**Module C: Waiting Line Models**

**Test Bank**

**Multiple Choice**

1. Which of the following statements is FALSE about customer waiting lines?

a. A waiting line occurs when customers arrive at a service facility at random rather than at predictable intervals.

b. A waiting time for a customer is dependent on the number of people waiting for service ahead of that customer.

c. Waiting lines can only be physical, with customers waiting in line for service.

d. The time it takes to service a customer varies, as each customer’s need for service is often unique.

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Introduction to Waiting Line Models

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

2. The primary objective of managing waiting lines is to \_\_\_\_\_\_ throughout any service or manufacturing facility.

a. maximize total costs

b. minimize total costs

c. maximize total time

d. minimize production volume

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

3. The total cost throughout any service or manufacturing facility consists of \_\_\_\_\_\_ components.

a. two

b. three

c. four

d. five

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

4. Waiting lines cause \_\_\_\_\_\_ and \_\_\_\_\_\_ costs.

a. fixed and variable

b. fixed and recurring

c. tangible and intangible

d. capacity and demand

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

5. Which of the following is one of the components of total costs involved with managing waiting lines?

a. Costs related to raw materials

b. Costs related to work-in-process inventory

c. Costs related to customer waiting time

d. Costs related to customer arrival rate

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

6. Consider a scenario in which customers decide not to wait and receive service from a competitor. The lost sales are an example of \_\_\_\_\_\_.

a. tangible costs

b. fixed costs

c. recurring costs

d. intangible costs

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

7. Wages paid to workers while the facility remains idle because of machine repair or lack of parts in an example of \_\_\_\_\_\_.

a. recurring costs

b. maintenance costs

c. intangible costs

d. tangible costs

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

8. \_\_\_\_\_\_ costs are incurred in order to maintain existing facility capacity or add additional capacity to provide the required service.

a. Customer waiting time–related

b. Capacity related

c. Manufacturing

d. Service

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

9. In waiting line systems, the cost of service levels provided are \_\_\_\_\_\_ to capacity-related costs.

a. directly related

b. linear

c. inversely related

d. proportional

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

10. Low level of service often results in \_\_\_\_\_\_.

a. higher customer satisfaction

b. longer waiting lines

c. lower waiting time cost

d. higher capacity-related costs

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

11. High level of service often results in \_\_\_\_\_\_.

a. higher capacity related costs and lower waiting time costs

b. lower capacity related costs and higher waiting time costs

c. lower capacity related costs and lower waiting time costs

d. higher capacity related costs and higher waiting time costs

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

12. The branch of mathematics that deals with the study and analysis of waiting lines is known as \_\_\_\_\_\_.

a. queuing theory

b. waiting line theory

c. queue analysis

d. game theory

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

13. \_\_\_\_\_\_ represents a certain number of customers waiting for service at a facility.

a. Queue

b. Service level

c. Service capacity

d. Arrival rate

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-1. Identify the various cost implications and the key features of waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

14. In \_\_\_\_\_\_, a mathematical model of a waiting line system is constructed so that the length of the queues and their associated waiting times can be predicted.

a. queuing theory

b. waiting line theory

c. queue analysis

d. game theory

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

15. In queuing theory models, the customers that potentially need service can be considered as arriving from \_\_\_\_\_\_.

a. finite population only

b. infinite population only

c. finite and infinite population

d. limited population only

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Customer Population

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

16. Toll booths on expressways, banks on busy streets, and theme parks are examples of \_\_\_\_\_\_.

a. finite population source

b. infinite population source

c. limited population source

d. constant population source

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Customer Population

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

17. The number of patients assigned to a doctor is an example of \_\_\_\_\_\_.

a. limited population source

b. constant population source

c. infinite population source

d. discrete population source

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Customer Population

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

18. \_\_\_\_\_\_ population source theoretically represents systems that potentially have a large number of possible customers.

a. Limited

b. Constant

c. Infinite

d. Discrete

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Customer Population

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

19. \_\_\_\_\_\_ describes the way customers arrive at the service system.

a. Arrival pattern

b. Arrival rate

c. Interarrival time

d. Service time

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

20. Which of the following statements is FALSE about random arrivals?

a. The exact time when a customer will arrive cannot be predicted.

b. Arrivals of customers are independent of each other.

c. Arrivals at most service facilities are random.

d. Arrivals of customers are dependent on each other.

