

Discrete Random Variables

4.1 Probability Distributions for Discrete Random Variables

To complete this section of homework watch Chapter Four, Lecture Example [61](#).

1. Let x = the number of A's you earn from the next five classes you take. Is X a discrete random variable?
2. Let x = the number of A's you earn from the next five classes you take. What are the possible values that X can take on?
3. Label each of the following as discrete or continuous:
 - a) The number of pets owned by the residents of an apartment building
 - b) The weight of all the food eaten each day by a set of test subjects
 - c) The number of red cars passing through a certain intersection.
 - d) The hip circumference for a set of women involved in a diet study.

4.1 Answers:

1. Yes
2. 0, 1, 2, 3, 4, or 5
3. A) discrete B) continuous C) discrete D)continuous

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4.2 Expected Value: The Mean of a Discrete Random Variable

To complete this section of homework watch Chapter Four, Lecture Examples: [62](#), [63](#), [64](#), and [65](#).

For the next six exercises, determine if a probability distribution has been given. If so, find its mean:

4. Number of male children out of four births:

| X | P(x) |
|---|-------|
| 0 | 0.058 |
| 1 | 0.240 |
| 2 | 0.375 |
| 3 | 0.260 |
| 4 | 0.067 |


5. Number of bull's-eyes out of three shots:

| X | P(X) |
|---|-------|
| 0 | 0.074 |
| 1 | 0.307 |
| 2 | 0.424 |
| 3 | 0.195 |

6. Number of tickets out of four speed traps:

| X | P(x) |
|---|-------|
| 0 | 0.233 |
| 1 | 0.152 |
| 2 | 0.469 |
| 3 | 0.121 |
| 4 | 0.129 |



7. Number of tails out of three flips:  [VS](#)


| X | P(x) |
|---|-------|
| 0 | 0.125 |
| 1 | 0.375 |
| 2 | 0.375 |
| 3 | 0.125 |

8. Number of goals out of four shots:


| X | P(X) |
|---|-------|
| 0 | 0.322 |
| 1 | 0.418 |
| 2 | 0.272 |
| 3 | 0.021 |
| 4 | 0.001 |


9. Number of sixes out of two rolls:


| X | P(X) |
|---|-------|
| 0 | 0.694 |
| 1 | 0.278 |
| 2 | 0.028 |

10. How much money on average will an insurance company make off a 1-year life insurance policy worth \$50,000, if they charge \$800.00 for the policy, and you have a 0.9999 probability of surviving the year?  [VS](#)

11. What is your expected value in the following game? It involves a single roll of a die. If you roll a 1, 3, or 5, you make \$1, \$3, or \$5 respectively. If you roll 2, 4, or 6, you lose \$2, \$4, or \$4 respectively.

 [VS](#) (note: when you roll a 6 on the die, you lose \$4, not \$6)

12. A pawn shop owner buys an old Pentax camera from a customer. There is a 35% chance of making \$200 off the deal, a 45% chance of breaking even, or a 20% chance of losing \$50. What is the expected profit?  [VS](#)

13. In the game roulette, there are 18 red numbers, 18 black numbers, and two green numbers. They are all equally likely. If a person makes a \$5 bet on red and a red number comes out, he/she will make a \$5 profit. If another color comes out, the person will lose his original \$5 bet. What is the expected value for this bet?  [VS](#)

4.2 Answers

4. $\mu = 2.04$
5. $\mu = 1.74$
6. Not a prob. distribution because the sum of $P(x)$ does not equal one.
7. $\mu = 1.5$
8. Not a prob. distribution because the sum of $P(x)$ does not equal one.
9. $\mu = 0.334$
10. \$795.00
11. $-\$0.17$ (-0.1667) or an approximate 17 cents loss per roll on average.
12. \$60.00
13. $-\$0.26$

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4.3 Standard Deviation of a Discrete Random Variable

To complete this section of homework watch Chapter Four, Lecture Example [67](#) and this section's [concept video](#).

For the next four exercises, use the given mean and the probability distribution to calculate the standard deviation.

14. Number of male children out of four births; $\mu = 2.04$

| X | P(x) |
|---|-------|
| 0 | 0.058 |
| 1 | 0.240 |
| 2 | 0.375 |
| 3 | 0.260 |
| 4 | 0.067 |



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15. Number of bull's-eyes out of three shots; $\mu = 1.74$

| X | P(X) |
|---|-------|
| 0 | 0.074 |
| 1 | 0.307 |
| 2 | 0.424 |
| 3 | 0.195 |

16. Number of tails out of three flips; $\mu = 1.50$

| X | P(x) |
|---|-------|
| 0 | 0.125 |
| 1 | 0.375 |
| 2 | 0.375 |
| 3 | 0.125 |

17. Number of sixes out of two rolls; $\mu = 0.334$

| X | P(X) |
|---|-------|
| 0 | 0.694 |
| 1 | 0.278 |
| 2 | 0.028 |

4.3 Answers:

- 14. $\sigma = 1.00$
- 15. $\sigma = 0.855$
- 16. $\sigma = 0.866$
- 17. $\sigma = 0.528$




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4.4 Binomial Distribution and Binomial Probability

To complete this section of homework watch Chapter Four, Lecture Examples: [69](#), [70](#), and [71](#).

