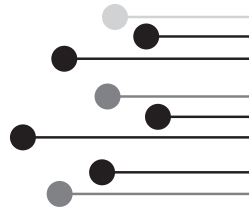# Math Review, Vocabulary, and Symbols

Learning Objectives

- Identify and define common statistical terms and symbols
- Understand the common algebraic rules to manipulate equations
- Review the basic arithmetic functions, rules, and procedures necessary to learn statistics

Module Summary

- Statistics is not a difficult subject, but it can seem that way. One of the difficult aspects of statistics is that it uses many different terms, which can be confusing when you are first learning the material. You should become familiar with all of the terms as you read the textbook to help you better understand the material. Another aspect that is commonly thought of as difficult is the mathematical component of statistics. However, the actual math that will be used for your introduction to statistics is relatively simple. In fact, in this textbook the hardest mathematical operations are exponents (X^2) and square roots ($\sqrt{}$). The difficult part of learning this material will be understanding the logic behind the math. To better grasp this logic, it is important for you to become fluent with the different terms.

- Here is a brief list of common statistical terms and their definitions.

  - Case/subject/participant: A unit of study. When the cases are human beings, they are often referred to as subjects or participants.

  - Sample: A group of subjects in a study that are part of a larger group.

  - Population: A large group from which samples are drawn. We use samples to learn about populations.

  - Statistic: A number that summarizes a sample.

  - Parameter: A number that summarizes a population.

  - Variable: A measurement that can vary from person to person in a sample. You can consider the height and weight of five different people to be variables because they will be different (vary) from person to person.

  - Constant: A measurement that remains the same for all cases.

  - Uppercase letters: These are used to represent variables.

  - Bar over a letter: This represents an average.

  - M: The mean of a sample.

  - p: The probability of an event occurring.

  - q: The probability that an event will not occur.

  - N, n: The number of cases. N refers to the number of cases in a population, whereas n refers to the number of cases in a sample.

  - Subscripts: Refer to a specific case. X_1 is the first case's score on variable X.

- ○ Wavy parallel lines: The symbol ≈ indicates an approximation, as opposed to =, which indicates a definite amount.
- ○ < and >: Less than a value and more than a value.
- ○ Summation: Adding up all scores for a particular variable.
- ○ Reciprocal: Dividing one by the number. The reciprocal of 7 is 1/7.
- ○ Exponent (superscripted number): Tells you to multiply a number by itself as many times as the exponent, or the superscripted number.
- ○ Radical sign: Take the square root of the number under the radical sign.
- Here are a few simple rules to keep in mind as you work through computations:
  - ○ Dividing a number is equivalent to multiplying that number by its reciprocal.
  - ○ When multiplying negative and positive numbers, the product will always be negative. When multiplying two negative numbers, the product will always be positive.
  - ○ Fractions, decimals, and percentages are different ways to represent the same amount: $1/4 = 0.25 = 25\%$.
  - ○ You can expect many of your mathematical operations to have multiple decimal places. It is common in the social sciences to round all work to three decimal places and the final answer to two decimal places.
  - ○ When rounding, values greater than 5 are rounded up, meaning that 1 is added to the previous digit; 0.56 becomes 0.6. Alternatively, values less than 5 are rounded down, meaning the previous digit remains the same; 0.54 becomes 0.5. If the last digit is exactly 5, whether or not you round depends on the preceding digit. If the preceding digit is odd, round up by adding one to it; if the preceding digit is even, leave it unchanged. For example, 32.635 rounds to 32.64, but 32.645 also rounds to 32.64.
  - ○ Always remember the order of operations in math. These are work in (1) parentheses, (2) exponents and square roots, (3) multiplication, (4) division, and (5) addition and subtraction. The acronym PEMDAS can help you to remember this order.
  - ○ Finally, remember that you may need to reorder an equation to solve for an unknown value. Remember the basic rules of algebra, which state that what is done to one side of an equation (equals sign) must be done to the other. For example, if $12 = 4X + 4$, subtracting 4 from both sides give you $12 - 4 = 4X$. Both sides can then be divided by 4, which provides the answer of $X = 2$.
- $\sum(X)$ is the symbol for summation. It indicates that you should sum all of the values of X.

