Program:	Software Engineering	Class:	VII-A, B
Course Name:	Modeling and Simulations	Topic	Simulation Using MS Excel
Instructor's Name:	M. Iftikhar Mubbashir	Date	June 06, 2024
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Risk Analysis

PortaCom manufactures personal computers and related equipment. PortaCom's product design group developed a prototype for a new high-quality portable printer. The new printer features an innovative design and has the potential to capture a significant share of the portable printer market. Preliminary marketing and financial analyses provided the following selling price, first-year administrative cost, and first-year advertising costs are:

- Selling price =$249 per unit
- Administrative cost = $400,000
- Advertising cost = $600,000

The cost of direct labor, the cost of parts, and the first-year demand for the printer are not known with certainty and are considered probabilistic inputs. At this stage of the planning process, PortaCom's best estimates of these inputs are $45 per unit for the direct labor cost, $90 per unit for the parts cost, and 15,000 units for the first-year demand. PortaCom would like an analysis of the first-year profit potential for the printer. Because of PortaCom's tight cash flow situation, management is particularly concerned about the potential for a loss.

Further analysis by PortaCom led to the following probability distributions for the direct labor cost per unit, the parts cost per unit, and first-year demand:

Direct Labor Cost PortaCom believes that the direct labor cost will range from $43 to $47 per unit and is described by the discrete probability distribution shown in Table 1.

Parts Cost This cost depends upon the general economy, the overall demand for parts, and the pricing policy of PortaCom's parts suppliers. PortaCom believes that the parts cost will range from $80 to $100 per unit and is described by the uniform probability distribution shown in Figure 1. Costs per unit between $80 and $100 are equally likely.

First-Year Demand PortaCom believes that first-year demand is described by the normal probability distribution shown in Figure 2. The mean or expected value of first-year demand is 15,000 units. The standard deviation of 4500 units describes the variability in the first-year demand.

Direct Labor Cost per Unit	Probability
$43	0.1
$44	0.2
$45	0.4
$46	0.2
$47	0.1

Table 1: Probability Distribution For Direct Labor Cost Per Unit

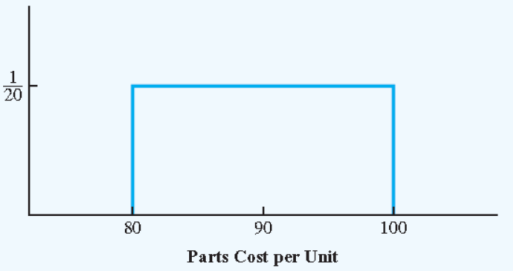

Figure 1: Uniform Probability Distribution For The Parts

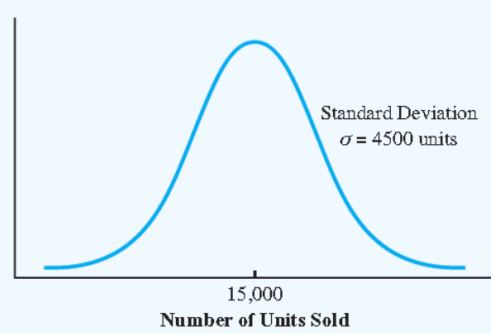

Figure 2: Normal Probability Distribution Of First-Year Demand

Direct Labor Cost per Unit	Probability	Interval of Random Numbers
$43	0.1	0.0 but less than 0.1
$44	0.2	0.1 but less than 0.3
$45	0.4	0.3 but less than 0.7
$46	0.2	0.7 but less than 0.9
$47	0.1	0.9 but less than 1.0

Table 2: Random Number Intervals For Generating Values Of Direct

Using an Excel worksheet, simulate the PortaCom project 500 times and generate useful statistics.

Inventory Simulation

The product is a home ventilation fan distributed by the Butler Electrical Supply Company. Each fan costs Butler $75 and sells for $125. Thus Butler realizes a gross profit of $125 - $75 = $50 for each fan sold. Monthly demand for the fan is described by a normal probability distribution with a mean of 100 units and a standard deviation of 20 units.

Butler receives monthly deliveries from its supplier and replenishes its inventory to a level of Q at the beginning of each month. This beginning inventory level is referred to as the replenishment level. If monthly demand is less than the replenishment level, an inventory holding cost of $15 is charged for each unit that is not sold. However, if monthly demand is greater than the replenishment level, a stockout occurs and a shortage cost is incurred. Because Butler assigns a goodwill cost of $30 for each customer turned away, a shortage cost of $30 is charged for each unit of demand that cannot be satisfied. Management would like to use a simulation model to determine the average monthly net profit resulting from using a particular replenishment level. Management would also like information on the percentage of total demand that will be satisfied. This percentage is referred to as the *service level*.

