

PGDM & PGDM (IB), 19-21

Supply Chain Analytics

DM-443 / IB-443

Trimester-IV, End Term Examination, September 2020

Time allowed: 2 hr 30 min

Max Marks: 50

Section A

- i. Attempt all questions (total marks: 30) in one Excel file; name the file using your roll number.**
- ii. Some questions involve random number generation using a seed value. Please follow the instructions for such questions carefully.**
- iii. Please attempt each question on a separate sheet of the excel. Please use more than one sheet for a question if required (e.g., question 2).**
- iv. The last question needs to be attempted on separate sheets of paper. These need to be uploaded along with your Excel file.**

1. Anthony's Lobsters is a small seafood restaurant in Newport, Road Island. The place is famous for its lobsters, and customers flock in every day to try it. The arrival rate of the customers is λ /hour with a coefficient of variation of 0.7. Anthony's Lobsters has only one chef, but he is very efficient, and the restaurant can satisfy around μ customers/hour with a coefficient of variation of 0.4.

NOTE: This problem needs to be done on the first sheet of your excel. Use the Random Number Generator in the Analysis Tool Pack to generate two random number values. Use uniform distribution with $\min = 40$ and $\max = 80$. Use the last three digits of your BIMTECH roll number as the seed; for example, if your Roll no. is 19DM054, then the seed will be 054. Then, $\lambda = \text{INT}(\text{the lower of the two values})$, and $\mu = \text{INT}(\text{the higher of the two values})$. Answers that do not follow these instructions (that can be verified) will not get any marks.

- a. What is the current utilization? (2 marks)
- b. What is the expected time an order waits in the queue (in minutes)? (2 marks)
- c. What is the expected flow time (total time in the system) in minutes? (2 marks)
- d. What is the expected number of orders in process? (2 marks)
- e. What is the expected number of orders waiting in the queue? (2 marks)

(CILO 2)

2. Bharatiya Ghar (BG) is an Indian real-estate development company that has just finished building a hotel in Goa. BG's hotel has 150 luxury rooms, and the company needs to decide on the long-term price levels to be charged for the hotel rooms. In particular, BG considers a potential price level of ₹ 10000 per room per day. Based on the analysis of the market research and past occupancy data, the company estimates that if it uses the ₹ 10000 price level, the daily demand D for rooms at the hotel will be distributed as a Poisson random variable with parameter $\lambda = 147$. The company assumes that if demand for rooms on a particular day exceeds 150, all extra room requests (above 150) will be lost to other hotels.

- a. Suppose the demand on a given day turns out to be 153. What is the total revenue that BG will receive on that day? (1 mark)
- b. What is the algebraic expression for the daily total revenue BG will receive, R , as a function of the daily demand D ? (2 marks)
- c. Suppose that Excel's Random Number Generation tool has generated the following sequence of 5 random values from the Poisson distribution with parameter 147: 171, 148, 156, 157, 140. These values reflect 5 random daily demand values. What is the sample standard deviation of the BG's **daily total revenue** values corresponding to these demand values? (3 marks)
- d. Use Excel to set up and run a simulation of the total daily revenue R using $n = 100$ simulation trials and the random seed = the last three digits of your BIMTECH roll number. Based on the results of this simulation, what are the estimates for the expected value and the standard deviation of the total daily revenue? (4 marks)

(CILO 1)

3. Consider an item whose demand is continuous but stochastic. This item is ordered once every cycle when the inventory in hand reaches the reorder level. The supply lead time is 5 periods. This means that the quantity ordered is delivered 5 periods after the order is placed. The per period demand is normally distributed with a mean of 30 units and a standard deviation of 7 units. The company wants to target a CSL of 95 percent. This means that out of a hundred cycles, the item will stock out about 5 times. A stock out event occurs when the demand during the lead time exceeds the reorder level.
 - a. Simulate the demand per period for 5 periods in any ordering cycle; repeat for 300 cycles. Please name the cycles as 1, 2, 3, ..., 300.
 - b. Calculate the reorder level (for continuous review) corresponding to the CSL and the other data given. Note that this value will be the same for all the cycles.
 - c. Denote a stock out event as 1. Use 0 to denote the cases when there is no stock out. Use a simple conditional function for this. Count the total number of stock out events. Estimate the empirical value of the probability of a stock out. Hence, estimate the empirical value of the CSL.

(CILO 1; 10 marks)

Section B (20 marks)

4. Power Cycle makes meters that gauge the speed and power with which cyclists ride their bikes. An electronic sensor, connected to the bicycle's pedal, communicates via Bluetooth to the rider's iPhone or Android phone.

Power Cycle buys the device's Bluetooth interface from an outside vendor that has offered the following terms.

- i. The vendor will deliver 50,000 interfaces to Power Cycle 60 days from now.
- ii. Power Cycle has the option to buy another 50,000 interfaces for delivery 120 days from now.
- iii. If it wants to buy the 2nd set of 50,000 interfaces, Power Cycle must let the supplier know at least 30 days before delivery; that is, by 90 days from now.
- iv. Power Cycle will pay £5 per unit for the interfaces.

The supplier incurs a fixed cost of £125,000 for *each* production run, plus a per-unit cost of £2 for each interface produced. The manufacturer believes that there is a 60% chance that Power Cycle will request the 2nd set of 50,000 interfaces, and it wants to decide which of the following options it should choose: 1) Enter into the contract, produce 50,000 units now, and produce a 2nd set of 50,000 units only if Power Cycle requests them later. 2) Enter into the contract, produce 100,000 units now, and bear the risk that Power Cycle does not reorder. If the supplier chooses option 2 and Power Cycle orders only 50,000 units in total, the leftover 50,000 units will have no salvage value for the supplier.

- a. Structure the supplier's choices using a decision tree. Make sure you explicitly define all of the elements of the tree: decisions, events, cash flows and probabilities associated with decisions and events, and payouts associated with the final outcomes. (14 marks)
- b. What are the maxi-min, maxi-max, and expected value maximizing decisions for the supplier? What are the monetary values associated with those choices? (6 marks)

(CILO 3)