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

21. \_\_\_\_\_\_ is the number of customer arrivals per unit of time.

a. Arrival pattern

b. Arrival rate

c. Interarrival time

d. Service time

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

22. When a variable’s outcomes take on numerical values that can be counted , the variable is known as a(n) \_\_\_\_\_\_.

a. discrete random variable

b. random variable

c. continuous random variable

d. independent variable

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

23. If 50 customers arrive at a teller window in a bank during a 5-hour period, then the arrival rate is \_\_\_\_\_\_.

a. 250 customers per hour

b. 10 customers per hour

c. five customers per hour

d. 50 customers per hour

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

24. In waiting line problems, the arrival rate is typically described by a discrete probability distribution known as \_\_\_\_\_\_.

a. Poisson distribution

b. binomial distribution

c. normal distribution

d. positive exponential distribution

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

25. The mathematical expression for the Poisson distribution is shown as *P(x) = e-λλx/x*! The term *x* stands for \_\_\_\_\_\_.

a. probability of arrivals

b. number of arrivals per unit of time

c. expected or average arrival rate

d. total arrival time

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

26. The mathematical expression for the Poisson distribution is shown as *P(x) = e-λλx/x*! The term *λ* stands for \_\_\_\_\_\_.

a. probability of arrivals

b. number of arrivals per unit of time

c. expected or average arrival rate

d. total arrival time

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

27. Assume the average arrival rate at a service center is five customers per hour. Determine the probability of three customers arriving in any random hour.

a. 4%

b. 5%

c. 10%

d. 14%

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

28. \_\_\_\_\_\_ is the elapsed time between one customer arrival and the next.

a. Arrival pattern

b. Arrival rate

c. Interarrival time

d. Service time

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

29. In waiting line problems, the interarrival time is assumed to follow a probability distribution known as \_\_\_\_\_\_.

a. Poisson distribution

b. binomial distribution

c. normal distribution

d. negative exponential distribution

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

30. \_\_\_\_\_\_ is a probability distribution that describes the time between events in a process in which events occur continuously and independently at a constant average rate.

a. Poisson distribution

b. binomial distribution

c. normal distribution

d. negative exponential distribution

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Arrival Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

31. \_\_\_\_\_\_ limit the size or length of a finite queue.

a. Capacity constraints

b. Demand constraints

c. Service constraints

d. Time constraints

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Queue Size and Discipline

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

32. \_\_\_\_\_\_ refers to the order in which customers waiting in line receive service at the facility.

a. Queue discipline

b. Queue size

c. Service pattern

d. Interarrival rate

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Queue Size and Discipline

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

33. Which of the following is the most commonly used queue disciplines?

a. last in, first out

b. first in, first out

c. random order

d. alphabetical order of last names

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Queue Size and Discipline

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

34. \_\_\_\_\_\_ is the design or structure of the service system.

a. Service pattern

b. Queue discipline

c. Service system structure

d. Phase design

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service System Structure

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

35. \_\_\_\_\_\_ refers to the total number of counters, service bays, or other providers that are part of the system.

a. Number of phases

b. Number of channels

c. Number of queues

d. Number of service systems

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service System Structure

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

36. \_\_\_\_\_\_ refers to the number of service stops that each customer must make in sequential servers to complete the required service.

a. Number of phases

b. Number of channels

c. Number of queues

d. Number of service systems

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service System Structure

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

37. There are \_\_\_\_\_\_ basic service system structures based on the number of channels and phases.

a. three

b. four

c. five

d. six

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service System Structure

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

38. An airport check-in and security-service system is an example of \_\_\_\_\_\_ structure.

a. single channel, single-phase

b. single channel, multiphase

c. multichannel, multiphase

d. multichannel, single-phase

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Figure C.3: Basic Service Structures

