Chapter 8 Homework Problems
Compiled by Joe Kahlig

Section 8.1

1. Classify the random variable as finite discrete, infinite discrete, or continuous.

   (a) X = the number of games that I won in my last tennis match.

   (b) X = the number of times you can buy lottery tickets and not win the grand prize.

   (c) X = The amount of time spent waiting in line to buy tickets to a concert.

   (d) X = The number of good jokes that I tell in a semester.

   (e) X = The temperature on a summer day.

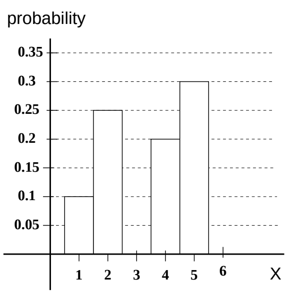
2. Classify the random variable as finite discrete, infinite discrete, or continuous. Also give all valid values of the random variable.

   (a) X = the number of cards drawn from a well-shuffled deck of 52 cards and cards are drawn without replacement until a heart is drawn.

   (b) X = the amount of time spent studying yesterday for the exam the day before the test.

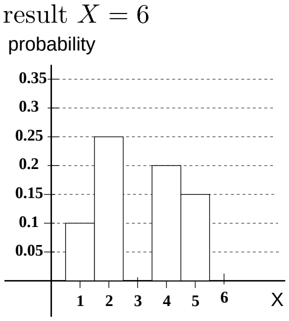
   (c) X = the number of rolls it takes to get a five on a six sided die.

3. The histogram for the random variable X is only missing one rectangle at $X = 3$



   Compute $P(X \geq 3) =$

4. The histogram for the random variable X is only missing two rectangles at $X = 3$ and at $X = 6$. We also know that the result $X = 3$ is twice as likely to happen as the result $X = 6$



   Compute $P(X \geq 4) =$

5. The number of students waiting for help at their professor's office was recorded at various times during the day. The following data was recorded

students	0	1	2	4	6
frequency	4	10	5	4	2

   (a) Find the probability distribution for the random variable X where X is the number of students waiting for help.

   (b) Draw the histogram representing the probability distribution.

6. Each word of the slogan "Get ahead, learn finite math. It's fun." is written on a card and is drawn at random. The random variable X is the number of letters in the word drawn.

   (a) Find the probability distribution of X.

   (b) Draw a histogram for X.

7. A city police department radar unit recorded the following speeds one afternoon on 17th street:

30	46	53	28	52	39	34	29
42	27	48	33	37	29	44	42
38	47	31	51	40	31	36	49
41	26	50	39	35	30	45	43
38	41	36	28	52	34	37	43

   (a) Make a frequency table representing this data. Use category intervals of 5 miles per hour.

   (b) Make a probability distribution table using your answer in part a).

8. An exam is given and the following grades.

90	89	79	68	59	48	39	84
89	79	67	57	42	30	99	74
89	79	67	57	41	30	89	63
79	66	54	40	98	88	79	96
66	53	97	87	78	66	51	83
97	85	77	64	50	97	84	72
75	63	97	84	75	63	96	94

   (a) Make a frequency table representing this data. Use the typical category intervals for grades: i.e. 90's, 80's,....

   (b) Make a probability distribution table using your answer in part a).

9. A number is selected at random from the numbers 1, 2, 3, 4, 5, 6, 7, and 8. The random variable X is the remainder when the selected number is divided by 3. Find the probability distribution of X.

10. An unfair coin, $P(H) = \frac{1}{3}$, is tossed until a head appears or until it has been tossed three times. Let the number of tosses be the random variable X. Determine the probability distribution of X.

11. Three cards are drawn from a deck of cards without replacement. Let X be the number of aces drawn. Compute.

    (a) $P(X = 0)$

    (b) $P(X = 2)$

12. A box has 3 yellow, 5 gray, and 4 black balls. If three balls are drawn at the same time (i.e. not replaced after drawn). Let X = the number of gray balls drawn. Compute the following.

    (a) $P(X = 2)$

    (b) $P(X \leq 2)$

Section 8.2

---

13. Use the probability distribution to answer the following.

X	1	2	4	5
P(X)	0.3	0.15	0.35	0.2

    (a) What is the expected value of X?

    (b) Draw a histogram for the probability distribution.

