(1) Three brands of coffee, X, Y, and Z, are to be ranked according to taste by a judge. Define the following events:

A: Brand X is preferred to Y.
B: Brand X is ranked best.
C: Brand X is ranked second best.
D: Brand X is ranked third best.

If the judge actually has no taste preference and randomly assigns ranks to the brands, is event A independent of events B, C, and D?

(2) Suppose that one of the genes associated with the control of carbohydrate metabolism exhibits two alleles—a dominant W and a recessive w. If the probabilities of the WW, Ww, and ww genotypes in the present generation are p, q, and r, respectively, for both males and females, what are the chances that an individual in the next generation will be a ww?

(3) Suppose that A and B are two events such that $P(A) = .8$ and $P(B) = .7$.
 (a) Is it possible that $P(A \cap B) = .1$? Why or why not?
 (b) What is the smallest possible value for $P(A \cap B)$?
 (c) Is it possible that $P(A \cap B) = .77$? Why or why not?
 (d) What is the largest possible value for $P(A \cap B)$?

(4) In a game, a participant is given three attempts to hit a ball. On each try, she either scores a hit, H, or a miss, M. The game requires that the player must alternate which hand she uses in successive attempts. That is, if she makes her first attempt with her right hand, she must use her left hand for the second attempt and her right hand for the third. Her chance of scoring a hit with her right hand is .7 and with her left hand is .4. Assume that the results of successive attempts are independent and that she wins the game if she scores at least two hits in a row. If she makes her first attempt with her right hand, what is the probability that she wins the game?

(5) A smoke detector system uses two devices, A and B. If smoke is present, the probability that it will be detected by device A is .95; by device B, .90; and by both devices, .88.
 (a) If smoke is present, find the probability that the smoke will be detected by either device A or B or both devices.
 (b) Find the probability that the smoke will be undetected.

(6) Two applicants are randomly selected from among five who have applied for a job. Find the probability that exactly one of the two best applicants is selected, event A.

(7) It is known that a patient with a disease will respond to treatment with probability equal to .9. If three patients with the disease are treated and respond independently, find the probability that at least one will respond.

(8) Observation of a waiting line at a medical clinic indicates the probability that a new arrival will be an emergency case is $p = 1/6$. Find the probability that the rth patient is the first emergency case. (Assume that conditions of arriving patients represent independent events.)

(9) Three radar sets, operating independently, are set to detect any aircraft flying through a certain area. Each set has a probability of .02 of failing to detect a plane in its area. If an aircraft enters the area, what is the probability that it
 (a) goes undetected?
 (b) is detected by all three radar sets?

(10) Of the items produced daily by a factory, 40% come from line I and 60% from line II. Line I has a defect rate of 8%, whereas line II has a defect rate of 10%. If an item is chosen at random from the day's production, find the probability that it will not be defective.

(11) An advertising agency notices that approximately 1 in 50 potential buyers of a product sees a given magazine ad, and 1 in 5 sees a corresponding ad on television. One in 100 sees both. One in 3 actually purchases the product after seeing the ad, 1 in 10 without seeing it. What is the probability that a randomly selected potential customer will purchase the product?

(12) A football team has a probability of .75 of winning when playing any of the other four teams in its conference. If the games are independent, what is the probability the team wins all its conference games?

(13) Suppose that two balanced dice are tossed repeatedly and the sum of the two uppermost faces is determined on each toss. What is the probability that we obtain

(a) a sum of 3 before we obtain a sum of 7?

(b) a sum of 4 before we obtain a sum of 7?

(14) A population of voters contains 40% Republicans and 60% Democrats. It is reported that 30% of the Republicans and 70% of the Democrats favor an election issue. A person chosen at random from this population is found to favor the issue in question. Find the conditional probability that this person is a Democrat.

(15) A diagnostic test for a disease is such that it (correctly) detects the disease in 90% of the individuals who actually have the disease. Also, if a person does not have the disease, the test will report that he or she does not have it with probability .9. Only 1% of the population has the disease in question. If a person is chosen at random from the population and the diagnostic test indicates that she has the disease, what is the conditional probability that she does, in fact, have the disease? Are you surprised by the answer? Would you call this diagnostic test reliable?

(16) A plane is missing and is presumed to have equal probability of going down in any of three regions. If a plane is actually down in region i, let $1 - \alpha_i$ denote the probability that the plane will be found upon a search of the ith region, $i = 1, 2, 3$. What is the conditional probability that the plane is in

(a) region 1, given that the search of region 1 was unsuccessful?

(b) region 2, given that the search of region 1 was unsuccessful?

(c) region 3, given that the search of region 1 was unsuccessful?

(17) Two methods, A and B, are available for teaching a certain industrial skill. The failure rate is 20% for A and 10% for B. However, B is more expensive and hence is used only 30% of the time. (A is used the other 70%.) A worker was taught the skill by one of the methods but failed to learn it correctly. What is the probability that she was taught by method A?