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

39. In \_\_\_\_\_\_, \_\_\_\_\_\_ structure, the customer joins a single waiting line but receives service in multiple phases.

a. single channel, single-phase

b. single channel, multiphase

c. multichannel, multiphase

d. multichannel, single-phase

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Figure C.3: Basic Service Structures

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

40. The number of customers served per unit of time is called \_\_\_\_\_\_.

a. service rate

b. service time

c. arrival rate

d. interarrival rate

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

41. In waiting line problems, the service rate is assumed to follow a probability distribution known as \_\_\_\_\_\_.

a. discrete Poisson distribution

b. binomial distribution

c. normal distribution

d. negative exponential distribution

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

42. In waiting line problems, the service time is assumed to follow a probability distribution known as \_\_\_\_\_\_.

a. discrete Poisson distribution

b. binomial distribution

c. normal distribution

d. negative exponential distribution

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

43. A waiting line grows infinitely long when \_\_\_\_\_\_.

a. service rate is greater than arrival rate

b. arrival rate is greater than service rate

c. service rate is equal to arrival rate

d. arrival rate is stable

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

44. Let us assume the average number of customers served per hour is five customers. What is the probability that the service exceeds 15 minutes for any customer?

a. 29%

b. 76%

c. 45%

d. 13%

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

45. Let us assume the average number of customers served per hour is five customers. What is the probability that the service exceeds 1 hour for any customer?

a. 0.67%

b. 1.23%

c. 0.98%

d. 9.00%

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Service Pattern

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

46. Which of the following is NOT one of the commonly used measures of the queuing model?

a. average number of customers waiting in line

b. average time a customer spends waiting in line for service

c. average value of transaction by the customer

d. capacity utilization factor for the system

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Measuring Performance of Waiting Line Systems

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

47. Which of the following assumptions is FALSE about the single-server queuing model?

a. The size of the queue is infinite.

b. Average arrival rates remain constant over time.

c. Arrival rates follow a negative exponential distribution.

d. It uses first-in, first-out (FIFO) queue discipline.

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Queuing Models

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

48. In the notation used to identify the single-channel queuing model (M/M/1), the second *M* refers to \_\_\_\_\_\_.

a. Poisson distribution of arrival rates

b. Poisson distribution of service rates

c. single channel or server

d. constant service rate

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

49. In queuing models, if the service rate forms a Poisson distribution, then the service times have a \_\_\_\_\_\_.

a. binomial distribution

b. positive exponential distribution

c. Poisson distribution

d. negative exponential distribution

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

50. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. Determine the capacity utilization for the system.

a. 56%

b. 78%

c. 83%

d. 98%

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

51. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. Determine the percentage of time the employee at the service booth will be idle.

a. 17%

b. 44%

c. 12%

d. 43%

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

52. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. Determine the average number of customers waiting in line.

a. 3.23 customers

b. 4.17 customers

c. 8 customers

d. 7.65 customers

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

53. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. Determine the average time a customer spends in the system.

a. 30 minutes

b. 20 minutes

c. 45 minutes

d. 15 minutes

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

54. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. Determine the probability of exactly five customers in the system.

a. 4.50%

b. 6.70%

c. 5.60%

d. 3.80%

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

55. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. It is estimated that the cost of customer waiting time associated with dissatisfied customers and loss of goodwill is $12 per hour. The employee at the service booth is paid $8 an hour. Determine the average customer waiting time cost per day in the queue. Assume total hours of operation as 10 hours per day.

a. $599

b. $625

c. $500

d. $700

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

56. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. It is estimated that the cost of customer waiting time associated with dissatisfied customers and loss of goodwill is $15 per hour. The employee at the service booth is paid $10 an hour. Determine the total expected cost per day for the waiting line system. Assume total hours of operation as 10 hours per day.