14. Find the expected value for the random variable X

X	30	32	46	49	63	70
prob	0.31	0.25	0.29	0.06	0.04	

15. Ten cards of a children's game are numbered with all possible pairs of two different numbers from the set $\{1, 2, 3, 4, 5\}$ A child draws a card. The random variable is the score of the card drawn. The score is 10 if the two numbers on the card add to 5; otherwise, the score is the smaller number on the card.

    (a) Find the probability distribution of the random variable.

    (b) Compute the expected value of the random variable.

16. Two cards are drawn from a deck of cards without replacement. The random variable X is the number of hearts drawn.

    (a) Find the probability distribution of X.

    (b) Find the expected number of hearts drawn.

17. An experiment consists of rolling two fair six sided die(one red and one green) and recording the large number that is rolled. Let the random variable X be the number that is recorded.

    (a) Find the probability distribution of X.

    (b) Find the expected value of this experiment.

18. In a lottery, 500 tickets are sold for \$1 each. One first prize of \$2000, 1 second prize of \$500, 3 third prizes of \$100, and 10 consolation prizes of \$25 are to be awarded. Let the random variable X = the net winnings of the person who buys only one ticket.

    (a) Find the probability distribution of X.

    (b) Compute the expected net winnings.

19. A plant manufactures microchips, 5% of which are defective. The plant makes a profit of \$18 on each good microchip and loses \$23 on each defective one. What is the expected profit on a microchip?

20. Suppose you pay \$5 to play a game where you toss 3 fair coins. You receive \$1 if one head results, \$4 if two heads result, and \$9 if three heads result. What are your expected net winnings?

21. A game cost \$1.50 to play. This game consists of an unfair coin ($P(H) = \frac{3}{7}$) and a fair 4 sided die. To play the game you start off by flipping the coin. If the coin comes up tails, the game is over. If it comes up heads, you roll the die to see how many dollars that you will win. If X is the net winnings of the person playing the game,

    (a) Find the probability distribution of X.

    (b) Find the expected value of X. Is the game fair?

22. Here is a game where you draw two balls, without replacement, from a box containing 4 red, 2 purple, and 3 green. If you get only one red ball then you win \$4. If you get two red balls, then you win three times the amount that you paid to play the game (i.e. if the game cost \$6 then you would win \$18). For any other result, you lose. What should be charged to make this game fair (or as fair as possible).

23. You pay \$5 to play a game where you will roll a die, with payoffs as follows:

roll	6	5	any other roll
payoff	\$7	\$6	\$2

    (a) What are your expected net winnings (i.e. profit)?

    (b) Is the game fair?

    (c) What should be charged so that the game is as fair as possible?

24. A company is looking at locations for a new restaurant. Computer models show that location A will receive 50% of its customers in the morning, 20% in the afternoon and 30% in the evening. Location B, which is downtown, can expect 25% of its customers in the morning, 20% in the afternoon, and 55% in the evening. Statistics show that a typical customer will spend \$4.5 in the morning, \$4 in the afternoon, and \$6.50 in the evening.

(a) Find the expected revenue for each location.

(b) The company projects that the location B will have on average 1500 customers per day. How many customers will be needed each day so that Location A would bring in more revenue than location B?

25. If the odds that a certain painting in the National Art Gallery was painted by Vermeer are 7 to 4, what is the probability the painting was really by Vermeer?

26. If the odds in favor that the elevators break down are 15 to 23, What is the probability that the elevators do not break down?

27. If $P(J) = .62$ find the odds in favor of J occurring.

28. If the odds in favor of A are 15 to 7, find the probability that A does not occur.

29. The odds in favor of E occurring are 2 to 7 and the odds in favor of F occurring are 10 to 19. If E and F are independent events, find the probability that E and F both occur.

30. The odds against E occurring are 19 to 21. Find the probability of E occurring.

31. You have a standard deck of cards. It has been well shuffled and cards are drawn one at a time without replacement. What are the odds in favor of the 5th card drawn being a Heart if it was known that the first card was the Ace of hearts, the second card was a club and the fourth card was the 2 of spades?

32. Your mom sent you 10 chocolate chip cookies as snack food when you studied for your math exam. Instead of eating the cookies, you counted the number of chocolate chips in each cookie. Your results were as follows.

# of chips	3	4	5	6
freq.	1	3	2	4

Find the mean, median and mode.

33. Compute the mean, median, and mode for the following data set.

x	19	20	21	22	23	24
frequency	7	4	1	2	1	7

34. The median of five test scores is 82. If four of the grades are 65, 93, 87, and 82, what can you determine about the fifth score?

