

5.7: Chapter 5 Exercises

? Chapter 5 Exercises

1. Determine if the following tables are valid discrete probability distributions. If they are not state why.

a)

x	-5	-2.5	0	2.5	5
P(X = x)	0.15	0.25	0.32	0.18	0.1

b)

x	0	1	2	3	4
P(X = x)	0.111	0.214	0.312	0.163	0.159

c)

x	0	1	2	3	4
P(X = x)	0.2	-0.3	0.5	0.4	0.2

2. The random variable X = the number of vehicles owned.

x	0	1	2	3	4
P(X = x)	0.1	0.35	0.25	0.2	0.1

- Compute the probability that a person owns at least 2 vehicles.
- Compute the $P(X > 2)$.
- Compute the probability that a person owns less than 2 vehicles.
- Compute the expected number of vehicles owned.
- Compute the standard deviation of the number of vehicles owned.
- Compute σ^2 .

3. The following discrete probability distribution represents the amount of money won for a raffle game.

x	-5	-2.5	0	2.5	5
P(X = x)	0.15	0.25	0.32	0.18	0.1

- Compute μ .
- Compute σ

4. Keke's Kookies sells mini cookies in packs of 5 and has determined a probability distribution for the number of cookies that they sell in a given day.

x = #sold	0	5	10	15	20
P(X = x)	0.22	0.38	0.14	..?	0.07

- What is the probability of selling 15 mini cookies in a given day?
- Find the expected number of mini cookies sold in a day using the discrete probability distribution.

c) Find the variance of the number of mini cookies sold in a day using the discrete probability distribution.

5. The bookstore also offers a chemistry textbook for \$159 and a book supplement for \$41. From experience, they know about 25% of chemistry students just buy the textbook while 60% buy both the textbook and supplement. Compute the standard deviation of the bookstore revenue.

6. A \$100,000 life insurance policy for a 50-year-old woman has an annual cost of \$335. The probability that a 50-year-old woman will die is 0.003118. What is the expected value of the policy for the woman's estate?

7. An LG Dishwasher, which costs \$1000, has a 24% chance of needing to be replaced in the first 2 years of purchase. If the company has to replace the dishwasher within the two-year extended warranty, it will cost the company \$112.10 to replace the dishwasher.

a) Fill out the probability distribution for the value of the extended warranty from the perspective of the company.

x		
P(X=x)		

b) What is the expected value of the extended warranty?

c) Write a sentence interpreting the expected value of the warranty.

8. The Oregon lottery has a game called Pick 4 where a player pays \$1 and picks a four-digit number. If the four numbers come up in the order you picked, then you win \$2000.

a) Fill out the probability distribution for a player's winnings

x		
P(X=x)		

b) What are your expected winnings?

c) Write a sentence interpreting the expected winnings.

9. The following table represents the probability of the number of pets owned by a college student.

x	0	1	2	3
P(X=x)	0.46	0.35	0.12	0.07

a) Is this a valid discrete probability distribution? Explain your answer.

b) Find the mean number of pets owned.

c) Find the standard deviation of the number of cars owned.

d) Find σ^2 .

10. Suppose a random variable, X, arises from a geometric distribution. If $p = 0.13$, compute the $P(X = 4)$.

11. Approximately 10% of all people are left-handed. You randomly sample people until you get someone who is left-handed. What is the probability that the 4th person selected will be the left-handed person?

12. An actress has a probability of getting offered a job after a tryout of 0.12. She plans to keep trying out for new jobs until she is offered a job. Assume outcomes of tryouts are independent. Compute the probability she will need to attend more than 7 tryouts.

13. A fair coin is flipped until a head is shown. What is the probability that head shows on the 6th flip?

14. When you post a picture on social media, it seems like your friends randomly "like" the picture. Independent of the quality or the humor of the photo, there seems to be an 18% chance of the picture being "liked" for any given picture. Let X represent the number of pictures you post until one is "liked." (X represents the photo number that is actually liked.) Compute $P(X = 15)$.