a. $725

b. $625

c. $500

d. $100

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

57. Customers at an amusement park arrive at the rate of 10 customers per hour. The entry booth is staffed by one employee. The mean service time at the booth to provide service to each customer is 5 minutes. The arrival rate follows a Poisson distribution, and the service time at the booth follows a negative exponential distribution. It is estimated that the cost of customer waiting time associated with dissatisfied customers and loss of goodwill is $15 per hour. The employee at the service booth is paid $10 an hour. Determine the capacity related cost per day for the waiting line system. Assume total hours of operation as 10 hours per day.

a. $725

b. $625

c. $500

d. $100

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model I: Single-Channel or Single-Server Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

58. In the notation used to identify the single-channel, constant service rate queuing model M/D/1, the letter *D* refers to \_\_\_\_\_\_.

a. Poisson distribution of arrival rates

b. Poisson distribution of service rates

c. single channel or server

d. constant service rate

Ans: D

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model II: Single-Channel or Server, Constant Service Rate Queuing Model

Difficulty Level: Easy

AACSB: Systems and processes in organizations, including planning and design, production/operations, supply chains, marketing, and distribution

59. An automatic car wash with a single bay takes a constant 3 minutes to wash. The arrival rate is 10 cars per hour. Determine the average number of cars waiting in line for the car wash. The arrival rate of cars tends to follow a Poisson distribution.

a. 0.25 cars

b. 0.5 cars

c. 1 car

d. 1.5 cars

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model II: Single-Channel or Server, Constant Service Rate Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

60. An automatic car wash with a single bay takes a constant 3 minutes to wash. The arrival rate is 10 cars per hour. Determine the average time a car spends in the system. The arrival rate of cars tends to follow a Poisson distribution.

a. 5 minutes

b. 6 minutes

c. 3.5 minutes

d. 4.5 minutes

Ans: D

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model II: Single-Channel or Server, Constant Service Rate Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

61. The notation *M/M/S* is a representation of which of the following models?

a. single-channel or single-server queuing model

b. single-channel, constant service rate queuing model

c. multiple-channel or multiple-server queuing model

d. finite population queuing model

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

62. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the probability that no customers are there in the system.

a. 50%

b. 60%

c. 70%

d. 45%

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

63. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the probability that an arriving customer will wait for service.

a. 16.67%

b. 34.54%

c. 12.32%

d. 11.56%

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

64. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the average number of customers waiting in line.

a. 0.75

b. 0.89

c. 0.08

d. 0.98

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

65. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the average number of customers waiting in the system.

a. 0.75

b. 0.89

c. 0.08

d. 0.98

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

66. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the average time the customer spends in the system.

a. 2.25 minutes

b. 3 minutes

c. 0.25 minutes

d. 1 minute

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

67. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. T The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. Determine the average time the customer spends in the queue.

a. 2.25 minutes

b. 3 minutes

c. 0.25 minutes

d. 1 minute

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

68. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. T The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. It is estimated that the cost of customer waiting time associated with dissatisfied customers and loss of goodwill is $20 per hour. The employee at the service booth is paid $10 an hour. Determine the customer waiting time cost per day for the waiting line system. Assume total hours of operation as 10 hours per day.

a. $16.67

b. $17.67

c. $15.67

d. $14.56

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

69. The owner of an amusement park has decided to open a second entry booth and hire another employee to service customers entering the park. Customers arrive at the rate of 20 per hour and will wait in a single line until one of the two employees is available to provide service. The average service time of both employees is 2 minutes to provide service. The arrival rate follows Poisson distribution, and the service time follows a negative exponential distribution. It is estimated that the cost of customer waiting time associated with dissatisfied customers and loss of goodwill is $20 per hour. The employee at the service booth is paid $10 an hour. Determine the total expected cost per day for the waiting line system. Assume total hours of operation as 10 hours per day.

a. $226.67

b. $245.67

c. $216.67

d. $234.21

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model III: Multiple-Channel or Multiple-Server Queuing Model

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

70. In queuing theory, \_\_\_\_\_\_ means that the number of customers or objects in a waiting line system is the same as the number of customers or objects leaving the system—the arrival rate is equal to the service rate.