35. The table gives the distribution of the ages (in years) of the residents (in hundreds) of a town of those under the age of 26.

Ages	0-5	6-11	12-18	19-25
Residents	8	12	24	35

Estimate the mean for the data set.

36. Estimate the mean for this grouped data set.

interval	frequency
0 - 12	5
13 - 25	2
26 - 38	8
39 - 51	10

Section 8.3

37. Compute the mean, median, mode, standard deviation and variance for the random variable X.

(a)

X	2	3	4	5	6
frequency	3	4	5	2	2

(b)

X	1	3	5	9	15
Frequency	9	3	1	2	9

38. A survey was taken to see how many Dr. Peppers a person drinks during a semester. The table shows the following results.

x	8	10	12	23	40	90
frequency	10	8	10	15	18	25

(a) Mean

(b) median

(c) mode

(d) standard deviation

(e) variance

(f) Calculate and explain the meaning of Q_1, Q_2, and Q_3.

39. A personnel office gave a typing test to all secretarial applicants.The number of errors for 150 applicants is summarized as follows:

Number of errors	0-5	6-10	11-20	21-30
Freq.	28	47	68	7

(a) Estimate the mean number of errors.

(b) Estimate the population standard deviation.

(c) Which interval would be the mode?

40. In order to persuade your parents to contribute to your new car fund, you have spent the last week surveying the ages of 2,000 cars on campus. Your findings are reflected in the following frequency table.

Age of Car in Years	0	1	2	3	4	5
Number of Cars	140	350	450	650	200	120

Age of Car in Years	6	7	8	9	10
Number of Cars	50	10	5	15	10

(a) Mean, Median, and Mode

(b) Calculate and explain the meaning of $Q_1, Q_2,$ and Q_3.

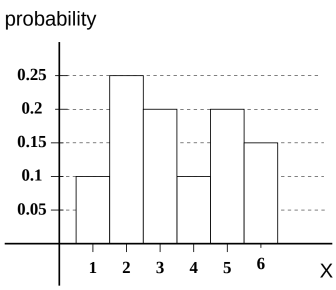
(c) Would the above data be considered a sample or a population? Why?

(d) Find the standard deviation.

(e) What are the ages of the cars that are within one standard deviation of the mean?

(f) What are the ages of the cars that are within 1.6 standard deviations of the mean?

41. Here is the histogram for the random variable X



(a) Compute $E(X) =$

(b) Compute standard deviation of X.

(c) Compute the variance of X.

---

42. A probability distribution has a mean of 20 and a standard deviation of 2.4. Estimate the probability that an outcome of the experiment lies between 12.8 and 27.2.

43. A probability distribution has a mean of 35 and a standard deviation of 4.5. Estimate the probability that an outcome of the experiment lies within 0.6 standard deviations of the mean.

44. A Christmas tree light has an expected life of 205 hours and a standard deviation of 2 hours.

(a) Estimate the probability that one of these lights will last between 197 and 213 hours.

(b) Estimate the probability that one of these lights will last less than 185 hours or more than 225 hours.

45. An office supply company sells a box of arround 100 paper clips. From previous data is is known that the average number of paperclips in a box is 100 and the standard deviation of 2.8. If the company ships 10,000 boxes, estimate the number of boxes having between 94 and 106 paperclips(inclusive).

Section 8.4

---

46. A biology quiz consists of eight multiple choice questions. Six must be answered correctly to receive a passing grade. Each question has five possible answers of which only one is correct. If a student randomly guesses at each question,

(a) Find the probability that they get only the first six questions correct.

(b) Find is the probability that they will pass the examination.

47. The probability of an adverse reaction to a flu shot is 0.15. Flu shots are given to a group of 80 people.

(a) Find the probability that exactly 5 of these people will have an adverse reaction to the shot.

(b) Find the probability that less than 16 people will have an adverse reaction to the shot.

(c) Find the probability that at least 3 and less than 11 people will have an adverse reaction to the shot

(d) Find the probability that at most 20 and more than 12 people will have an adverse reaction to the shot.

48. The probability of an adverse reaction to a flu shot is 0.18. Flu shots are given to a group of 80 people. Find the expected number of people that will

(a) have an adverse reaction.

(b) not have an adverse reaction.

