## SECTION 9.1 PROBLEM SET: BINOMIAL PROBABILITY

Do the following problems using the binomial probability formula.

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| 1) A coin is tossed ten times. Find the probability of getting six heads and four tails. | 2) A family has three children. Find the probability of having one boy and two girls. |
| 3) What is the probability of getting three aces(ones) if a die is rolled five times? | 4) A baseball player has a .250 batting average. What is the probability that he will have three hits in five times at bat? |
| 5) A basketball player has an 80% chance of sinking a basket on a free throw. What is the probability that he will sink at least three baskets in five free throws? | 6) With a new flu vaccination, 85% of the people in the high risk group can go through the entire winter without contracting the flu. In a group of six people who were vaccinated with this drug, what is the probability that at least four will not get the flu? |

***SECTION 9.1 PROBLEM SET: BINOMIAL PROBABILITY***

Do the following problems using the binomial probability formula.

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| 7) A transistor manufacturer has known that 5%  of the transistors produced are defective.  What is the probability that a batch of twenty five transistors will have two defective? | 8) It has been determined that only 80% of the people wear seat belts. If a police officer stops a car with four people, what is the probability that at least one person will not be wearing a seat belt? |
| 9) What is the probability that a family of five children will have at least three boys? | 10) What is the probability that a toss of four coins will yield at most two heads? |
| 11) A telemarketing executive has determined that for a particular product, 20% of the people contacted will purchase the product. If 10 people are contacted, what is the probability that at most 2 will buy the product? | 12) To the problem: "Five cards are dealt from a deck of cards, find the probability that three of them are kings," the following incorrect answer was offered by a student.  5C3 (1/13)3(12/13)2  What change would you make in the wording of the problem for the given answer to be correct? |

***SECTION 9.1 PROBLEM SET: BINOMIAL PROBABILITY***

Do the following problems using the binomial probability formula.

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| 13) 63% of all registered voters in a large city voted in the last election. 20 registered  voters from this city are randomly selected. Find the probability that  a. exactly half of them voted in the last election.        b. all of them voted | 14) 30% of customers at BigMart pay cash for their purchases. Suppose that 15 customers are randomly selected. Find the probability that  a. 5 or 6 of them pay cash  b. at most 1 pays cash |
| 15) 12% of all cars on Brighton Expressway exceed the speed limit. If 10 vehicles on this road are randomly selected and their speed is recorded by radar, find the probability that  a. none of them are exceeding the speed limit  b. 1 or 2 are exceeding the speed limit. | 16) Suppose that 73% of all people taking a professional certification exam pass the exam. If 12 people who take this exam are randomly selected, find the probability that  a. exactly half of them pass the exam  b. all of them pass the exam  c. 8 or 9 of them pass the exam |

## SECTION 9.2 PROBLEM SET: BAYES' FORMULA

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| 1) Jar I contains five red and three white marbles, and Jar II contains four red and two white marbles. A jar is picked at random and a marble is drawn. Draw a tree diagram below, and find the following probabilities.  a) P(marble is red)  b) P(It came from Jar II | marble is white)  c) P(Red | Jar I) | 2) In Mr. Symons' class, if a student does homework most days, the chance of passing the course is 90%. On the other hand, if a student does not do homework most days, the chance of passing the course is only 20%.   H = event that the student did homework  C = event that the student passed the course Mr. Symons claims that 80% of his students do homework on a regular basis. If a student is chosen at random from Mr. Symons' class, find the following probabilities.    a) P(C)  b) P(H |C)  c) P(C|H) |
| 3) A city has 60% Democrats, and 40% Republicans. In the last mayoral election,  60% of the Democrats voted for their Democratic candidate while 95% of the Republicans voted for their candidate.  Which party's mayor runs city hall? | 4) In a certain population of 48% men and 52% women, 56% of the men and 8% of the women are color-blind.    a) What percent of the people are color-blind?  b) If a person is found to be color-blind, what is the probability that the person is a male? |