a. equilibrium

b. steady state

c. FIFO state

d. stable state

Ans: B

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Little’s Law

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

71. Let us consider that customers arrive at the rate of seven per hour and wait for an average 0.25 hour in a shop. Using Little’s law, determine the average number of customers in the queuing system.

a. 2

b. 2.4

c. 1.25

d. 1.75

Ans: D

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Little’s Law

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

72. Suppose an item stays in an inventory system for an average of 8 days, and the demand rate for this item is 15 units per day. Determine the average inventory level for this item.

a. 100

b. 80

c. 120

d. 150

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Little’s Law

Difficulty Level: Medium

AACSB: Application of knowledge (able to translate knowledge of business and management into practice)

73. Which of the following statements is FALSE about finite population queuing model?

a. Arrival rates have a Poisson distribution.

b. Services time has a negative exponential distribution.

c. Length of the queue has an impact on the arrival rate.

d. Arrival rate is independent of the length of the queue.

Ans: D

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Easy

AACSB: Economic, political, regulatory, legal, technological, and social contexts of organizations in a global society

74. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the average number of machines working.

a. 3.59

b. 2.87

c. 3.43

d. 2.54

Ans: B

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

75. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the average number of machines that will break down.

a. 1.41

b. 2.13

c. 1.57

d. 2.46

Ans: B

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

76. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the average cost per hour of downtime.

a. $500.34

b. $532.50

c. $234.50

d. $675.50

Ans: B

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

77. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the total cost per hour.

a. $550.34

b. $582.50

c. $284.50

d. $725.50

Ans: B

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

78. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the average number of machines working if the number of technicians is equal to two.

a. 3.72

b. 3.21

c. 2.32

d. 1.32

Ans: A

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

79. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the average cost per hour of downtime if number of technicians is equal to two.

a. $234

b. $432

c. $320

d. $345

Ans: C

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

80. ABS specializes in repair and maintenance of industrial machines. One repair technician has been assigned to five identical grinding machines for repair and maintenance. The machine breaks down after about 20 hours of use, and breakdowns have a Poisson probability distribution. It takes 6 hours to repair a machine, and repair times follow an exponential distribution. Machine downtime costs the company $250 an hour, and the technician is paid $50 an hour. Determine the cost savings of having two technicians as compared to one technician.

a. $320.50

b. $100.50

c. $162.50

d. $175.00

Ans: C

Cognitive Domain: Analysis (Analyze)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model IV: Finite Population Queuing Model

Difficulty Level: Hard

AACSB: Analytical thinking (able to analyze and frame problems)

81. The primary objective of managing waiting lines is \_\_\_\_\_\_.

a. to maximize customer satisfaction

b. to minimize their total costs throughout any service or manufacturing facility

c. to make people who are waiting feel that they are not really waiting for a long time

d. to maximize throughput

Ans: B

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

82. Which of the following is NOT a tangible cost of waiting lines?

a. wages paid to workers while the factory remains idle

b. costs of materials used while waiting

c. lost sales because customers decided to go elsewhere

d. lost productivity while workers are idle

Ans: C

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Cost Implications of Managing Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

83. In waiting line systems, there is a(n) \_\_\_\_\_\_ relationship between customer waiting time costs and capacity-related costs.

a. direct

b. inverse

c. exponential

d. null

Ans: B

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Capacity-Related Costs

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

84. In waiting line systems, a \_\_\_\_\_ level of service means \_\_\_\_\_\_\_ waiting time costs because of reductions in customer dissatisfaction.

a. low, lower

b. high, lower

c. high, higher

d. low, higher

Ans: B

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Capacity-Related Costs

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

85. In modeling a waiting line, we can consider several characteristics. Which of the following is NOT such a characteristic?

a. customer population

b. arrival pattern

c. queue size and discipline

d. revenue or yield per customer

Ans: D

Cognitive Domain: Comprehension (Understand)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

86. Which of the following is LEAST likely to have a very large number of possible customers?

a. banks on busy streets

b. movie theaters

c. theme parks

d. the number of patients assigned to a nurse in the gynecology ward of a hospital

Ans: D

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

87. In queuing models, we make several assumptions about the arrival pattern of customers. Which of the following is NOT one of those assumptions?

a. Customers will patiently wait in line for their turn to receive service.

b. Customers will switch lines to whichever line is moving fastest.

c. Customers will not leave the waiting line.

d. Customers will not refuse to join the line (balk).