49. Bob is taking a 10 question multiple choice exam and he will answer all of the questions. Each question has 6 choices with only one correct answer. If Bob guesses at all of the questions,

(a) What is the probability that he will only get the first four questions correct?

(b) What is the probability that Bob will get at most 3 questions correct?

(c) What is the probability that Bob will get exactly 1, 2, or 6 questions correct?

(d) What is Bob's expected grade on the exam.

50. The probability that a certain machine turns out a defective item is 0.05. A run of 75 items is produced.

(a) Find the probability that exactly 5 defective items are obtained.

(b) Find the expected number of defective items.

51. A die is rolled 12 times. Find the probability of rolling the following.

(a) Exactly 6 ones.

(b) no more then 3 ones.

52. suppose an 8 sided die is rolled 20 times. what is the expected number of times that a three is rolled?

53. Brian makes 65% of his free throws in basketball. Find the probability that he makes at least three out of five free throws assuming that there is independence between his free throw shots.

54. A new drug cures 70% of the people taking it. Suppose 20 people take the drug; find the probability of the following

    (a) exactly 18 people are cured.
    (b) at least 17 people are cured.
    (c) exactly 10, 11, 12, 15, or 16 are cured.

55. The probability of an adverse reaction to a flu shot is 0.15. Flu shots are given to a group of 80 people. Let X represent the number of people with an adverse reaction.

    (a) Find the mean and standard deviation of X.
    (b) Find the probability that the number of people with an adverse reaction is within 1 standard deviation of the mean.
    (c) Find the probability that the number of people with an adverse reaction is within 1.75 standard deviations of the mean.

56. Find the probability that in a group of 7 people that at least two of them were born in July.

    (a) Assume that all months are equally likely.
    (b) Assume that all days are equally likely.

57. In a group of 18 people, find the probability that more than 3 were born in the months of June, July or August. Assume that months are equally likely.

58. 6 cards are drawn from a standard deck of cards, with replacement after each draw.

    (a) Find the probability that only the first four draws give a card with an even number on it.
    (b) Find the probability that exactly four of the draws give a card with an even number on it.
    (c) What is the expected number of times in which an even number will be drawn.?

Section 8.5

---

59. Compute the following.

    (a) $P(Z > 1.25) =$
    (b) $P(-1 < Z < 1.5) =$
    (c) $P(Z > -.75) =$
    (d) $P(Z < 2.5) =$
    (e) $P(Z = 2) =$
    (f) $P(Z < -1) + P(Z > 1.15) =$
    (g) Find the value of A such that $P(Z < A) = 0.647$
    (h) Find the value of J such that $P(Z > J) = .791$

60. Find the value of A such that $P(-A < Z < A) = .76$

61. The random variable X is normally distributed with a mean of 100 and a standard deviation of 20.

    (a) Find the probability that x is between 110 and 135
    (b) Find the probability that x is between 85 and 120
    (c) Find the probability that x is above 75
    (d) Find the value of A such that $P(X < A) = .42$

62. The random variable X is normally distributed with a mean of 140 and a standard deviation of 8. Find the probability that x is

    (a) between 144 and 156
    (b) between 130 and 156
    (c) below 148
    (d) equal to 140
    (e) Find the value of B such that $P(X > B) = .37$

63. The random variable X is normally distributed with a mean of 65 and a standard deviation of 6.

    (a) Find the percent of the area under the normal curve that is within 1.5 standard deviations of the mean.
    (b) Find the percent of the area under the normal curve that is above 2 standard deviations above the mean.

64. Find the value of A such that $P(35 < X < A) = 0.40$, if X is a continuous random variable that is normally distributed with $\mu = 45$ and a variance of 225

65. X is a continuous random variable that is normally distributed with a mean of 50 and a standard deviation of 10. Find the value of A if we know that
$P(50 < X < B) = .48$ and $P(A < X < B) = .75$

Section 8.6

---

66. Systolic blood pressure for a group of women is normally distributed with a mean of 120 and a standard deviation of 10. Find the probability that a woman selected at random has systolic blood pressure less than 112.

67. A tire manufacturer claims that the life of its tires, calculated in miles, is a normally distributed random variable with a mean of 24,000 and a standard deviation of 1,400 miles.

    (a) What is the probability that a tire will last for more than 27,000 miles?

(b) What is the probability that a tire will last between 22,500 miles and 28,000 miles?
(c) If four tires are selected and experience even wear, what is the probability that exactly two of them will last between 22,500 miles and 28,000 miles?