18. Is the following a binomial experiment? If not, state the condition that is violated: We plan to count the number of hits out of five first times at bat ('first time at bat' means the first time at bat during a game) for a major league baseball player. On any given first time at bat there is a 28% chance the player gets a hit.
19. Is the following a binomial experiment? If not, state the condition that is violated: We plan to count the number of red cards out of a ten-card hand drawn from a well shuffled deck. Half the deck or 26 out of 52 cards are red in a standard deck of cards.
20. Is the following a binomial experiment? If not, state the condition that is violated: We plan to count the number of correct guesses on a quiz that has four multiple choice questions (with four answer choices each) and two true false questions.
21. Is the following a binomial experiment? If not, state the condition that is violated: We plan to ask immigrants if they think America has lived up to their expectations. We will ask as many people as it takes until we have 30 people who say, "Yes, America has lived up to my expectations."
22. Is the following a binomial experiment? If not, state the condition that is violated: We plan to ask 500 people to roll a six-sided die and record the number that turns up on each roll. Each number on the die has a $1/6^{\text{th}}$ chance of turning up on the die.
23. If you flip a fair coin 30 times, what is the probability that you get exactly 15 heads?
24. What is the probability that when making random guesses on a fifty-question multiple choice exam, with four answer choices for each question, that you miss only thirty-five of the questions?
25. A car dealership sells extended warranties on 50% of its vehicles. What is the probability that only 10 car sales out of 30 sold purchase the extended warranty?  [VS](#)
26. An IRS agent must review a stack of 9 randomly chosen tax returns for mistakes. If mistakes occur in 10% of the returns, what is the probability that there is at most one return with a mistake?  [VS](#)
27. A marksman can hit the ten-spot on a target at 50 yards 89% of the time. If he makes 6 shots, find the probability that he lands 4 of them in the ten-spot.  [VS](#)



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28. A marksman can hit the ten-spot on a target at 50 yards 89% of the time. If he makes 6 shots, find the probability that he will land at least 5 of them in the ten-spot.  [VS](#)
29. At FIU, 94% of the graduates entering the workforce find work within six months of their graduation. What is the probability that among 15 graduates exactly 12 of them find jobs within six months of graduation? [VS](#) 
30. At FIU, 94% of the graduates entering the workforce find work within six months of their graduation. What is the probability that among 15 graduates more than two of them find jobs within six months of graduation? [VS](#) 
31. If 25% of eleven-year-old children have no decayed, missing, or filled (DMF) teeth, find the probability that in a sample of 20 children there will be:  [VS](#)
- Exactly 3 of them with no DMF teeth.
 - Less than 3 with no DMF teeth.
 - 3 or more with no DMF teeth.

4.4 Answers:

18. Yes, it is binomial.
19. No, the trials are not independent.
20. No, the probability of success does not remain constant from trial to trial.
21. No, there is not a fixed number of trials.
22. No, there are more than two possible outcomes.
23. 0.144
24. 0.089
25. 0.028
26. 0.775
27. 0.114
28. 0.866
29. 0.047
30. $1.00 = 100\%$
31. A. 0.134, B. 0.091, C. 0.909

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4.5 Using the Binomial Table

To complete this section of homework watch Chapter Four, Lecture Example [72](#).

32. An IRS agent must review a stack of 9 randomly chosen tax returns for mistakes. If mistakes occur in 10% of the returns, what is the probability that there is at most four returns with a mistake?
33. A marksman can hit the ten-spot on a target at 50 yards 90% of the time. If he makes 6 shots, find the probability that he lands at least 4 of them in the ten-spot.
34. A marksman can hit the ten-spot on a target at 50 yards 90% of the time. If he makes 6 shots, find the probability that he lands less than four of them in the ten-spot.
35. At FIU, 95% of the graduates entering the workforce find work within six months of their graduation. What is the probability that among 15 graduates at least 12 of them find jobs within six months of graduation?
36. At FIU, 95% of the graduates entering the workforce find work within six months of their graduation. What is the probability that among 15 graduates more than ten of them find jobs within six months of graduation?