Ans: B

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

88. In waiting line models, the variable interarrival time is assumed to follow a probability distribution known as the \_\_\_\_\_\_, which is a probability distribution that describes the time between events in a process in which events occur continuously and independently at a constant average rate.

a. Poisson distribution

b. normal distribution

c. negative exponential distribution

d. binomial distribution

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

89. Which of the following is NOT a type of queue discipline?

a. first come, first served

b. last in, first out

c. marginal profit principle

d. prior appointments

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

90. If the average number of customers served per hour is two customers per hour, then the probability that the service exceeds 9 minutes for any customer is \_\_\_\_\_\_.

a. 74.1%

b. 54.9%

c. 36.8%

d. 17.4%

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

91. If the average number of customers served per hour is three, then the probability that the service exceeds 12 minutes for any customer is \_\_\_\_\_\_.

a. 74.1%

b. 54.9%

c. 36.8%

d. 17.4%

Ans: B

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

92. If the average number of customers served per hour is four, then the probability that the service exceeds 15 minutes for any customer is \_\_\_\_\_\_.

a. 74.1%

b. 54.9%

c. 36.8%

d. 17.4%

Ans: C

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

93. If the average number of customers served per hour is five, then the probability that the service exceeds 21 minutes for any customer is \_\_\_\_\_\_.

a. 74.1%

b. 54.9%

c. 36.8%

d. 17.4%

Ans: D

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

94. If the average number of customers served per hour is five, then the probability that the service exceeds 27 minutes for any customer is \_\_\_\_\_\_.

a. 74.1%

b. 10.5%

c. 36.8%

d. 17.4%

Ans: B

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

95. If the average number of customers served per hour is two, then the probability that the service exceeds 45 minutes for any customer is \_\_\_\_\_\_.

a. 22.3%

b. 10.5%

c. 36.8%

d. 17.4%

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

96. If the arrival rate is 12 cars per hour, and the number of cars serviced in 1 hour is 15, then the service time per car is \_\_\_\_\_\_.

a. 4 minutes

b. 5 minutes

c. 20 minutes

d. 3 minutes

Ans: A

Cognitive Domain: Application (Apply)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Model II: Single-Channel or Server, Constant Service Rate Queuing Model

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

97. In queuing theory, a queue represents \_\_\_\_\_\_.

a. a certain number of customers waiting for service at a facility

b. the number of people waiting to attend on customers

c. the infrastructure to serve customers

d. the service level

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

98. In queuing theory, “random arrivals” means that \_\_\_\_\_\_.

a. customers arrive at given times

b. the arrivals of customers are independent of each other

c. the interval between each customer arrival is fixed

d. you can predict the arrival of the next customer based on the previous customer’s arrival time

Ans: B

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

99. A discrete random variable is a variable whose outcomes take on numerical values \_\_\_\_\_\_.

a. that can be counted

b. that are continuous

c. that are binary

d. that are negative

Ans: A

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)

100. Which of the following statements is FALSE about interarrival time?

a. It is the elapsed time between one customer arrival and the next.

b. It is a continuous random variable.

c. It is a variable whose numerical outcomes can be counted.

d. It is used in analyzing arrival patterns.

Ans: C

Cognitive Domain: Knowledge (Remember)

Learning Objective: C-2. Employ the various queuing models and understand when and how to use them in order to calculate optimal queuing solutions, including the psychology underlying waiting lines.

Answer Location: Characteristics of Waiting Lines

Difficulty Level: Easy

AACSB: Analytical thinking (able to analyze and frame problems)