IE 375 Production Planning, Fall 2020
Assignment: Case 3

Due: December 21, Monday, strict due time: 17:00

Information on the case assignments:

1) Each Case is 10%.
2) You are permitted to work together in groups of two students on the case assignments. If you prefer, you can work on the case alone, but this is not recommended.
3) Case 3 is an assignment for all sections of IE 375. Hence, students from different sections can be in the same group.
4) Case 3 involves a lot of computations that should be handled as efficiently as possible. Similar computations may be required in different parts of the case. Therefore, you are strongly encouraged to use a spreadsheet or write a computer code for your computations. Please report the code that you use and the formulas that you implement. DO NOT simply submit the output of your code or spreadsheet.
5) Review the course material before you start. Cite sources used if any.
6) Present your results in such a way that you show your understanding of the solution approach as well as the solution. Your report should clearly reflect your knowledge and ideas so that somebody else (your peers or superiors) can easily follow and work on it for further needs.

Academic dishonesty: You are not allowed to communicate with other groups, but instead you can contact the TA for your questions. The communication among the group members is essential and expected for the success of the outcome. Any violation of the above understanding will result in measures outlined in the student rules and regulations.

Submission information: Please send your solution as a **pdf file** clearly indicating your names to Izzet Egemen Elver (egemen.elver@bilkent.edu.tr) if you are in Section 1 and Parinaz Toufani (parinaz.toufani@bilkent.edu.tr) if you are in Sections 2 and 3. If two group members are not in the same section, please send your solution to both TAs.

What is expected? How to study? Make sure that you read the questions carefully. In some cases, the approach you are expected to take is written in some detail.

To answer the questions, you need to go over the course materials as well as the reading materials from the textbook. Make sure that you understand each case question and present your answers clearly. Questions are numeric and hence you have chances of making computational errors. To avoid the possibility of receiving no partial grade, present all the formulas that you are using and explain how you are proceeding with computations. If you use a computer code for your computations, report the code and explain how you are implementing the formulas clearly. Make sure that you present your findings clearly and neatly.

Luxe Glasses Part II

Luxe is a new optic store located in Florence which has been operating for a couple of years. Luxe is open for six days in a week and assume there are 48 weeks in a year. There are two types of glasses that Luxe sells: regular glasses and sunglasses. The distributors for both glasses are in China. It costs €3000 to place an order for regular glasses and €4000 to place an order for sunglasses. The lead time of the orders is expected to be six weeks. The orders of the regular glasses and sunglasses are independent from each other.

For the regular glasses, Luxe can observe the inventory daily. Past data indicates that most of the regular glasses are sold on Fridays and Saturdays, and the least on Tuesdays. On the other hand, based on your forecasting results in Case I, you assume that the weekly demand follows a stationary normal distribution with a mean of 140 glasses and a standard deviation of 22 glasses (disregarding the variation within the week). The demand is practically observed continuously. Luxe purchases regular glasses for €40 per unit and sells them for €90 per unit. It costs €8 per unit to keep regular glasses for one year in the inventory. Any demand that cannot be met on time is backlogged, incurring a shortage cost that is 20% of the selling price, that is, €18 per unit.

For the sunglasses, Luxe keeps the data of monthly sales. Most of the sunglasses are sold in summer and the sales considerably increase in December and January due to the skiing season. Luxe purchases sunglasses for €60 per unit and sells them for €150 per unit. The holding cost for sunglasses is €6 per unit per month. In Case I, you forecasted the monthly demand and computed the forecast error term for the normally distributed demand values. The forecasted demand values for the coming year you found using the best forecasting procedure are given in the following table. Based on your results, you assume that the standard deviation of the monthly demand is 9 (constant regardless of the month).

Months	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Demand	105	64	65	74	76	93	113	122	67	61	26	66

Regular Glasses

A) (5 points) If Luxe is planning to assume that the demand is deterministic (at a constant rate of 140 per week) and order regular glasses according to the basic EOQ model, calculate the optimal order quantity, cycle length, and reorder point.

B) (5 points) Using the values you found in Part A, calculate the associated annual ordering, purchasing, and holding costs. Calculate the total annual cost as well.

C) (5 points) If there is an ordering capacity of 1500 units/order, is the EOQ you found in Part A still implementable? If not, determine the new optimal order quantity and explain your reasoning. Calculate the associated cycle length and total annual cost as well.

D) (20 points) Luxe wants to keep track of the inventory more precisely and decides to apply a continuous review (Q,R) policy. Calculate the optimal order quantity and reorder level as well as the expected total annual cost.

E) (15 points) Luxe thinks that the six-week lead time is too long and talks to the manager of the supplier. The manager says that they can lower the lead time to two weeks with air delivery, but it will cost an additional €1000 per order. For the air delivery, recalculate the optimal order quantity and reorder level of the (Q,R) policy as well as the expected total annual cost. Is it reasonable to choose the air delivery?

Sunglasses

A) (25 points) You take the following approach (to be discussed in the "Comments on Case 3" report after the case is graded):

- Compute a safety stock level by targeting a 95% Type 1 service level as if it was a continuous review system. However, since there is more uncertainty in a periodic review system compared to the continuous review counterpart, use the demand distribution over the response time rather than the lead time (the response time is the sum of the lead time and the length of one period). Hence, the 95% Type 1 service level implies that the probability of the response time demand exceeding the reorder level should be 0.05. Thus, you compute the reorder level from the service level definition and deduct the expected response time demand to obtain the safety stock level.
- Independent of the safety stock consideration, use the point forecasts given in the above table as deterministic (but time varying) demand values.
- Solve the deterministic dynamic demand problem to obtain the order quantities. Assume that your initial on-hand inventory is equal to the safety stock level you computed above. Also, while solving the deterministic dynamic demand problem, do not consider the lead time without loss of generality.

Determine the safety stock requirement. Also, determine the optimal ordering policy for the following year using any optimization algorithm you learned (Shortest Path Algorithm, Wagner-Whitin Algorithm or MIP in general). In which months and how much should Luxe order and what is the optimal total annual cost?

B) (20 points) After the coronavirus outbreak, the managers of Luxe realized that the store may encounter replenishment problems since the supplier of glasses is in China, so they decided to place a single order that will cover the demand of the entire year (assuming that the currently available sunglasses will become out-of-fashion after one year). The unsold (out-of-fashion) sunglasses remaining at the end of December will be sold for €40 per unit. To minimize any possible loss that may arise due to overstocking or understocking, the managers chose to implement a newsvendor model in which the annual demand distribution is obtained by taking the sum of the random variables representing the monthly demands. Calculate the critical ratio and optimal order quantity. Note that there might be alternative ways to convert the problem

stated for sunglasses to a newsvendor problem. Hence, while determining the costs of overage and underage, provide a justification for your approach.

C) (5 points) Using the values you found in Part B, calculate the expected number of units sold, expected number of units not sold, and expected number of excess demands.