MGTA 456

SAMPLE FINAL EXAM

This exam is open readings, class handouts and class notes. The Honor Code restrictions are as follows:

1. You will have 180 minutes (three hours) to do this exam. You must stop working on the exam immediately when "time's up" is announced. Failure to do so will result in failing the exam.
2. You must do this exam completely by yourself. This includes not discussing the exam with anybody else until all students have taken the exam.
3. You may consult your textbook, class handouts (including material from the class Canvas site), and class notes. Materials from Canvas must be downloaded before the exam starts (except downloading the data for the last question). You may use a calculator and/or laptop computer. *Using any email or instant messaging package will lead to failing the exam and hence the course.*
4. Write your answer in the space indicated. Show supporting calculations in the box below the question. Anything written outside these areas will not be considered during grading. Rambling qualitative answers and not giving quantitative answers in requested units will be penalized. *If you use R, Python and/or Excel, show the formula used on the exam so any mistakes can be tracked.*

*******This year we have the four hour exam, which means that there will be more questions than the sample final exam*******

I acknowledge and accept the Honor Code and the restrictions outlined above:

NAME (print): .....

(sign): .....

Question 1 [10 points]

Growing asparagus is labor-intensive and thus expensive. At Wakefield Farms (WF), it is estimated that it costs 82 cents per pound for harvesting and another $1.48 per pound for cleaning and processing. WF sells asparagus through a distributor or at a farmers' market. The distributor pays $3.00 per pound and will take all the asparagus that WF offers. Asparagus sells for $4.25 per pound at the farmers' market but demand is uncertain (see the distribution below). Further asparagus unsold at the market is thrown out.

D	P(Demand=D)	P(Demand≤D)		D	P(Demand=D)	P(Demand≤D)		D	P(Demand=D)	P(Demand≤D)
50	5.1%	5.1%		**75**	6.5%	47.3%		**100**	3.3%	61.6%
55	7.4%	12.5%		**80**	4.3%	51.6%		**105**	10.2%	71.8%
60	9.5%	21.9%		**85**	2.8%	54.4%		**110**	15.9%	87.7%
65	10.0%	32.0%		**90**	2.0%	56.5%		**115**	9.8%	97.5%
70	8.8%	40.8%		**95**	1.8%	58.2%		**120**	2.5%	100.0%

It is the morning before the farmers' market and WF has just harvested and processed 120 pounds of asparagus. How many pounds should they bring to the farmers' market?

They should bring _____ pounds to the farmers' market.

$C_o = \$3$

$C_u = \$4.25 - \$3 = \$1.25$

$SL = \frac{1.25}{1.25+3} = 29.4\%$

$Q = 65$ pounds

Note that the harvest and processing costs are sunk!

In this class, we covered all concepts through data. So, instead of probability table, data will be given and you will take percentile of the data to find Q.

Question 2 [10 points]

Matsuzaka Specialty Foods (MSF) distributes gourmet Japanese soy sauces. For one product, demand is 30 bottles a week (although there is variation in weekly sales). Because the lead time is 5 weeks, MSF has used a reorder point of 200 bottles, using a continuous review policy. The supplier has said that because of earthquake damage, it will now take 7 weeks to fill orders, causing the purchasing manager to change the reorder point to 260 bottles. *The cycle service level (i.e., the probability that all demand will be met during the cycle) will consequently*

Circle one: **INCREASE** **DECREASE** **STAY THE SAME**

Explain:

For 5 week lead time, ROP=200, then safety stock = 200 – 5*30 = 50.
For 7 week lead time, ROP = 260, then safety stock = 260 – 7*30 = 50.
The variability of 7 week lead time demand is typically larger than the variability of 5 week lead time demand.
With the same safety stock but larger variability, it then implies that 7 week lead time will have smaller service level. Hence, the service level decreases.

Question 3 [10 points]

On an average day University Photo Copying (UPC) uses 40 reams of plain white paper (a ream is 500 sheets of paper). They purchase reams for $7 per ream. UPC's supplier charges $56 to deliver an order regardless of the number of reams ordered and delivers an order four days after it has been placed.

a) UPC's annual cost of capital is 25%. How many reams should UPC order at a time? What are their annual inventory-related costs (i.e., holding and ordering costs)? (Assume 250 days per year.) [5 points]

UPC's optimal order is _____reams.

UPC's inventory costs are $ _____ per year.

$EOQ = \sqrt{\frac{2 \times S \times R}{H}} = \sqrt{\frac{2 \times 56 \times 40 \times 250}{0.25 \times 7}} = 800$ reams.

$S \times \frac{R}{EOQ} + H \times \frac{EOQ}{2} = \$1400$

b) UPC's usage of plain white paper is normally distributed and highly variable. The standard deviation of daily demand is 3.618 reams. What reorder point should they use to achieve a service level of 85% under the continuous review policy? What is the additional annual inventory related cost (i.e., on top of the costs you found in part a))? [5 points]

They should use a reorder point of _____reams.

The additional inventory-related costs are $ _____ per year.

