Lecture 10

1. You are the marketing manager for a soft drink company. You need to determine the amount of drink to produce next year and maximize total revenue. The company predicts the following economic situations and their respective probabilities: recession 25%, recovering 30%, stable 15%, and booming 30%. The production cost per drink is estimated to be $0.45. The demand for the drink in each type of economy is shown in the following table:

Economy	Probability	Demand
Recession	25%	20,000
Recovering	30%	35,000
Stable	15%	85,000
Booming	30%	100,000

Price per unit is determined by the actual demand and is shown in the following table:

Demand	Price/Unit
20,000	$0.70
35,000	$0.80
85,000	$0.90
100,000	$1.00

a. Create an Excel template that calculates the total revenue for various production levels.
b. Use a combination of RAND() and VLOOKUP() functions to allow the template to randomly suggest production levels and price levels considering the distribution of the state of the economy.
c. Generate 1,000 data points and calculate the revenue for each of these data points.
d. Use summary statistics to decide the best production level that provides the highest-possible expected revenue

Answers: see *ch10_P1softdrink_solution.xlsx*

2. A new airline wants to determine how many flights to assign between two cities. Each flight can carry 100 passengers and the demand is estimated to follow the distribution indicated in the following table:

Demand	Probability
100	0.05
200	0.2
300	0.4
400	0.3
500	0.05

It costs the airline $70 to fly a passenger and each empty seat is costing the airline $50. The airline is charging an average rate of $250 per seat for every ticket sold.
a. Create an Excel template that calculates the total revenue for a given number of flights between the two cities.

b. Modify the template with RAND() and VLOOKUP() functions to allow for random generation of passenger demands.
c. Generate 500 data points and calculate the airline revenue for each of these data points.
d. Use summary statistics to decide the optimal number of flights between two cities that maximizes the expected revenue.

Answers: see *ch10_P2_P3airline_solution.xlsx*

3. Consider the airline case from the previous problem and assume the following impact of the established price on attracting the existing customer demand for the two cities:

Price	**Demand Attracted**
Below $250	100%
$251—$300	80%
$301—$400	50%
Over $400	0%

When the price is above $400, passengers will use an alternative route between two cities.

a. Modify the previously created Excel template to calculate the total revenue for a given number of flights between two cities and for a given price tag.
b. Modify the template with RAND() and VLOOKUP() functions to allow for random generation of passenger demands.
c. Create a matrix that calculates the average airline revenue for different numbers of flights and different price levels.
d. Use summary statistics to decide the optimal ticket prices and number of flights between two cities that maximizes the expected revenue.

Answers: see *ch10_P2_P3airline_solution.xlsx*

4. The state variables of a weather system change continuously as weather patterns evolve. As such, a weather simulation model can be represented with a continuous simulation model.
    a. True
    b. False

5. The state variables of a restaurant change when a customer arrives, when an order is taken, and when the food is served. As such, the restaurant can be represented with a continuous simulation model.
    a. True
    b. False

6. A static simulation model represents the system over a period of time.
    a. True
    b. False

7. Dynamic models have an embedded simulation clock and mimic the behavior of the system from a given start time to a given end time.
    a. True
    b. False

8. When one or more input variables are random, then the output variables are also random.
    a. True
    b. False

9. The simulation modeler must perform a pilot run in order to compare the performance of the model with the performance of the system being simulated.
    a. True
    b. False

10. The purpose of pilot runs in a simulation model is to generate enough solutions to perform model validation and verification.
    a. True
    b. False

11. Which of the following explains why simulation is a preferred prescriptive analytics tool when investigating the behavior of complex systems?
    a. Simulation can be used to find optimal solutions for complex systems.
    b. Simulation can be used to mimic the complexity of the systems and test alternative solutions.
    c. Simulation can be used to replace other mathematical programming techniques.
    d. All of the above

12. Which of the following is not an advantage of simulation methodology as compared to mathematical programming techniques?
    a. Finding optimal solutions
    b. Investigating hypothetical scenarios before implementing potential costly changes
    c. Dealing with relatively complex systems
    d. None of the above

13. Simulation methodology can be used to test business scenarios without significant process disruptions. These scenarios include:
    a. Testing different machines with different capabilities.
    b. Testing new facility locations.
    c. Testing alternative product designs.
    d. Testing scheduling policies.
    e. All of the above

14. A simulation model is discrete when the state of the variables:

a. Does not change over time.
b. Changes at discrete points in time.
c. Changes at continuous points in time.
d. All of the above

15. Which of the following is true about a static simulation model?
    a. A static simulation model represents the system at a given point in time.
    b. A static simulation model is different from Monte Carlo simulation model.
    c. A static simulation model is used for decision-making under certainty.
    d. All of the above

16. Which of the following is true about a deterministic simulation model?
    a. The model contains no random variables.
    b. The model is also known as a Monte Carlo simulation model.
    c. The model may have one or more random variables.
    d. All of the above

17. Which of the following is a step in the simulation methodology?
    a. Describing the problem in order to understand the business model
    b. Designing a conceptual model
    c. Collecting data
    d. All of the above

18. The conceptual model of the simulation model involves:
    a. Identifying the scope of the model.
    b. Identifying the timeframe of the simulation study.
    c. Identifying the goals of the model.
    d. All of the above

19. Which of the following is a goal of the conceptual design stage of the simulation methodology?
    a. Identifying the information needed to build the simulation model
    b. Identifying the information already available to build the simulation model
    c. Identifying the information that needs to be collected to build the simulation model
    d. All of the above

20. Which of the following can be a source of input data for a simulation model?
    a. Historical records
    b. Observations
    c. Interviews
    d. All of the above

21. A simulation model is valid when it represents:
    a. The correct real-life system.

b. The real-life system correctly.
c. Both a and b
d. Neither a nor b

22. A simulation model is verified when it represents:
    a. The correct real-life system.
    b. The real-life system correctly.
    c. Both a and b
    d. Neither a nor b

23. In a simulation run, the warm-up period is used to:
    a. Validate the model performance.
    b. Bring the system to a stable state.
    c. Test the system with idle resources.
    d. All of the above

24. Big Data offers opportunities when applied to simulation models, mostly due to the dimension(s) of:
    a. Volume.
    b. Velocity.
    c. Variety.
    d. All of the above

25. Big Data poses challenges when applied to simulation models, mostly due to the dimension(s) of:
    a. Volume.
    b. Veracity.
    c. Variety.
    d. All of the above