A}{I} = 40$

(c) (4 points) Suppose a trip to the store costs Ernie at least $15. If $15 is indeed the trip cost, what interest rate would make it optimal for Ernie to go to the store every other day?

(d) (6 points) Assuming this interest rate, what trip cost would be implicit if it were optimal for Ernie to visit the store every three days? Every four days?

2. Two products are stocked at a retail outlet. Product *A* is controlled under continuous review and stock is maintained to achieve 98% of demand filled without backorder. Product *A* is replenished using package express transportation which has a cost of $50 per delivery plus $10 per unit ordered. The delivery lead time is two days with no variance. Product *B* is controlled under weekly (periodic review) and stock is maintained to achieve 98% of deliveries arriving without stockout. Product *B* is replenished using parcel post which has a cost of $5 per unit ordered. The delivery lead time is 4 days with a standard deviation of 2 days. The average demand rate for both products is 100 per day, and the mean absolute percentage error in the one-day-ahead forecast is 20% for both. The purchase cost of each product is $100 per unit. Assume the outlet values its inventories at 0.06% per unit per day.

(a) (3 points) What is the best order size for product *A*? (You can use the average demand rate to compute the best order size for deterministic demand and round to the nearest integer.)

(b) (2 points) What is the average order size for product *B*?

(c) (10 points) What is the average inventory level of each product?

(d) (3 points) What is the average shipping and ordering cost per day for each product?

(e) (2 points) Assuming the order size you recommended in part (a) is followed, which product has a higher total cost rate?

3. Answer the following true-false questions. A statement that is not always true should be considered false. One point for each correct answer, 0 points for each blank, and minus two points for each wrong answer. 15 total points possible.

a. Methods utilizing any of moving-average, exponential smoothing or regression can be developed to effectively account for trend and seasonality in generating forecasts. T

b. For a given sales item to be forecast, exponential smoothing involves less data storage and less computation than either moving-average or regression methods with comparable forecast errors. T

for causal, also good

↳ has no advantage over exponential smoothing

c. If forecasts are unbiased and forecast errors are independent and identically distributed, then the mean absolute deviation equals 1.25 times the standard deviation of forecast errors. F

$\sigma_e \sim 1.25$ MAD

d. In inventory control formulas for safety stock we use the standard deviation of forecast error instead of the standard deviation of the demand rate itself because we implicitly assume the forecast for demand is the demand rate. T

ordering for next cycle

look at when we are at risk

e. For a given product, a service level of 95% of demand satisfied from stock requires more safety stock than a service level of 94% of replenishment cycles completed without backorders. F

↳ look at the whole cycle

f. In the case of continuous review of an item with uncertain demand, an effective and practical analytical approach is to set the order quantity based on deterministic analysis of the forecasted demand rate and to set the safety stock level based on a service level goal and analysis of forecast errors. T

g. In a base stock system, the decision problem is to simultaneously determine the reorder quantity and the safety stock level. F

h. If the potential times for delivery of replenishments are restricted to a fixed time grid, then a periodic review inventory control system is appropriate while a continuous review system is not. T

i. Suppose the demand rate is normally distributed with mean 500 and standard deviation 100, while the lead time is normally distributed with mean 16 and standard deviation 3. Then a 10% increase in lead time standard deviation will lead to a greater increase in required safety stock than a 10% increase in demand rate standard deviation. T

j. In the case of incremental quantity discounts, the best order quantity is often one of the price break points. F

k. When determining optimal batch sizes, the cost rate function needs to be formulated with the batch size(s) as the decision variable(s). Formulating the problem with the cycle length(s) as the decision variable(s) does not enable practical calculation of the optimal batch size(s). F

l. When determining efficient batch sizes for a single machine that must replenish 10 different items all with on-going demand rates, it is practical to analytically determine optimal batch sizes if all items are required to be produced every rotation cycle. If some items are allowed to be produced once every 2, 3, 4 or 5 cycles, then it becomes computationally impractical to determine optimal batch sizes. T T

triangle $\leftarrow \frac{DR}{2}$ SS $\nearrow$ rectangle

m. In a periodic-review inventory system, cycle stock is larger than safety stock. F

n. Continuous-review inventory control systems generally achieve lower average inventory levels and higher customer service levels than periodic-review systems, but only if replenishment is feasible at any time. T

↳ more restricted → soln is also feasible for cont review.

o. For a given item, it is possible to choose parameters for a moving-average forecasting system and for an exponential-smoothing forecasting system such that they will generate the same forecasts for the item. F

↳ forecast error will be the same, but not the forecast