***SECTION 9.2 PROBLEM SET: BAYES' FORMULA***

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| 5) A test for a certain disease gives a positive result 95% of the time if the person actually carries the disease. However, the test also gives a positive result 3% of the time when the individual is not carrying the disease. It is known that 10% of the population carries the disease. If a person tests positive, what is the probability that he or she has the disease? | 6) A person has two coins: a fair coin and a two-headed coin. A coin is selected at random, and tossed. If the coin shows a head, what is the probability that the coin is fair? |
| 7) A computer company buys its chips from three different manufacturers. Manufacturer I provides 60% of the chips and is known to produce 5% defective; Manufacturer II supplies 30% of the chips and makes 4% defective; while the rest are supplied by Manufacturer III with 3% defective chips. If a chip is chosen at random, find the following probabilities:  a) P(the chip is defective)  b) P(chip is from Manufacturer II | defective)  c) P(defective |chip is from manufacturer III) | 8) Lincoln Union High School District is made up of three high schools: Monterey, Fremont, and Kennedy, with an enrollment of 500, 300, and 200, respectively. On a given day, the percentage of students absent at Monterey High School is 6%, at Fremont 4%, and at Kennedy 5%.  If a student is chosen at random, find the probabilities below: *Hint: Convert the enrollments into percentages.*  a) P(the student is absent)  b) P(student is from Kennedy | student is absent)  c) P(student is absent | student is from Fremont) |

***SECTION 9.2 PROBLEM SET: BAYES' FORMULA***

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| 9) At a retail store, 20% of customers use the store’s online app to assist them when shopping in the store ; 80% of store shoppers don’t use the app.  Of those customers that use the online app while in the store, 50% are very satisfied with their purchases, 40% are moderately satisfied, and 10% are dissatisfied.  Of those customers that do not use the online app while in the store, 30% are very satisfied with their purchases, 50% are moderately satisfied and 20% are dissatisfied.  Indicate the events by the following: A = shopper uses the app in the store  N = shopper does not use the app in the store V = very satisfied with purchase  M = moderately satisfied  D = dissatisfied  a. Find P(A and D), the probability that a store customer uses the app and is dissatisfied  b. Find P(A|D), the probability that a store customer uses the app if the customer is dissatisfied. | 10**)** A medical clinic uses a pregnancy test to confirm pregnancy in patients who suspect they are pregnant. Historically data has shown that overall, 70% of the women at this clinic who are given the pregnancy test are pregnant, but 30% are not.  The test's manufacturer indicates that if a woman is pregnant, the test will be positive 92% of the time.  But if a woman is not pregnant, the test will be positive only 2% of the time and will be negative 98% of the time.  a. Find the probability that a woman at this clinic is pregnant **and** tests positive.  b. Find the probability that a woman at this clinic is actually pregnant **given that** she tests positive. |

## SECTION 9.3 PROBLEM SET: EXPECTED VALUE

Do the following problems using the expected value concepts learned in this section,

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| 1) You are about to make an investment which gives you a 30% chance of making $60,000 and 70% chance of losing $ 30,000. Should you invest? Explain. | 2) In a town, 40% of the men and 30% of the women are overweight. If the town has 46% men and 54% women, what percent of the people are overweight? |
| 3) A game involves rolling a Korean die (4 faces). If a one, two, or three shows, the player receives the face value of the die in dollars, but if a four shows, the player is obligated to pay $4. What is the expected value of the game? | 4) A game involves rolling a single die. One receives the face value of the die in dollars. How much should one be willing to pay to roll the die to make the game fair? |
| 5) In a European country, 20% of the families have three children, 40% have two children, 30% have one child, and 10% have no children. On average, how many children are there to a family? | 6) A game involves drawing a single card from a standard deck. One receives 60 cents for an ace, 30 cents for a king, and 5 cents for a red card that is neither an ace nor a king. If the cost of each draw is 10 cents, should one play? Explain. |

***SECTION 9.3 PROBLEM SET: EXPECTED VALUE***

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| 7) Hillview Church plans to raise money by raffling a television worth $500. A total of 3000 tickets are sold at $1 each. Find the expected value of the winnings for a person who buys a ticket in the raffle. | 8) During her four years at college, Niki received A's in 30% of her courses, B's in 60% of her courses, and C's in the remaining 10%. If A = 4, B = 3, and C = 2, find her grade point average. |
| 9) Attendance at a Stanford football game depends upon which team Stanford is playing against.  If the game is against U. C. Berkeley,attend-ance will be 70,000; if it is against another California team, it will be 40,000; and if it is against an out of state team, it will be 30,000. If the probability of playing against U. C. Berkeley is 10%, against a California team 50% and against an out of state team 40%, how many fans are expected to attend a game? | 10) A Texas oil drilling company has determined that it costs $25,000 to sink a test well.  If oil is hit, the revenue for the company will  be $500,000. If natural gas is found, the revenue will be $150,000. If the probability  of hitting oil is 3% and of hitting gas is 6%, find the expected value of sinking a test well. |
| 11) A $1 lottery ticket offers a grand prize of $10,000; 10 runner-up prizes each pay $1000; 100 third-place prizes each pay $100; and  1,000 fourth-place prizes each pay $10.  Find the expected value of entering this contest if 1 million tickets are sold. | 12) Assume that for the next heavyweight fight the odds of current champion winning are 15 to 2. A gambler bets $10 that the current champion will lose. If current champion loses, how much can the gambler hope to receive? |

