

### Section 8.1

- A **random variable** is a rule that assigns a number to each outcome of an experiment.
- A **finite discrete** random variable is one which can only take on a limited number of values that can be listed.
- An **infinite discrete** random variable is one which can take on an unlimited number of values that can be listed in some sort of sequence.
- A random variable is **continuous** if the values it may assume comprise an interval of real numbers.
- We use **histograms** to visually represent probability distributions of random variables.

### Sections 8.2 and 8.3

- For a random variable  $X$  that takes on the values  $x_1, x_2, \dots, x_n$  with associated probabilities  $p_1, p_2, \dots, p_n$  The **expected value** of the random variable  $X$  is defined by  $E(X) = x_1p_1 + x_2p_2 + \dots + x_np_n$
- A **fair game** is one in which the expected value of both players' net winnings is zero. (i.e.  $E(X) = 0$ )
- If  $P(E)$  is the probability of an event occurring then  $\frac{P(E)}{P(E^c)}$  is the **odds for the event occurring** and  $\frac{P(E^c)}{P(E)}$  is the **odds against the event occurring**.
- If the odds of an event occurring are  $a$  to  $b$ , then the probability that the event will occur is  $P(E) = \frac{a}{a+b}$ .
- The **median** is the middle value when the data points are listed in increasing or decreasing order if there are an odd number of values. The median is the average of the middle two values if there are an even number of values.
- The **mode** is the value that occurs most frequently.
- The **variance**,  $\text{Var}(X)$ , is a measure of how spread out the distribution is away from the mean. The **standard deviation**,  $\sigma$ , (also a measure of spread) is the square root of the variance.
- You can use 1-Var Stats to compute the mean, median, standard deviation, and variance. Make sure that you enter 1-Var Stats  $L_1, L_2$  on the home screen if you enter in a probability distribution into  $L_1$  and  $L_2$ .
- If a random variable has a mean of  $\mu$  and a standard deviation of  $\sigma$  then **Chebychev's Inequality** allows you to estimate the probability that a randomly selected outcome will be within  $k$  standard deviations of the mean. It states:

$$P(\mu - k\sigma \leq X \leq \mu + k\sigma) \geq 1 - \frac{1}{k^2}$$

1. Classify each random variable as finite discrete, infinite discrete, or continuous AND describe/list the possible values of the random variable.
  - (a) A bag contains 10 purple skittles, 15 red skittles, and 20 green skittles. An experiment consists of randomly selecting skittles with replacement out of the bag until a purple skittle is selected. Let  $X$  represent the number of skittles drawn.
  - (b) An experiment consists of randomly selecting a sample of twenty oranges out of a crate containing 100 oranges of which 10 are rotten. Let  $Y$  represent the number of rotten oranges selected.
  - (c) An experiment consists of randomly selecting a sample of twenty oranges out of a crate containing 100 oranges of which 10 are rotten. Let  $Z$  represent the amount of time it takes you to select the sample of 20 oranges.
  - (d) An experiment consists of rolling a fair six-sided die five times. Let  $W$  represent the number of times the die lands on 2.
  - (e) An experiment consists of randomly selecting 5 cards (with replacement) out of a standard deck of 52 cards. Let  $M$  represent the number of spades drawn.
  - (f) An experiment consists of randomly selecting cards (without replacement) out of standard deck of 52 cards. Let  $N$  represent the number of cards drawn until a king is drawn.
  - (g) An experiment consists of measuring the amount of water in an aquarium that can hold up to 30 gallons of water. Let  $P$  represent the actual amount of water in the aquarium (measured in gallons).
  - (h) An experiment consists of randomly selecting a banana out of the produce department and weighing it in ounces. Let  $Q$  represent the weight of the banana.
  - (i) An experiment consists of polling students on the exact amount of sleep they get in a 24 hour day. Let  $R$  be the amount of sleep in hours.
2. An experiment consists of randomly selecting a sample of three coins out of a bowl containing 8 nickels and 12 dimes. Let  $X$  represent the monetary value of the coins in the sample. Find the  $E(X)$ .
3. A bowl contains two snickers and ten butterfingers. An experiment consists of randomly drawing a piece of candy out of the bowl (without replacement) until a butterfinger is drawn. Let  $X$  represent the number of pieces of candy drawn until a butterfinger is drawn. Find the probability distribution of  $X$  and then draw the histogram for  $X$ .
4. In a lottery, 5000 tickets are sold for \$2 each. One grand prize of \$10,000 and 100 consolation prizes of \$100 are to be awarded. What are the expected net earnings of a person who buys one ticket?
5. Donna wants to purchase a 3-year term life insurance policy that will pay the beneficiary \$50,000 in the event that Donna doesn't survive the next three years. Using life insurance tables, she determines that the probability that she will live another three years is 0.998. If the company charges \$700 for the policy, what is the company's expected net gain?

6. Jack and Jill decide to play a game. Jill rolls a pair of fair six-sided dice. If the sum of the numbers is less than 4, Jill pays Jack \$1. If the sum of the number is greater than 9, Jack pays Jill \$10. Otherwise, Jill pays Jack \$A. Find the value of A that makes this game fair.
7. Suppose you play a game in which you pay a certain amount to draw two cards out of a standard deck of 52. You receive twice of what you paid if both cards drawn are aces. You don't receive anything if the two cards drawn are from the same suit. For anything else, you receive \$6. How much should be charged to make this a fair game?
8. The odds of an event occurring are 3 to 8. What is the probability that the event will not occur?
9. The weather forecaster predicts that the probability that it will rain on Friday is 0.38. What are the odds that it will NOT rain on Friday?
10. Find the odds of drawing an ace, from a standard deck of cards, on the second draw if we know that the first card drawn was a king.
11. The table below gives the results of an experiment in which the number of green skittles in randomly selected bags was recorded.

Number of Green Skittles	20	21	22	23	24
Number of Bags	35	42	50	51	21

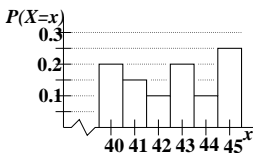
Find the mean and standard deviation of the number of green skittles in a randomly selected bag.

12. An experiment consists of counting the number of prime factors in the factorization of two digit numbers. The results are given below:

Three Digit Number	16	25	36	49	64	81
Number of Prime Factors	4	2	4	2	6	4

Based on this experiment, find the mean and standard deviation of the number of prime factors in a two digit number.

13. The following is a histogram for the random variable X.



- (a) Find  $E(X)$ .
  - (b) What is the mode?
  - (c) What is the median?
  - (d) What is the standard deviation?
  - (e) What is the variance?
  - (f) Find  $P(X > 43)$
14. A Christmas tree light has an expected life of 205 hours and a standard deviation of 2 hours. Use Chebychev's Inequality to estimate the probability that one of these Christmas tree lights will last between 197 and 213 hours.
  15. A random variable X has a mean of 214 and a standard deviation of 8. Use Chebychev's Inequality to determine the value of c for which  $P(214 - c \leq X \leq 214 + c) \geq 0.99$ .