The controllable input to the Butler simulation model is the replenishment level, Q. The probabilistic input is the monthly demand, D. The two output measures are the average monthly net profit and the service level. The computation of the service level requires that we keep track of the number of fans sold each month and the total demand for fans for each month. The service level will be computed at the end of the simulation run as the ratio of total units sold to total demand. A diagram of the relationship between the inputs and the outputs is shown in Figure -3. When demand is less than or equal to the replenishment level ($D \leq Q$), D units are sold, and an inventory holding cost of $15 is incurred for each of the $Q \geq D$ units that remain in inventory. Net profit for this case is computed as follows:

Case 1: $D \leq Q$

Gross profit = $50D

Holding cost = $15(Q – D)

Net profit = Gross profit - Holding cost = $50D - $15(Q - D)

When demand is greater than the replenishment level ($D > Q$), Q fans are sold, and a shortage cost of $30 is imposed for each of the D - Q units of demand not satisfied. Net profit for this case is computed as follows:

Case 2: $D > Q$

Gross profit =$50Q

Shortage cost =$30(D - Q)

Net profit = Gross profit - Shortage cost = $50Q - $30(D - Q)

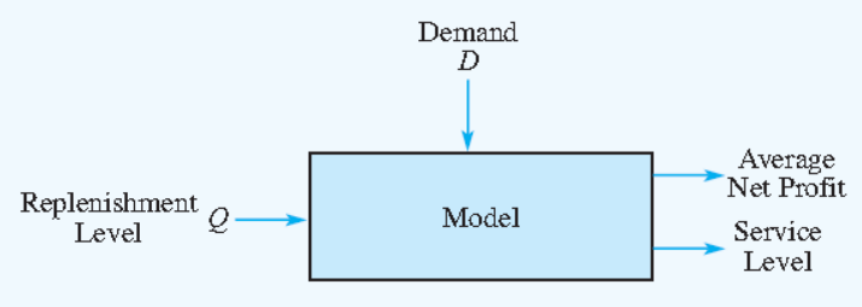

Figure 3: Butler Inventory Simulation Model

Using Excel, to simulate for 300 months. Generate the useful results related to the inventory system.

Hammondsport Savings Bank ATM Waiting Line

Hammondsport Savings Bank will open several new branch banks during the coming year. Each new branch is designed to have one automated teller machine (ATM). A concern is that during busy periods several customers may have to wait to use the ATM. This concern prompted the bank to undertake a study of the ATM waiting line system. The bank's vice president wants to determine whether one ATM will be sufficient. The bank established service guidelines for its ATM system stating that the average customer waiting time for an ATM should be one minute or less. Let us show how a simulation model can be used to study the ATM waiting line at a particular branch. The customer interarrival times are assumed to be uniformly distributed between 0 and 5 minutes, past data from similar ATMs indicate that a normal probability distribution with a mean of 2 minutes and a standard deviation of 0.5 minutes, a diagram of the ATM simulation model is in Figure-4.

Using an Excel worksheet, to simulate all 1000 customers. Mention the statistics for this system.

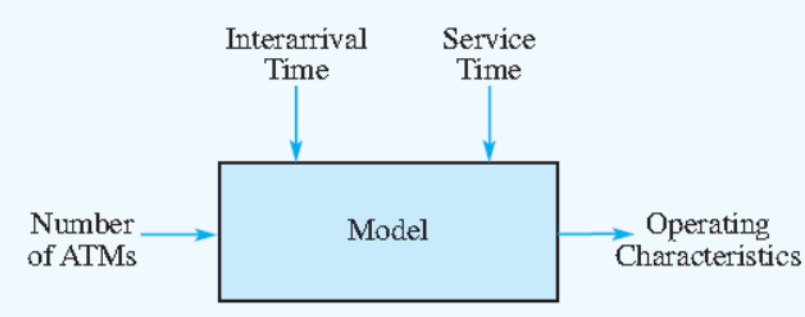

Figure 4: Hammondsport Savings Bank ATM Simulation Model

Simulation with Two ATMs

Let us assume that the bank has two ATMs. For the second ATM, we also assume that the service time is normally distributed with a mean of 2 minutes and a standard deviation of 0.5 minutes. We assume that, when a new customer arrives, the customer will be served by the ATM that frees up first. When the simulation begins, the first customer is assigned to ATM 1. Use the Excel worksheet to conduct a simulation for 1000 customers using two ATMs.