***SECTION 9.3 PROBLEM SET: EXPECTED VALUE***

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| 13) In a housing development, 35% of households have no school age children, 20% of households have 1 school age child, 25% of households have 2 school age children, 15% have 3, and 5% have 4 school age children.  a. Find the average number of children per household  b. If there are 300 homes in this housing development, what is the total number of children expected to attend school? | 14) At a large community college, 30% of students take one course, 15% take two courses, 25% take three courses and 20% take four courses.  The rest of the students take five courses.  a. What percent of students take 5 courses?  b. Find the average number of courses that students take. |

## SECTION 9.4 PROBLEM SET: PROBABILITY USING TREE DIAGRAMS

Use a tree diagram to solve the following problems.

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| 1) Suppose you have five keys and only one key fits to the lock of a door. What is the probability that you can open the door in at most three tries? | 2) A coin is tossed until a head appears. What is the probability that a head will appear in at most three tries? |
| 3) A basketball player has an 80% chance of making a basket on a free throw. If he makes the basket on the first throw, he has a 90% chance of making it on the second. However, if he misses on the first try, there is only a 70% chance he will make it on the second. If he gets two free throws, what is the probability that he will make at least one of them? | 4) You are to play three games. In the first game, you draw a card, and you win if the card is a heart. In the second game, you toss two coins, and you win if one head and one tail are shown. In the third game, two dice are rolled and you win if the sum of the dice is 7 or 11. What is the probability that you win all three games? What is the probability that you win exactly two games? |

***SECTION 9.4 PROBLEM SET: PROBABILITY USING TREE DIAGRAMS***

Use a tree diagram to solve the following problems.

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| 5) John's car is in the garage, and he has to take a bus to get to school. He needs to make all  three connections on time to get to his class.  If the chance of making the first connection on time is 80%, the second 80%, and the third 70%, what is the chance that John will make it to his class on time? | 6) For a real estate exam the probability of a person passing the test on the first try is .70. The probability that a person who fails on the first try will pass on each of the successive attempts is .80. What is the probability that a person passes the test in at most three attempts? |
| 7) On a Christmas tree with lights, if one bulb goes out, the entire string goes out. If there are twelve bulbs on a string, and the probability of any one going out is .04, what is the probability that the string will not go out?  \ | 8) The Long Life Light Bulbs claims that the probability that a light bulb will go out when  first used is 15%, but if it does not go out on the first use the probability that it will last the first year is 95%, and if it lasts the first year, there is a 90% probability that it will last two years. Find the probability that a new bulb will last 2 years. |

***SECTION 9.4 PROBLEM SET: PROBABILITY USING TREE DIAGRAMS***

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| 9) A die is rolled until an ace (1) shows. What is the probability that an ace will show on the fourth try? | 10) If there are four people in a room, what is the probability that no two have the same birthday? |
| 11) Dan forgets to set his alarm 60% of the time. If he hears the alarm, he turns it off and goes back to sleep 20% of the time, and even if he does wake up on time, he is late getting ready 30% of the time. What is the probability that Dan will be late to school? | 12) It has been estimated that 20% of the athletes take some type of drugs. A drug test is 90% accurate, that is, the probability of a false-negative is 10%. Furthermore, for this test the probability of a false-positive is 20%. If an athlete tests positive, what is the probability that he is a drug user? |

## SECTION 9.5 PROBLEM SET: CHAPTER REVIEW

1) A coin is tossed five times. Find the following

a) P(2 heads and 3 tails) b) P(at least 4 tails)

2) A dandruff shampoo helps 80% of the people who use it. If 10 people apply this shampoo to their hair, what is the probability that 6 will be dandruff free?

3) A baseball player has a .250 batting average. What is the probability that he will have 2 hits in 4 times at bat?

4) Suppose that 60% of the voters in California intend to vote Democratic in the next election. If we choose five people at random, what is the probability that at least four will vote Democratic?

5) A basketball player has a .70 chance of sinking a basket on a free throw. What is the probability that he will sink at least 4 baskets in six shots?

6) During an archery competition, Stan has a 0.8 chance of hitting a target. If he shoots three times, what is the probability that he will hit the target all three times?

7) A company finds that one out of four new applicants overstate their work experience. If ten people apply for a job at this company, what is the probability that at most two will overstate their work experience?

8) A missile has a 70% chance of hitting a target. How many missiles should be fired to make sure that the target is destroyed with a probability of .99 or more?