$ROP = R \times L + Z_{0.85} \times \sigma \times \sqrt{L}$

$= 40 \times 4 + 1.04 \times 3.618 \times \sqrt{4} = 167.5$

safety stock = 7.45

Additional inventory-related costs = safety stock holding cost

$= 7.45 \times (0.25 \times 7) = \$13.12$

Question 4 [10 points]

(a) A periodic review policy requires more safety inventory than a continuous review policy for the same cycle service level. [5 points]

Circle one: **AGREE** **DISAGREE**

Explain: **For the periodic review, the exposed demand uncertainty is for the lead time + review period while for the continuous review, the exposed demand uncertainty is only for the lead time. Hence, for the same service level, more demand uncertainty requires more safety inventory.**

(b) Which of the following statement(s) is (are) true?
Circle the statement(s) that is (are) true. [5 points]

(i) Increasing the order frequency does not affect the safety inventory if a continuous review policy is followed.
(ii) Increasing the order frequency does not affect the safety inventory if a periodic review policy is followed.
(iii) Increasing the order frequency decreases the safety inventory if a continuous review policy is followed.
(iv) Increasing the order frequency decreases the safety inventory if a periodic review policy is followed.
(v) Increasing the order frequency increases the safety inventory if a continuous review policy is followed.
(vi) Increasing the order frequency increases the safety inventory if a periodic review policy is followed.

Explain: **For the continuous review, order frequency is determined by EOQ, which does not affect safety inventory. For the continuous review, safety inventory depends on ROP.**

For the periodic review, increasing order frequency implies shorter review period. It means less exposed demand uncertainty, since we need to consider demand uncertainties during the lead time and the review time. Less demand uncertainty then leads to less safety inventory.

Question 5 [15 points]

Mattel has traditionally allowed ToysRUs to place two orders to meet Christmas demand. The first order is placed by the 10th of November for delivery by Thanksgiving and the second order is placed by the 10th of December for delivery by December 17th. For 2017, Mattel has required all firms to place only a single order by November 10th for the entire season. Assume that ToysRUs targets a service level of 60%.

(a) As a result of the change in Mattel's policy, the total amount ordered by ToysRUs is expected to [5 points]

Circle One:

(i) Increase

(ii) Decrease

(iii) Remain unchanged

Explain why?

The single order increases the uncertainty exposure for ToysRUs. ⇒ More safety stock. ⇒ Increased order quantity.

(b) As a result of the change in Mattel's policy, the total profit at ToysRUs is expected to [5 points]

Circle One:

(i) Increase

(ii) Decrease

(iii) Remain unchanged

Explain why?

Profits decline with an increase in uncertainty exposure because the expected quantity that will remain unsold increases.

(c) ToysRUs has two products which have the same coefficient of variation, which of the following statements is true? [5 points]

Circle One:

(i) If two products have the same coefficient of variation, they must hold the same number of days of safety inventory (irrespective of standard deviation), if they want the same CSL.

(ii) If two products have the same coefficient of variation, the product with the higher standard deviation must hold more days of safety inventory, if they want the same CSL.

(iii) If two products have the same standard deviation, they must hold the same number of days of safety inventory, if they want the same CSL.

Explain why?

number of days of safety inventory (time)

$$= \frac{\text{safety inventory}}{\text{mean demand}}$$

$$= \frac{z_{SL} \times \text{stdev}}{\text{mean}} = z_{SL} \times \text{coefficient of variation}$$

This is a challenging problem. You need to understand the Little's Law for *days of safety inventory* first. Days of Inventory = Inventory/ Throughput (daily demand)

Safety Stock (for normal distribution case) = z_SL * STDEV.

Coefficient of Variation = STDEV / MEAN

Question 6 [20 points]

Cathy Hunt opened her new premium coffee roasting company called *Lofty* in Solana beach. She roasts her coffee only in the morning before opening the shop to sell during the day. All the leftovers by the end of the day are donated for free.

The first 50 days of data about the demand (pounds of coffee) are in TritonED (Final Exam folder). Cathy recognized that the demands are linearly increasing in time (days). Assume that the demands are Normally distributed.

She purchases her raw coffee from the global coffee trading company in Sorrento Valley at $3 per pound, and she sells the coffee at Lofty at $10 per pound after roasting. Cathy estimated that all of the variable costs associated with roasting amount to $1 per pound.

(a) Use the first 30 days of data and build the forecasting model for the demand. What is the forecast for t**he day 70**? [5 points]

The demand forecast for the day 70 is _____ pounds of coffee.

Use a linear regression model ⇒

$y = 107 + 20 \times day$

There might be rounding errors.

(To be more precise,

$y = 107.3 + 19.8 \times day \Rightarrow \underline{\underline{1492}}$

(b) On the day 70, Cathy plans to have 30 pounds of coffee as a leftover, on average. What will be the service level on the day 70? [5 points]

The service level for the day 70 will be _____ %.

This is a challenging problem. We used day 1 – day 30 to "train" our regression model. So, in order to estimate the forecasting error, we don't want to reuse the training data set. Rather, we will use day 31 to day 50 to estimate the forecasting error. Then, we find the percentile of 30 in the forecasting error. Please see the Excel solution file attached. → 87%

(c) On the day 70, what will be the optimal pounds of coffee to roast? [10 points]

Cathy should roast _____ pounds of coffee at the day 70.

This is also a challenging problem. First, Cu = 10 – (3+1)=6, and Co = 4. Then the target SL = 6/(6+4)=60%. Then, find 60 th percentile of the forecasting error (see Excel) = 10, which becomes the safety stock. Optimal pounds of coffee = 1492 + 10 = 1502.