

MgtOp 470—Business Modeling with Spreadsheets
Washington State University
Sample Final Exam Spring 2020

Section 1—Multiple Choice

1. An information desk at a rest stop receives requests for assistance (from one server). Assume that a Poisson probability distribution with a mean rate of 5 requests per hour can be used to describe the arrival pattern and that service times follow the exponential probability distribution, with a mean service rate of 1 request per minute. What is the probability that there are no requests for assistance in the system?

A. 0%
B. 8.3%
C. -4%
D. -400%
E. 91.7%

2. Consider a single-server queuing system (with Poisson arrivals and exponential service times). If the arrival rate is 30 units per hour, and each customer takes 30 seconds on average to be served, what is the average length of the queue?

A. 1.03
B. -1.03
C. 0.166
D. 0.333
E. 0.083

3. Consider a single waiting line, single server queueing system. The arrival rate is 80 people per hour, and the service rate is 120 units per hour. What is the probability of having 3 or more units in the system?

A. 29.64%
B. 33.33%
C. 0.00%
D. 9.88%
E. 66.67%

4. Customers walk into a bank at an average rate of 20 per hour. On average, there are 5 people waiting in the queue to be served. How long does the average customer wait in queue?

A. 15 minutes
B. 0.25 minutes
C. 4 minutes
D. 3 minutes
E. 8 minutes

5. Which of the following statements is not correct?
- A. A multiple variable function can be linear.
 - B. If the feasible region is empty, then the problem is infeasible.
 - C. Given a linear program with a maximization objective, the optimal objective function value may increase if a $\geq$ constraint is added to the program.
 - D. Nonnegativity constraints should be added to linear programs when the decision variables represent units of production.
 - E. An “unbounded” solution to a mathematical program may occur if there is not a constraint stopping the objective function value from continuing towards $-\infty$.

6. How can the following linear program be characterized?

$$\begin{array}{ll}\text{Max } & X + Y \\ \text{Subject to} & \\ & X \leq 34 \\ & X, Y \geq 0\end{array}$$

- A. bounded and feasible
 - B. unbounded and feasible
 - C. bounded and infeasible
 - D. unbounded and infeasible
7. *Capital Co.* is considering 5 different projects. Define X_i as a binary variable that equals 1 if project i is undertaken and 0 otherwise, for $i = 1, 2, 3, 4, 5$. Which of the following represents the constraint(s) stating that projects 2, 3, and 4 cannot all three be undertaken simultaneously?
- A. $X_2 + X_3 + X_4 \leq 3$
 - B. $X_1 + X_2 + X_3 + X_4 + X_5 \leq 3$
 - C. $X_2 + X_3 + X_4 \leq 1$
 - D. $X_2 + X_3 + X_4 \leq 2$
 - E. $X_2 + X_3 \leq 1$ and $X_3 + X_4 \leq 1$
8. For “The Assignment Problem,” what is the best and safest way to handle prohibited assignments?
- A. Insert 100,000 for the cost of that assignment.
 - B. Use infinity or a letter that represents a huge number for the cost of that assignment.
 - C. Solve the problem graphically as a linear program.
 - D. There is no way to handle prohibited assignments.

9. Consider a typical employee shift scheduling problem that can be formulated as a linear program as done in class and in the homework. Ignoring nonnegativity and integer constraints, how many constraints will the program have?
- A. equal to the number of shifts
 - B. equal to the number of separate time periods of demand
 - C. equal to the number of hours that each shift works
 - D. equal to the number of different labor costs

(For problems 10-12)

Riker Co. is considering which of 4 different projects to undertake in order to maximize its net present value (NPV). Define X_i as a binary variable that equals 1 if project i is undertaken and 0 otherwise, for $i = 1, 2, 3, 4$. The NPV and required capital (in millions) for each project are listed below.

<u>Project</u>	<u>Net Present Value</u>	<u>Capital Required</u>
1	60	7
2	50	10
3	40	6
4	20	3

10. Which of the following ensures that project 3 can only be undertaken if project 2 is undertaken?
- A. $X_3 \leq X_2$
 - B. $X_2 \leq X_3$
 - C. $X_3 = X_2$
 - D. $X_2 + X_3 \leq 1$
 - E. $X_2 + X_3 \leq 2$
 - F. $X_2 + X_3 \geq 1$
11. Which of the following represents the constraint(s) stating that project 1 must be undertaken and at least 1 of the other projects must be undertaken?
- A. $X_1 + X_2 \leq 1$, and $X_1 + X_3 \leq 1$, and $X_1 + X_4 \leq 1$
 - B. $X_1 \geq 1$, and $X_2 + X_3 + X_4 \geq 1$
 - C. $X_1 + X_2 \geq 1$, and $X_1 + X_3 \geq 1$, and $X_1 + X_4 \geq 1$
 - D. $X_1 \geq 1$, and $X_2 + X_3 + X_4 \leq 3$
 - E. $X_1 + X_2 + X_3 + X_4 \geq 2$

