Case 6
Simulation

Problem 1 Monte Carlo Simulation

Suppose you are inspecting components at a factory. Historically, 20% of the components are rejected because of defects. Simulate the inspection of 50 components using Random Numbers (decimals). Reject the component if Random Number (RN) ≤ 0.20.

How many components are accepted? Rejected? Compare the simulated rejection rate with the theoretical rejection rate.

Problem 2 Airport Hotel

An airport hotel has 100 rooms. On any given night, it takes up to 105 reservations, because of the possibility of no-shows. Past records indicate that the number of daily reservations is uniformly distributed over the integer range [96, 105]. That is, each integer number in this range has an equal probability, 0.1, of showing up. The no-shows are represented by the distribution in the table below.

No. of No-Shows	Probability
0	0.1
1	0.2
2	0.25
3	0.3
4	0.1
5	0.05

Develop a simulation model to find the following measures of performance of this booking system: the expected number of rooms used per night and the percentage of nights when more than 100 rooms are claimed.

Problem 3 Widget Inventory System

Simulate the following inventory system described below.

A store selling widgets is in operation everyday. Customer demand for widgets approximately follows the probability distribution shown:

Daily Demand	0	1	2	3	4	5	6
Probability	0.14	0.27	0.27	0.18	0.09	0.04	0.01

- The review period (P) is 1 week. This means that stock is only examined at the end of every week, or at the end of every 7th day (day 7, 14, etc.).
- The order quantity (Q) is 14 units, and the reorder point (R) is 6 units. This means that if the stock level was found to have reached 6 units or less on a day that it was examined, an order for 14 widgets is immediately placed.
- The lead time (days until delivery) is probabilistic and obeys the following discrete distribution:

Lead time (days)	1	2	3
Probability	0.25	0.45	0.30

- Stock is always delivered at the start of a day, ready for sale for that day.
- No backorders are allowed. Thus, stockouts always result in lost sales.
- The inventory costs are considered as follows: holding or carrying costs are PhP 5 per unit per day, ordering costs are PhP 100 per order, and stockout costs are PhP 40 per unit of lost sales due to stockouts.

Instructions:

1. In your spreadsheet, make a table with the following headings (notation explained on next page):
2. Day, RN Demand, RN Leadtime, Begin Inv, Demand, Order Rcvd, Ending Inv, Stockout, Order Placed, Leadtime, Holding Cost, Order Cost, Stockout Cost, Total Cost
3. Create a simulation for the inventory system described above. When the simulation begins, assume that it is the beginning of the week, and 12 widgets are on hand. Simulate the daily operation for 5 weeks (35 days) of operation of this system.
4. When setting up the tables for RN ranges for Monte Carlo simulation, let the first RN range begin with 0. For example, the RN range for a daily demand of 0 widgets is [0.00, 0.14), given a probability of 0.14.
5. Automate the simulation to allow the user to easily change values for P, Q, and R.
6. Assess the original system by computing the following performance measures for the 35-day simulation run: total holding costs, total ordering costs, total stockout costs, and total inventory costs.
7. Perform additional simulations to determine the effect on the inventory costs if the following changes were made:
    a. the review period (P) was 5 days instead of 7 days
    b. the reorder quantity (Q) was 10 units instead of 14 units
    c. the reorder point (R) was 3 units instead of 6 units
8. Each of the scenario a, b, and c should be evaluated independently of each other (for example, in evaluating scenario b, fix P and R in their original values).
9. Fill out the worksheet and answer the question provided.
10. **Notation for Problem 3:** Spreadsheet Simulation of an Inventory System

Day	Day of simulation – numbers 1 through 35
RN Demand	Random Numbers for Demand - whole numbers obtained from Excel
RN Leadtime	Random Numbers for Lead Time - whole numbers obtained from Excel
Begin Inv	Beginning Inventory – based on the ending inventory the previous day and any order arrivals on that day
Demand	Demand – daily demand for widgets computed from RD Demand based on the given discrete (Poisson) distribution
Order Rcvd	Order Received – order arrival on a given day
Ending Inv	Ending Inventory – based on the beginning inventory of the same day and the demand for widgets on that day
Stockout	Stockout – excess of demand over available or on-hand inventory
Order Placed	Order Placed – order quantity (Q) placed at the end of every review period (P) if the ending inventory on that day falls equal to or below the reorder point (R)
Leadtime	Delivery Lead Time – number of days for an order to arrive after the order has been placed, based on the given discrete distribution
Holding Cost	Holding Cost – carrying costs incurred from storing units of inventory that day, based on the given holding cost per unit per day (PhP 5.00)
Order Cost	Order Cost – cost of placing an order that day, based on the given order cost per order (PhP 100.00)
Stockout Cost	Stockout Cost - costs incurred due to lost sales that day, based on the given stockout cost per unit of lost sales (PhP 40.00)
Total Cost	Total Cost – total inventory costs for that day, based on the Holding Cost, OrderCost, and Stockout Cost

Computed value	Day			
	1	7	17	35
RN Demand				
RN Leadtime				
Begin Inv				
Demand				
Order Rcvd				
Ending Inv				
Stockout				
Order Placed				
Leadtime				
Holding Cost				
Order Cost				
Stockout Cost				
Total Cost				
	Total Holding	Total Order	Total Stockout	Total Inventory
Original Scenario				
Scenario a				
Scenario b				
Scenario c				