IE460 Fall 2023
Comments on Exam I

In general, the exam was unsuccessful. The grades were low, and most of the class did not correctly answer the questions. The exam difficulty was moderate.

Each part of a question was perfectly solved by at least one student. At least one student solved a question almost perfectly. This may show that problems are actually solvable.

Here are some comments that I want to make in general:

1) The formulas supplied needed to be adequately utilized. This fact shows that either you were unaware that formulas would be supplied (not reading the information on the exam) or are not familiar with those formulas (indicating lack of study thinking that you will be supplied with formulas).

2) You must read the question carefully to understand what is asked. For example, in questions 2 and 3, figures might help to understand the relations and what is asked. Another example of not reading is in question 1, where I asked you to derive, and most of you did not even try for a derivation. Holistic understanding before initiating the solution is always essential and should be followed in solving homework problems, exams, or cases. My mistake is probably stating the parts of a question on different pages – next time, I will give the problem statement on the same page and let the remaining be used for the solution.

3) Memorizing is of no help while learning. Unfortunately, I have noticed signs of memorization at various levels in the work I evaluated. As a result, the following mistakes were common:

> a. Write a formula without critically assessing if that formula is the one that fits;
>
> b. Write an incomplete model and add terms from the problem statement, resulting in inconsistent quantities (as an example, cost function starts with terms of cost per unit time and continues with terms which are cost(unit or even just time);
>
> c. Write a formula that does not fit the situation (for a problem with deterministic demand statements, you write the newsvendor formula);

4) As engineers, you are expected to understand numbers and accordingly criticize your numeric results. For example, if you have obtained a Q value in Question 3 greater than the upper bound of the uniform distribution (or smaller than the lower bound), you should be able to state that there is a mistake.

While determining a partial grade, my general approach is to check if your approach makes sense. Some of you have received reasonable partial grades, even if the solution approach was not completely correct. Similarly, I always check if you are consistent in what you are doing in a problem to grant for additional partial grades. On the contrary, if your approach is inconsistent (sometimes irrelevant as you list a number of meaningless issues together) you may be taken extra points off (like a red card in sports!).

Remember that there are other grades to be received. It is an advantage for those of who received very low knowing that the average is low. Nevertheless, those of you who received 40 or below are not doing everything correctly. The following are the statistics that might be of interest:

Average = 41.03 STD = 17.96 min = 8 max = 88

Grades	**0-10**	**11-20**	**21-30**	**31-40**	**41-50**	**51-60**	**61-70**	**71-80**	**81-90**	**91-100**
#of students	1	4	4	9	8	4	4	1	1	0

The results indicate that there is a uniformity in grades – clustered around the average.

Question 1:

This question is similar to what you had in the homework. Additionally, you were asked to check for the feasibility of the lot sizes found in parts b) and c). In part b), as there are independent deliveries to each customer, you need to have a constraint stating that the quantity carried to each customer is less than or equal to the capacity C. In part c), on the other hand, as each customer is visited in a single delivery, you need to have a constraint stating that the sum of the quantities carried to customers is less than or equal to the capacity C.

Part c) asked you to derive the problem from scratch, meaning you needed to write the average total cost function with proper specifications of lot sizes required for the single delivery. You can do it in one of the following ways:

> 1) State the decision variable as the time between two consecutive deliveries; call it T. Then state lot sizes as a function of T ($Q_A = TD_A$, $Q_B = TD_B$) and write the average inventory carrying cost components for both customers as a function of T. Write the fixed cost of a delivery as a function of T (one term, of course, as it is a single delivery). Optimize T.
>
> 2) State the decision variable as the number of deliveries per unit time (per year); call it n. Noting that $n = 1/T$, implement the above steps, now with n.

This question can be extended in several ways. However, one issue inconsistent with an arbitrary capacity C is that the fixed cost is constant (regardless of the value of C). In reality, one would expect the fixed cost to be different as the capacity changes (economies of scale in the fixed cost: as capacity increases, the fixed cost associated with the per unit capacity decreases).

Your performance in this question is about 60%. Part a) was solved by the majority. The partials were not granted generously as the question was clear. A few students had the problem of not being able to with the average cost function – they received little, if no partial grades. In Part b) the typical mistake was using an incorrect fixed cost value. You could have used the average cost at EOQ supplied in the front page to compute the average carrying cost and fixed cost components (they are equal, if you recall from IE375). Finally, the constraint on the lot size was missed by some of you (2 points were deducted). Finally, part c): If you have written a correct, but memorized formula 4 points are deducted (you can expect this to be more in the forthcoming exams). An incorrect formulation (or argumentation – as a frequent example: aggregation of lots of A and B together without any consideration of the demand rates) receives at least a deduction of 15 points.