9) Jar I contains 4 red and 5 white marbles, and Jar II contains 2 red and 4 white marbles. A jar is picked at random and a marble is drawn. Draw a tree diagram and find,

a) P(Marble is red) b) P(It is white given that it came from Jar II)

c) P(It came from Jar II knowing that the marble drawn is white)

10) Suppose a test is given to determine if a person is infected with HIV. If a person is infected with HIV, the test will detect it in 90% of the cases; and if the person is not infected with HIV, the test will show a positive result 3% of the time. If we assume that 2% of the population is actually infected with HIV, what is the probability that a person obtaining a positive result is actually infected with HIV?

11) A car dealer’s inventory consists of 70% cars and 30% trucks. 20% of the cars and 10% of the trucks are used vehicles. If a vehicle chosen at random is used, find the probability that it is a car.

12) Two machines make all the products in a factory, with the first machine making 30% of the products and the second 70%. The first machine makes defective products 3% of the time and the second machine 5% of the time.

a) Overall what percent of the products made are defective?

b) If a defective product is found, what is the probability that it was made on the second machine?

c) If it was made on the second machine, what is the probability that it is defective?

13) An instructor in a finite math course estimates that a student who does his homework has a 90% of chance of passing the course, while a student who does not do the homework has only a 20% chance of passing the course. It has been determined that 60% of the students in a large class do their homework.

a) What percent of all the students will pass?

b) If a student passes, what is the probability that he did the homework?

***SECTION 9.5 PROBLEM SET: CHAPTER REVIEW***

14) Cars are produced at three factories. Factory I produces 10% of the cars and it is known that 2% are defective. Factory II produces 20% of the cars and 3% are defective. Factory III produces 70% of the cars and 4% of those are defective. A car is chosen at random. Find the following probabilities:

a) P(The car is defective) b) P(The car came from Factory III | the car is defective)

15) A stock has a 50% chance of a 10% gain, a 30% chance of no gain, and otherwise it will lose 8%.  
Find the expected return.

16) A game involves rolling a pair of dice. One receives the sum of the face value of both dice in dollars. How much should one be willing to pay to roll the dice to make the game fair?

17) A roulette wheel consists of numbers 1 through 36, 0, and 00. If the wheel shows an odd number you win a dollar, otherwise you lose a dollar. If you play the game ten times, what is your expectation?

18) A student takes a 100-question multiple-choice exam in which there are four choices to each question. If the student is just guessing the answers, what score can he expect?

19) Mr. Shaw invests 50% of his money in stocks, 30% in mutual funds, and the remaining 20% in bonds. If the annual yield from stocks is 10%, from mutual funds 12%, and from bonds 7%, what percent return can Mr. Shaw expect on his money?

20) An insurance company is planning to insure a group of surgeons against medical malpractice. Its research shows that two surgeons in every fifteen are involved in a medical malpractice suit each year where the average award to the victim is $450,000. How much minimum annual premium should the insurance company charge each doctor?

21) In an evening finite math class of 30 students, it was discovered that 5 students were of age 20, 8 students were about 25 years old, 10 students were close to 30, 4 students were 35, 2 students were 40 and one student 55. What is the average age of a student in this class?

22) Jar I contains 4 marbles of which one is red, and Jar II contains 6 marbles of which 3 are red. Katy selects a jar and then chooses a marble. If the marble is red, she gets paid 3 dollars, otherwise she loses a dollar. If she plays this game ten times, what is her expected payoff?

23) Jar I contains 1 red and 3 white, and Jar II contains 2 red and 3 white marbles. A marble is drawn from Jar I and put in Jar II. Now if one marble is drawn from Jar II, what is the probability that it is a red marble?

24) Let us suppose there are three traffic lights between your house and the school. The chance of finding the first light green is 60%, the second 50%, and the third 30%. What is the probability that on your way to school, you will find at least two lights green?

25) Sonya has just earned her law degree and is planning to take the bar exam. If her chance of passing the bar exam is 65% on each try, what is the probability that she will pass the exam in at least three tries?

26) Every time a particular baseball player is at bat, his probability of getting a hit is .3, his probability of walking is .1, and his probability of being struck out is .4. If he is at bat three times, what is the probability that he will get two hits and one walk?

27) Jar I contains 4 marbles of which none are red, and Jar II contains 6 marbles of which 4 are red. Juan first chooses a jar and then from it he chooses a marble. After the chosen marble is replaced, Mary repeats the same experiment. What is the probability that at least one of them chooses a red marble?

28) Andre and Pete are two tennis players with equal ability. Andre makes the following offer to Pete: We will not play more than four games, and anytime I win more games than you, I am declared a winner and we stop. Draw a tree diagram and determine Andre's probability of winning.