

Some more exercise questions for Chapter 3 Probability

3.89 State, with evidence, whether each of the following statements is true or false:

- (a) The complement of the union of two events is the intersection of their complements.
- (b) The sum of the probabilities of collectively exhaustive events must be equal to 1.
- (c) The number of combinations of x objects chosen from n is equal to the number of combinations of $(n-x)$ objects chosen from n , where $1 \leq x \leq (n - 1)$.
- (d) If A and B are two events, the probability of A , given B , is the same as the probability of B , given A , if the probability of A is the same as the probability of B .
- (e) If an event and its complement are equally likely to occur, the probability of that event must be 0.5.
- (f) If A and B are independent, then \bar{A} and \bar{B} must be mutually exclusive.

3.96. An insurance company estimated that 30% of all automobile accidents were partly caused by weather conditions and that 20% of all automobile accidents involved bodily injury. Further, of those accidents that involved bodily injury, 40% were partly caused by weather conditions.

- (a) What is the probability that a randomly chosen accident both was partly caused by weather conditions and involved bodily injury?
- (b) Are the events "Partly caused by weather conditions" and "Involved bodily injury" independent?
- (c) If a randomly chosen accident was partly caused by weather conditions, what is the probability that it involved bodily injury?
- (d) What is the probability that a randomly chosen accident both was not partly caused by weather conditions and did not involve bodily injury?

3.98. Staff Inc., a management consulting company, is surveying the personnel of Acme Ltd. It determined that 35% of the analysts have an MBA and that 40% of all analysts are over age 35. Further, of those who have an MBA, 30% are over age 35.

- (a) What is the probability that a randomly chosen analyst both has an MBA and also is over age 35?
- (b) What is the probability that a randomly chosen analyst who is over age 35 has an MBA?
- (c) What is the probability that a randomly chosen analyst has an MBA or is over age 35?
- (d) What is the probability that a randomly chosen analyst who is over age 35 does not have an MBA?
- (e) Are the events MBA and over age 35 independent?
- (f) Are the events MBA and over age 35 mutually exclusive?
- (g) Are the events MBA and over age 35 collectively exhaustive?

3.100. It is known that 20% of all farms in a state exceed 160 acres and that 60% of all farms in that state are owned by persons over 50 years old. Of all farms in the state exceeding 160 acres, 55% are owned by persons over 50 years old.

- (a) What is the probability that a randomly chosen farm in this state both exceeds 160 acres and is owned by a person over 50 years old?
- (b) What is the probability that a farm in this state either is bigger than 160 acres or is owned by a person over 50 years old (or both)?
- (c) What is the probability that a farm in this state, owned by a person over 50 years old, exceeds 160 acres?
- (d) Are size of farm and age of owner in this state statistically independent?

3.102. A large corporation organized a ballot for all the workers on a new bonus plan. It was found that 65% of all night-shift workers favored the plan and that 40% of all female workers favored the plan. Also, 50% of all employees are night-shift workers and 30% of all employees are women. Finally, 20% of all night-shift workers are women.

- (a) What is the probability that a randomly chosen employee is a woman in favor of the plan?
- (b) What is the probability that a randomly chosen employee is either a woman or a night-shift worker (or both)?
- (c) Is employee gender independent of whether the night shift is worked?
- (d) What is the probability that a female employee is a night-shift worker?

3.103. A jury of 12 members is to be selected from a panel consisting of 8 men and 8 women.

- (a) How many different jury selections are possible?
- (b) If the choice is made randomly, what is the probability that a majority of the jury members will be men?

3.104. A consignment of 12 electronic components contains 1 component that is faulty. Two components are chosen randomly from this consignment of testing.

- (a) How many different combinations of 2 components could be chosen?
- (b) What is the probability that the faulty component will be chosen for testing?

3.105. Of 100 patients with a certain disease 10 were chosen at random to undergo a drug treatment that increases the cure rate from 50% for those not given the treatment to 75% for those given the drug treatment.

- (a) What is the probability that a randomly chosen patient both was cured and was given the drug treatment?
- (b) What is the probability that a patient who was cured had been given the drug treatment?

- (c) What is the probability that a specific group of 10 patients was chosen to undergo the drug treatment? (Leave your answer in terms of factorials.)

3.107. In a large city 8% of the inhabitants have contracted a particular disease. A test for this disease is positive in 80% of people who have the disease and is negative in 80% of people who do not have the disease. What is the probability that a person for whom the test results is positive has the disease?

3.109. A professor finds that he awards a final grade of A to 20% of his students. Of those who obtain a final grade of A, 70% obtained an A on the midterm examination. Also, 10% of the students who failed to obtain a final grade of A earned an A on the midterm exam. What is the probability that a student with an A on the midterm examination will obtain a final grade of A?

3.113. A restaurant manager classifies customers as regular, occasional, or new, and finds that of all customers 50%, 40% and 10%, respectively fall into these categories. The manager found that wine was ordered by 70% of the regular customers, by 50% of the occasional, and by 30% of the new customers.

- (a) What is the probability that a randomly chosen customer orders wine?
- (b) If wine is ordered, what is the probability that the person ordering is a regular customer?
- (c) If wine is ordered, what is the probability that the person ordering is an occasional customer?

3.114. A record store owner assesses customers entering the store as high school age, college age, or older, and finds that of all customers, 30%, 50% and 20%, respectively, fall into these categories. The owner also found that purchases were made by 20% of high school age customers, by 60% of college age customers, and by 80% of older customers.

- (a) What is the probability that a randomly chosen customer entering the store will make a purchase?
- (b) If a randomly chosen customer makes a purchase, what is the probability that this customer is high school age?

3.117 You are responsible for detecting the source of the error when the computer system fails. From your analysis you know that the sources of error is the disk drive, the computer memory, or the operating system. You know that 50% of the errors are disk drive errors, 30% are computer memory errors and the remainder are operating system errors. From the component performance standards you know that when a disk drive error occurs, the probability of failure is 0.601 when a computer memory error occurs, the probability of failure is 0.7; and when an operating system error occurs, the probability of failure is 0.3. Given the information from the component performance standards, what is the probability of a disk drive error, given that a failure occurred?