12. What is the proper objective function?

- A. $\text{Max } X_1 + X_2 + X_3 + X_4$
- B. $\text{Min } 60X_1 + 50X_2 + 40X_3 + 20X_4$
- C. $\text{Max } 60X_1 + 50X_2 + 40X_3 + 20X_4$
- D. $\text{Max } 7X_1 + 10X_2 + 6X_3 + 3X_4$
- E. $\text{Min } 7X_1 + 10X_2 + 6X_3 + 3X_4$
- F. $\text{Max } 170(X_1 + X_2 + X_3 + X_4)$

13. Which of the following does not represent a technique to simplify a model?

- A. make variables into constants
- B. eliminate variables
- C. use linear relations
- D. weaken some assumptions and restrictions
- E. suppress randomness

14. Which area of a pivot table contains the numeric fields that you want to summarize?

- A. FILTERS
- B. COLUMNS
- C. VALUES
- D. ROWS
- E. TOTALS

(For Questions 15 through 19)

Consider the following payoff table (profits in millions).

		States of Nature				
		1	2	3	4	5
Alternatives	A	15	2	21	-2	20
	B	4	4	4	4	4
	C	-2	-9	-3	-5	45
	D	20	-16	0	16	-20
	E	3	6	15	16	18

15. What is the best decision using the Maximax decision criterion?

- A. A
- B. B
- C. C
- D. D
- E. E

16. What is the best decision using the Maximin decision criterion?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
17. What is the best decision using the Minimax Regret decision criterion?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
18. What is the best decision using the Principle of Insufficient Reason decision criterion?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
19. What is the best decision using the Hurwicz Criterion with $\alpha = 0.6$?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E
20. Consider the paper, "Using Bivalent Integer Programming to Select Teams for Intercollegiate Women's Gymnastics Competition." Which of the following statements is not true about the objective function?
- A. It can accommodate historical scores of the gymnasts.
 - B. It can accommodate predicted scores of the gymnasts.
 - C. It gives credit to gymnasts with slightly lower average but less variable scores (i.e., the "steady" or "consistent" performer).
 - D. All events are assigned the same priority weight.
 - E. For any given event, all-around gymnasts are assigned the same priority weight as individual event gymnasts are.

21. A distribution of service times at a waiting line indicates that service takes 6 minutes 30 percent of the time, 7 minutes 30 percent of the time, 8 minutes 20 percent of the time, and 9 minutes 20 percent of the time. In preparing this distribution for Monte Carlo analysis, the service time of 8 minutes would be represented by what random number range?
- A. 20 through 40
 - B. 61 through 80
 - C. 70 through 90
 - D. 71 through 90
 - E. 01 through 20
22. From a portion of a probability distribution, you read that $P(\text{demand} = 0)$ is 0.25, and $P(\text{demand} = 1)$ is 0.40. What are the random number intervals for this distribution beginning with 01?
- A. 01 through 25, and 26 through 40
 - B. 01 through 25, and 01 through 40
 - C. 01 through 25, and 26 through 55
 - D. 01 through 25, and 26 through 65
 - E. 00 through 25, and 26 through 65
23. From a portion of a probability distribution, you read that $P(\text{demand} = 0)$ is 0.05 and $P(\text{demand} = 1)$ is 0.15. The cumulative probability for demand = 1 would be which of the following?
- A. 0.05
 - B. 0.075
 - C. 0.10
 - D. 0.15
 - E. 0.20
24. A distribution of service times at a waiting line indicates that service takes 12 minutes 30 percent of the time and 14 minutes 70 percent of the time. This distribution has been prepared for Monte Carlo analysis. The first four random numbers drawn are 07, 60, 77, and 49. What is the average service time of this simulation?
- A. 12 minutes
 - B. 13 minutes
 - C. 13.5 minutes
 - D. 14 minutes
 - E. 54 minutes

25. The Excel screen shots below show the output from 10 trials of a simulation along with the bin range for an associated histogram.

	A	B	C	D
1	<u>Trial</u>	<u>Profit</u>		<u>Bins</u>
2	1	\$498		250
3	2	\$783		500
4	3	\$124		750
5	4	\$222		
6	5	\$227		
7	6	\$287		
8	7	\$365		
9	8	\$861		
10	9	\$21		
11	10	\$638		

In the histogram frequency table, what would be the frequency next to the 500 bin?

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4