68. The life span of a 60 watt light bulb is normally distributed with an average life span of 8,000 hours and a standard deviation of 15 days.
    (a) What is the probably that a bulb selected at random will last at least 8,250 hours?
    (b) If 4 light bulbs are selected at random, what is the probability that all of the bulbs will last at least 8,250 hours?
    (c) How many bulbs in a shipment of 400 would last at least 8,250 hours?

69. The amount of time between taking a pain reliever and getting relief is normally distributed with a mean of 20 minutes and a standard deviation of 5 minutes. Find the probability that the time between taking the medication and getting relief is
    (a) at least 28 minutes.
    (b) exactly 20 minutes.
    (c) If 500 people take this medication, for approximately how many of them would it take between 16 and 26 minutes to them to get relief from the pain.

70. The time it takes an employee to package the components of a certain product is normally distributed with $\mu = 10$ minutes and $\sigma = 2.5$ minutes. As an incentive, management has decided to give special training to the 20% of employees who took the greatest amount of time to package the components. What is the longest amount of time that you can take and not have to attend the special training course?

71. The medical records of infants at a hospital show that the infants birth weight are normally distributed with a mean of 7.4 pounds and a standard deviation of 1.2 pounds. Find the probability that an infant selected at random from among those delivered at the hospital weighed
    (a) more than 9.2 pounds at birth.
    (b) exactly 7.8 pounds at birth.

72. The length of what are considered "one-inch" bolts is found to be a normally distributed random variable with a mean of 1.001 inches and a standard deviation 0.002 inches. If a bolt measures more than two standard deviations from the mean, it is rejected as not meeting factory tolerances.
    (a) What is the minimum and maximum length a bolt may have and still meet factory tolerances?
    (b) What percentage of the bolts will the factory reject?
    (c) If 10,000 "one-inch" bolts are made, approximately how many of them will the factory reject for not meeting factory tolerances?

73. A government agency checked the gasoline mileage of a particular make of automobile and found the mileages to be normally distributed, with a mean of 28.6 mpg and a standard deviation of 2.3 mpg. for one of these automobiles, what is the probability that the mileage will be
    (a) At least 30 mpg?
    (b) exactly 27 mpg?
    (c) Between 28 and 32 mpg?

74. A government agency checked the weights of bags of peanuts, on which were stamped, "net weight 14 oz." the agency found that the weights were normally distributed, with a mean of 14.1 oz and a standard deviation of 0.2 oz. Based on this information, what is the probability that a bag of these peanuts
    (a) What is the probability that a bag of these peanuts will weigh at least 14 oz?
    (b) What is the probability that a bag of these peanuts will weigh between 13.8 and 14.5 oz?
    (c) What percentage of the bags will be within 1.5 standard deviations of the mean?

75. A particular brand of dishwasher has a life expectancy that is estimated to be normally distributed, with a mean of 10 years, 8 months and a standard deviation of 1 year, 2 months.
    (a) If you buy one of these dishwashers, what is the probability that it will last 12 years?
    (b) Suppose that such dishwashers are guaranteed to last 9 years. Of every 250 sold, how many will fail to last through the guarantee period?

76. Z–mart is considering buying a large number of automobile batteries from a manufacturer. They have an independent laboratory test the life expectancies of these batteries. The laboratory found the lives of these batteries to be normally distributed, with a mean life of 42 months and a standard deviation of 2 months.
    (a) What is the probability that one of these batteries will last more than 45 months?
    (b) If Z–Mart agrees to distribute these batteries and guarantees them for 36 months, what percentage will be returned for warranty adjustment?

77. To be graded extra large, an egg must weigh at least 2.2 oz. If the average weight for an egg is 1.5 oz, with a standard deviation of 0.4 oz, how many eggs in a sample of ten dozen (120 eggs) would you expect to grade extra large?

78. A particular brand of roof shingles has a life span that is normally distributed, with a mean of 20 years and a standard deviation of 15 months. How long should the company guarantee the shingles if they want to be sure that at least 97% will not fail while under warranty?

79. A teacher gives an exam whose scores are normally distributed with an average of 63 with a standard deviation of 15. The teacher decided to grade on a bell curve and that the top 8% will get an A and the next 18% will get a B and the next 25% will to get a C. What are the lowest grades that a student could get on the test and get an A, B, or C.