15. Suppose a random variable, x , arises from a binomial experiment. If $n = 14$, and $p = 0.13$, find the following probabilities.
- $P(X = 3)$
 - $P(X \leq 3)$
 - $P(X < 3)$
 - $P(X > 3)$
 - $P(X \geq 3)$
16. Suppose a random variable, X , arises from a binomial experiment. If $n = 25$, and $p = 0.85$, find the following probabilities.
- $P(X = 15)$
 - $P(X \leq 15)$
 - $P(X < 15)$
 - $P(X > 15)$
 - $P(X \geq 15)$
17. Suppose a random variable, X , arises from a binomial experiment. If $n = 14$, and $p = 0.13$, compute the standard deviation.
18. Suppose a random variable, X , arises from a binomial experiment. If $n = 25$, and $p = 0.85$, compute the variance.
19. A fair coin is flipped 30 times.
- What is the probability of getting exactly 15 heads?
 - What is the probability of getting 15 or more heads?
 - What is the probability of getting at most 15 heads?
 - How many times would you expect to get heads?
 - What is the standard deviation of the number of heads?
20. Approximately 10% of all people are left-handed. Out of a random sample of 15 people, find the following.
- What is the probability that 4 of them are left-handed?
 - What is the probability that less than 4 of them are left-handed?
 - What is the probability that at most 4 of them are left-handed?
 - What is the probability that at least 4 of them are left-handed?
 - What is the probability that more than 4 of them are left-handed?
 - Compute μ .
 - Compute σ .
 - Compute σ^2 .
21. Approximately 8% of all people have blue eyes. Out of a random sample of 20 people, find the following.
- What is the probability that 2 of them have blue eyes?
 - What is the probability that at most 2 of them have blue eyes?
 - What is the probability that less than 2 of them have blue eyes?
 - What is the probability that at least 2 of them have blue eyes?
 - What is the probability that more than 2 of them have blue eyes?
 - Compute μ .
 - Compute σ .
 - Compute σ^2 .

22. An unprepared student takes a 10 question TRUE/FALSE quiz and ended up guessing each answer.
- What is the probability that the student got 7 questions correct?
 - What is the probability that the student got 7 or more questions correct?
23. A local county has an unemployment rate of 7.3%. A random sample of 20 employable people are picked at random from the county and are asked if they are employed. The distribution is a binomial. Round answers to 4 decimal places.
- Find the probability that exactly 3 in the sample are unemployed.
 - Find the probability that there are fewer than 4 in the sample are unemployed.
 - Find the probability that there are more than 2 in the sample are unemployed.
 - Find the probability that there are at most 4 in the sample are unemployed.
24. About 1% of the population has a particular genetic mutation. Find the standard deviation for the number of people with the genetic mutation in a group of 100 randomly selected people from the population.
25. You really struggle remembering to bring your lunch to work. Each day seems to be independent as to whether you remember to bring your lunch or not. The chance that you forget your lunch each day is 25.6%. Consider the next 48 days. Let X be the number of days that you forget your lunch out of the 48 days. Compute $P(10 \leq X \leq 14)$.
26. A flu vaccine has a 90% effective rate. If a random sample of 200 people are given the vaccine, what is the probability that at most 180 people did not get the flu?
27. The Lee family had 6 children. Assuming that the probability of a child being a girl is 0.5, find the probability that the Smith family had at least 4 girls?
28. If a seed is planted, it has a 70% chance of growing into a healthy plant. If 142 randomly selected seeds are planted, answer the following.
- What is the probability that exactly 100 of them grow into a healthy plant?
 - What is the probability that less than 100 of them grow into a healthy plant?
 - What is the probability that more than 100 of them grow into a healthy plant?
 - What is the probability that exactly 103 of them grow into a healthy plant?
 - What is the probability that at least 103 of them grow into a healthy plant?
 - What is the probability that at most 103 of them grow into a healthy plant?
29. A manufacturing machine has a 6% defect rate. An inspector chooses 4 items at random.
- What is the probability that at least one will have a defect?
 - What is the probability that exactly two will have a defect?
 - What is the probability that less than two will have a defect?
 - What is the probability that more than one will have a defect?
30. A large fast-food restaurant is having a promotional game where game pieces can be found on various products. Customers can win food or cash prizes. According to the company, the probability of winning a prize (large or small) with any eligible purchase is 0.162. Consider your next 33 purchases that produce a game piece. Calculate the following:
- What is the probability that you win 5 prizes?
 - What is the probability that you win more than 8 prizes?
 - What is the probability that you win between 3 and 7 (inclusive) prizes?
 - What is the probability that you win 3 prizes or fewer?
31. A small regional carrier accepted 20 reservations for a particular flight with 17 seats. 15 reservations went to regular customers who will arrive for the flight. Each of the remaining passengers will arrive for the flight with a 60% chance, independently of each other.

