GLOSSARY

Queue A waiting line.

Queueing theory The body of knowledge dealing with waiting lines.

Operating characteristics The performance measures for a waiting line including the probability that no units are in the system, the average number of units in the waiting line, the average waiting time, and so on.

Single-channel waiting line A waiting line with only one service facility.

Poisson probability distribution A probability distribution used to describe the arrival pattern for some waiting line models.

Arrival rate The mean number of customers or units arriving in a given period of time.

Exponential probability distribution A probability distribution used to describe the service time for some waiting line models.

Service rate The mean number of customers or units that can be served by one service facility in a given period of time.

First-come, first-served (FCFS) The queue discipline that serves waiting units on a first-come, first-served basis.

Transient period The start-up period for a waiting line, occurring before the waiting line reaches a normal or steady-state operation.

Steady-state operation The normal operation of the waiting line after it has gone through a start-up or transient period. The operating characteristics of waiting lines are computed for steady-state conditions.

Multiple-channel waiting line A waiting line with two or more parallel service facilities.

Blocked When arriving units cannot enter the waiting line because the system is full. Blocked units can occur when waiting lines are not allowed or when waiting lines have a finite capacity.

Infinite calling population The population of customers or units that may seek service has no specified upper limit.

Finite calling population The population of customers or units that may seek service has a fixed and finite value.

PROBLEMS

1. Willow Brook National Bank operates a drive-up teller window that allows customers to complete bank transactions without getting out of their cars. On weekday mornings, arrivals to the drive-up teller window occur at random, with an arrival rate of 24 customers per hour or 0.4 customer per minute.
   a. What is the mean or expected number of customers that will arrive in a five-minute period?
   b. Assume that the Poisson probability distribution can be used to describe the arrival process. Use the arrival rate in part (a) and compute the probabilities that exactly 0, 1, 2, and 3 customers will arrive during a five-minute period.
   c. Delays are expected if more than three customers arrive during any five-minute period. What is the probability that delays will occur?
2. In the Willow Brook National Bank waiting line system (see Problem 1), assume that the service times for the drive-up teller follow an exponential probability distribution with a service rate of 36 customers per hour or 0.6 customer per minute. Use the exponential probability distribution to answer the following questions.

a. What is the probability the service time is one minute or less?
b. What is the probability the service time is two minutes or less?
c. What is the probability the service time is more than two minutes?

3. Use the single-channel drive-up bank teller operation referred to in Problems 1 and 2 to determine the following operating characteristics for the system.
   a. The probability that no customers are in the system
   b. The average number of customers waiting
   c. The average number of customers in the system
   d. The average time a customer spends waiting
   e. The average time a customer spends in the system
   f. The probability that arriving customers will have to wait for service
4. Use the single-channel drive-up bank teller operation referred to in Problems 1–3 to determine the probabilities of 0, 1, 2, and 3 customers in the system. What is the probability that more than three customers will be in the drive-up teller system at the same time?