The following are the statistics that might be of interest:

Average = 24.89 (out of 40) STD = 8.29 min = 2 max = 40

Grades	**0-8**	**9-16**	**17-24**	**25-32**	**33-40**
#of students	1	4	13	10	8

Question 2:

This is the question where the success rate turned out to be the lowest (30%). I believe most of you did not have any clue about what the topic was about (two-thirds of the class received a grade below 5 points – 20% of the total grade). I will go over the solution in the classroom.

The question is related to a discounting mechanism that can result in achieving a supply chain optimal result.

Further discussion: The condition obtained in part b)ii) is not complete as there are infinite possibilities for setting A and B. Hence, one needs another restriction (or piece of information) to narrow down the solution to a single one – a typical would be the share of the supply chain profit that may be negotiable.

Grading: In part a), some of you were not able to formulate the average profit function. In that case, you were not able to come up with the EOQ solution. Those received at most 1 point as partials in those cases. In part b)i) you were expected to formulate the profit function. Of course, you were expected to have unit costs in a standard EOQ-type problem replaced with the discounted unit cost. If you missed this approach, you received at most four points as partials. After writing the function, if you did not optimize (taking derivatives, etc.), you lost at least three points depending on what you did incorrectly. Finally, in part b)ii) if you considered equating lot sizes (regardless of whether you found the correct ones), you received a considerable partial grade (up to four points out of five).

The following are the statistics that might be of interest:

Average = 5.86 (out of 25) STD = 6.64 min = 0 max = 24

Grades		**0-5**	**6-10**	**11-15**	**16-20**	**21-25**
#of students		24	5	1	5	1

Question 3:

This question was supposed to an easy one, as practically speaking, all the solution was given by the formulas, only requiring you to understand what they were.

Part A.i) asked the order quantity for the centralized system. You were mostly successful, but some of you did not understand the meaning of uniform distribution. The solution is the newsvendor percentile $\{c_u/(c_u+c_o)\}$ computed from the given formula such that $F(x) = \{c_u/(c_u+c_o)\}$ where

$F(x) = (x - 200)/100$ for x between 200 and 300 ($F(x)$ is the cdf)

Part A.ii) asked the expected number of equipment sold. This is what you have done in the homework, as well. One needs to write the integrals and evaluate them.

There are two ways of shortcutting the computations:

1) Exp.# sold = Exp demand – expected number not satisfied.

   Using the formulas supplied, the third quantity gives you the expected number not satisfied. Expected demand is simply 250 (uniform distribution – if you did not know, you can always use f(x) definition to compute).

2) Exp.# sold = Q* (ordered quantity) – expected number on hand

   Using the formulas supplied, the forth quantity gives you the expected number on hand. Q* was computed in part A.i)

Part A.iii) asked the expected supply chain profit (maximum) under Q* (optimal). This is what you have done in the homework, as well. One needs to write the integrals and evaluate them.

It will be simpler if you used the newsvendor problem knowledge to come uo with the following "short-cut":

Exp. Profit = - Cost paid for Q*+ revenue received from the expected sales (Part A.ii) + revenue received from the salvage (on-hand ones are sold in the secondary market) (The expected number on hand was already mentioned in Part A.ii).

Part B.i) was an application of the buyback contract. Two equations to obtain are obtained in Step 3):

1) Check the formula Retailer (Expected Cost) in the front page:

$\lambda\{(c-s)(Q^*\text{-µ})+(p-s)\int_{Q^*}^{\infty}((x-Q^*)f(x)dx\}$

2) The formula for the Expected Cost of the supply chain is the sum of Retailer (Expected Cost) and Manufacturer (Expected Cost).

   $(c-s)(Q^*-\text{µ})+(p-s)\int_{Q^*}^{\infty}((x-Q^*)f(x)dx$

3) As Q* should be the same for both and using the fact that retailer costs of overage and underage are given in the front page, we equate the coefficients of terms with Q.

   $\lambda(c-s) = (w-s-b)$

   $\lambda(p-s) = (w-s-b) + (p-w) = (p-s-b)$

Part B.ii) was an application which asked the same question in the reverse way.

With respect to grading: In part A, I granted very little partial, as the mistakes were significant and various (from using normal to obtaining Q values above 300, below 200 to considering all Q* value sold to using simple expectations replacing the role of the uniform loss function). IN Part B, I granted some partials (at most 7 for part i) there was a logic in the mistakes made. Unfortunately, very few students received 1or 2 points as partials.

The following are the statistics that might be of interest:

Average = 10.28 (out of 35) STD = 10.38 min = 0 max = 34

Grades	**0-7**	**8-14**	**15-21**	**22-28**	**29-35**
#of students	19	10	0	3	4