- a) Find the probability that overbooking occurs.
- b) Find the probability that the flight has empty seats.
32. A poll is given, showing 72% are in favor of a new building project. Let X be the number of people who favor the new building project when 37 people are chosen at random. What is the probability that between 10 and 16 (including 10 and 16) people out of 37 favor the new building project?
33. A committee of 5 people is to be formed from 10 students and 7 parents. Compute the probability that the committee will consist of exactly 3 students and 2 parents.
34. In endurance horse racing, people over the age of 15 are called seniors and people 15 years or younger are called juniors. An endurance horse race consists of 25 seniors and 5 juniors. What is the probability that the top three finishers were:
- a) All seniors.
- b) All juniors.
- c) 2 seniors and one junior.
- d) 1 senior and two juniors.
35. A bag contains 9 strawberry Starbursts and 21 other flavored Starbursts. 5 Starbursts are chosen randomly without replacement. Find the probability that 3 of the Starbursts drawn are strawberry.
36. A jury selection room has 12 people that are married and 20 people that are not married to choose from. What is the probability that in a jury of 12 randomly selected people, exactly 3 of them would be married?
37. A pharmaceutical company receives large shipments of ibuprofen tablets and uses this acceptance sampling plan: randomly select and test 25 tablets, then accept the whole batch if there is at most one that doesn't meet the required specifications. If a particular shipment of 100 ibuprofen tablets actually has 5 tablets that have defects, what is the probability that this whole shipment will be accepted?
38. In a shipment of 24 keyboards, there are 3 that are defective (a success is a defective keyboard). A random sample of 4 keyboards are selected. The shipment will be returned if one or more of the 4 keyboards in the sample is defective. What is the probability that the shipment will be returned?
39. A writer makes on average one typographical error every page. The writer has landed a 3-page article in an important magazine. If the magazine editor finds any typographical errors, they probably will not ask the writer for any more material. What is the probability that the reporter made no typographical errors for the 3-page article?
40. A coffee shop serves an average of 75 customers per hour during the morning rush, which follows a Poisson distribution. Find the following.
- a) Compute the probability that 80 customers arrive in an hour during tomorrow's morning rush.
- b) Compute the probability that less than 60 customers arrive in an hour during tomorrow's morning rush.
- c) Compute the probability that more than 60 customers arrive in an hour during tomorrow's morning rush.
41. Suppose a random variable, x , follows a Poisson distribution. Let $\mu = 2.5$ every minute, find the following probabilities.
- a) $P(X = 5)$ over a minute.
- b) $P(X < 5)$ over a minute.
- c) $P(X \leq 5)$ over a minute.
- d) $P(X > 5)$ over a minute.
- e) $P(X \geq 5)$ over a minute.
- f) $P(X = 125)$ over an hour.
- g) $P(X \geq 125)$ over an hour.
42. The PSU computer help line receives, on average, 14 calls per hour asking for assistance. What is the probability that the company will receive more than 20 calls per hour?

43. There are on average 5 old-growth Sitka Spruce trees per $\frac{1}{8}$ of an acre in a local forest.
- a) Compute the probability that there are exactly 30 Sitka Spruce trees in 1 acre.
 - b) Compute the probability that there are more than 8 Sitka Spruce trees in a $\frac{1}{4}$ acre.
44. The number of rescue calls received by Pacific Northwest Search & Rescue follows a Poisson distribution with an average of 2.83 rescues every eight hours.
- a) What is the probability that the squad will have exactly 4 calls in two hours?
 - b) What is the probability that the company will receive 2 calls in a 12-minute period?
 - c) What is the probability that the squad will have at most 2 calls in an hour?
45. Suppose a random variable, x , follows a Poisson distribution. Let $\mu = 3$ every day; compute the $P(X \leq 12)$ over a week.

Answer to Odd Numbered Exercises

- 1) a) Yes b) No c) No
- 3) a) -\$0.425 b) \$2.9592
- 5) \$69.283
- 7) a) $x = -112.1$ 887.9 $P(X = x)$ 0.76 0.24 b) \$127.90 c) For many of these extended warranties bought by customers, they can expect to gain 127.9 dollars per warranty on average.
- 9) a) Yes, $\sum P(x) = 1$ and $0 \leq P(x) \leq 1$ b) 0.8 c) 0.9055 d) 0.82
- 11) 0.0729
- 13) 0.0156
- 15) a) 0.1728 b) 0.9021 c) 0.7292 d) 0.0979 e) 0.2708
- 17) 1.2583
- 19) a) 0.1445 b) 0.5722 c) 0.5722 d) 15 e) 2.7386
- 21) a) 0.2711 b) 0.7879 c) 0.5169 d) 0.4831 e) 0.2121 f) 1.6 g) 1.2133 h) 1.472
- 23) a) 0.1222 b) 0.9464 c) 0.1759 d) 0.9873
- 25) 0.5923
- 27) 0.3438
- 29) a) 0.2193 b) 0.0191 c) 0.9801 d) 0.0199
- 31) a) 0.6826 b) 0.087
- 33) 0.4072
- 35) 0.1238
- 37) 0.6328
- 39) 0.0498
- 41) a) 0.0668 b) 0.8912 c) 0.958 d) 0.042 e) 0.1088 f) 0.0039 g) 0.9835
- 43) a) 0.0185 b) 0.6672
- 45) 0.0245