Decision Making

BUS 735: Business Decision Making and Research

Learning Objective	Active Learning Activity
Learn how to simulate probability distribution	Example problem in Excel.
Learn how to simulate inventory systems.	Example problem in Excel.
Learn how to simulate queuing systems.	Example problem in Excel
More practice.	Read Chapter 14, Homework exercises.

- **Simulation:** drawing random numbers from a probability distribution.
- **Monte Carlo Simulation:** Use simulated data to simply compute means, standard deviations, etc.
- More complicated computations can be made based on the simulated data.
    - Create linear combinations of variables.
    - Take ratios!

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- Suppose the MacGuys sell somewhere between 0 and 4 computers each week from their store, according to the probability distribution to the right.
- Computers sell for $4,300 each.
- Analytically compute the mean and standard deviation for weekly demand for computers.
- Analytically compute the mean and standard deviation for weekly revenue.
- Simulate data for a number of weeks, and compute these same statistics.

Probability Distribution:

Demand	**Prob.**
0	0.2
1	0.4
2	0.2
3	0.1
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- Suppose there is an inventory cost of $50 per computer.
- If the company falls short, the company not only fails to make a sale, but is estimated to loose $500 in future revenue per computer, due to making a customer unhappy.
- Suppose the company orders 1 computer per week.
- Simulate demand for two years (104 weeks), simulate inventory for each week:

$$\text{Inventory}_t = \max(\text{Inventory}_{t-1} - \text{Demand}_{t-1}, 0) + 1.$$

- Simulate revenue, adjusting for $50 inventory cost, $500 shortage cost.

$$\text{Revenue}_t = (\$4,300)\ \min(\text{Inventory}_t, \text{Demand}_t)$$
$$-(\$50)\ \text{Inventory}_t - (\$500) \max(\text{Demand}_t - \text{Inventory}_t, 0)$$

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Something More Complicated

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Queuing System Example

- A denim manufacturing facility receives yarn at varying time intervals (according to the probability distribution in the following slide).
- Then it dyes the yarn, which takes varying amounts of time according to the second probability distibution (according to the second probability distribution on the following slide).
- If a batch of yarn arrives at the facility, it is possible it must wait for the previous batch to complete.
- It is possible that facility sits not utilized while it waits for another batch of yarn to arrive.
- Calculate the mean and std dev for the total time in the facility (waiting time + dying time).
- Calculate the mean and std dev for the waiting time.
- Calculate the average number of days per month the facility is idle.

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Distribution of Arrival Intervals:

Arrival Interval	Probability
1 day	0.2
2 days	0.4
3 days	0.3
4 days	0.1

Distribution of Dying Times:

Dying Time	Probability
0.5 days	0.2
1 day	0.5
2 days	0.3

Compute the following:

1. Simulate Interval_i.
2. $\text{Arrival}_i = \text{Arrival}_{i-1} + \text{Interval}_i$.
3. $\text{Waiting}_i = max(\text{Finish}_{i-1} - \text{Arrival}_i, 0)$
4. $\text{Idle}_i = max(\text{Arrival}_i - \text{Finish}_{i-1}, 0)$
5. Simulate Dying_i.
6. $\text{TimeSystem}_i = \text{Waiting}_i + \text{Dying}_i$
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Homework

- End of Chapter 14 (pages 665-666), problems 7 and 8.
- Due Tuesday, November 6, before class.
- Type up answers in a Microsoft Word file, include your Excel file.
- Upload to D2L dropbox.