4.5 Answers:

32. 0.999
33. 0.984
34. 0.016
35. 0.995
36. 0.999

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4.6 Mean, Variance, and Standard Deviation of a Binomial Random Variable

To complete this section of homework watch Chapter Four, Lecture Example [73](#).

37. Twenty-two percent of homes no longer use a traditional land line for telephone service. If 50 homes are randomly surveyed, what is the average number of homes we'd expect to find that do not have a land line? What is the standard deviation for the number of homes that do not have a land line out of 50 surveyed homes? Would it be unusual to survey fifty homes and to find that only two of them did not use a land line?  [VS](#)



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38. A survey found in *Harper's Index* found that 86% of Americans have **never** been the victim of a violent crime. If researchers plan to survey randomly selected groups of 20 people, what is the expected (average) number and standard deviation of people they will encounter who have been a victim of a violent crime? Would it be unusual to find a group that has 9 people in it who have been victims of violent crime?
39. Seventy-five percent of kids (aged 12 – 17) have systolic blood pressures under 136 mm of mercury. If we survey batches of 30 kids (aged 12 – 17), what will the average and standard deviation be for the number of kids with a systolic blood pressure under 136 mm? Would it be unusual to randomly select a group of 30 kids and find that half of them have systolic bp values under 136 mm?
40. 51.5% of women aged 20-34 are overweight in the US 1999-2000 (Health United States, 2003, NCHS). A researcher plans to conduct a phone survey of 50 women aged 20 – 34 and as part of the survey ask about their height, weight, and exercise habits. What is the average number of women out of 50 that will indicate they are overweight? What is the standard deviation? Would it be unusual to find that only 10 women report information that indicates they are overweight? If this happens, what are we likely to believe?
41. Fifty-eight percent of men aged 20-34 are overweight in the US 1999-2000 (Health United States, 2003, NCHS). If we study groups of 100 men, what will the mean and standard deviation be for the number of overweight men in groups of 100 men aged 20 – 34? Would it be unusual to find that only 42 of them are overweight?

4.6 Answers:

37. $\mu = 11, \sigma = 2.93$, yes, since it is more than 3 st.dev's from the mean.
38. $\mu = 2.8, \sigma = 1.55$, yes, since it is more than 3 st.dev's above the mean.
39. $\mu = 22.5, \sigma = 2.37$, yes, since it is more than 3 st.dev's from the mean.
40. $\mu = 25.75, \sigma = 3.53$, yes, since it is more than 3 st.dev's from the mean. We are likely to think the women are lying over the phone.
41. $\mu = 58, \sigma = 4.94$, yes, since it is more than 3 st.dev's from the mean.

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Chapter 4 Mixed Review

42. Does the following table meet the requirements of a probability distribution? If not, state why it is not a probability distribution.

| X | P(X) |
|---|-------|
| 0 | 0.152 |
| 1 | 0.244 |
| 2 | 0.103 |
| 3 | 0.091 |
| 4 | 0.023 |

43. According to a recent survey, 3.5% of the residents of a local municipality have served time in prison. Find the mean number of residents from this municipality that have served time in prison when taking random samples of 65 residents.
44. The following table is a probability distribution for X, where X represents the number of students who have completed all their homework out of a random sample of five students. What is the probability that at least three of them have completed all their homework out of the five selected?

| X | P(X) |
|---|-------|
| 0 | 0.168 |
| 1 | 0.360 |
| 2 | 0.309 |
| 3 | 0.132 |
| 4 | 0.028 |
| 5 | 0.002 |

45. Your campus newspaper decides to run a raffle that has relatively good odds. The raffle involves paying \$5 to draw a single-colored marble from a bag. The bag contains 2 red, 6 white, 18 blue, and 54 yellow marbles. If the participant selects a red marble, he/she is given \$25. If a white marble is drawn, he/she gets \$7. If a blue marble is selected, he/she gets \$5, and if a yellow marble is selected, he/she is given \$4. What is the expected value for a single raffle drawing?
46. The probability that an individual is a registered democrat in Florida is 40%. The remaining 60% of voters are registered as either Republican or Independents. In a random selection of 20 voters, what is the probability of finding 14 voters who are not registered as democrats?
47. A recent survey found that 71% of the public recycles at home. In a random sample of 35 people, what is the standard deviation of those who recycle at home?



Chapter 4 Mixed Review Answers

42. It is not a probability distribution because the sum of all the probabilities is not equal to one.

43. 2.275 residents

44. At least three is three or more, so: $P(x = 3) + P(x = 4) + P(x = 5) = 0.162$

45. $-\$.025$

46. 0.124

47. 2.68