Computational Exercises

1. $(4)(5) + 3 =$

2. $\dfrac{(14+13)}{3} =$

3. $\dfrac{(3+7)\,2}{4} =$

4. Round your answer to two decimal places: $\dfrac{(9+13)\,6}{8} =$

5. Round the following numbers to two decimal places:
   a. 6.8236;   b. 3.4623;   c. 5.2181

6. What is the reciprocal of the following?
   a. 4;   b. 3;   c. 2;   d. 2/3

7. Complete the following chart:

Fraction	Percentage	Decimal
9/45		
	92%	
		0.35

8. Solve the following equations, remembering the rules of the order of operations:

   a. $(12 + 45) - (54 - 9) =$

   b. $\dfrac{12 + 56}{4} + \dfrac{12}{2 + 4} =$

   c. $\dfrac{12 + 56 + 12}{4 + 2 + 4} =$

   d. $(4 + 3)2 - (20 - 7) =$

   e. $\sqrt{5 + 11} + \left(\dfrac{5 + 4}{3}\right)^2 =$

9. Solve for X in the following equations:

   a. $X + 3 = 10$ b. $6X - 8 = 22$ c. $X - (2 + 6)^2 = 36$

10. Solve for X in the following equations:

    a. $aX + b = c$

    b. $\dfrac{aX - b}{c} = Z$

    c. $\dfrac{b(X - a)}{(c + d)} = Z$

11. Expand and solve the following expressions if $X_1 = 2$; $X_2 = 4$; $X_3 = 9$:

    a. $\sum X =$

    b. $(\sum X)^2 =$

    c. $\sum X^2 =$

    d. $\sum 2X =$

    e. $2\sum X =$

12. Expand the following binomials:

    a. $2(a + b) =$

    b. $(a + b)^2 =$

    c. $3(a + b)^2 =$

Computational Answers

1. 23

2. 9

3. 5

4. 16.5

5. a. 6.82;   b. 3.46;   c. 5.22

6. a. 1/4;   b. 1/3;   c. 1/2;   d. 3/2

7. Complete the following chart:

Fraction	Percentage	Decimal
9/45	20%	0.2
23/25	92%	0.92
7/20	35%	0.35

8. Solve the following equations, remembering the rules of the order of operations:

   a. 12;   b. 19;   c. 8;   d. 36;   e. 13

9. Solve for X in the following equations:

   a. $X = 7$;   b. $X = 5$;   c. $X = 100$

10. Solve for X in the following equations:

    a. $X = \dfrac{c-b}{a}$

    b. $X = \dfrac{Zc+b}{a}$

    c. $X = \dfrac{Z(c+d)+ba}{b}$

11. Expand and solve the following expressions if $X_1 = 2$; $X_2 = 4$; $X_3 = 9$:

    a. 15;   b. 225;   c. 101;   d. 30;   e. 30

12. Expand the following binomials:

    a. $2a + 2b$;   b. $a^2 + 2ab + b^2$;   c. $3a^2 + 6ab + 3b^2$

True/False Questions

1. Statistics are used to summarize populations, whereas parameters are used to summarize samples.

2. Both X-bar ($\overline{X}$) and M are symbols for means.

3. p and q are related in that as one increases the other decreases.

4. The absolute value of -8 is -8.

5. In doing a complicated math problem, you should complete work in parentheses first.

6. 6.42338139 rounded to two decimal places is 6.42.

7. $\sum(X + Y)$ is the same as $\sum X + \sum Y$.

True/False Answers

1. False

2. True

3. True

4. False

5. True

6. True

7. True

Short-Answer Questions

1. Describe how a sample and a population differ and how they are related.

2. What is precision in mathematical calculation? How precise should you be when working on a question in statistics? When stating your answer?

3. What is the correct order in which mathematical operations must be conducted?

4. What, if any, is the difference between a case and a subject or participant?

Answers

1. Samples are small subgroups of populations. Populations consist of larger groups that contain all of the individuals in your area of interest. They are related in that samples are derived from populations and are used to infer about populations.

2. Precision is the exactness of the calculation, or how many decimal places are used. In social science statistics, we generally use three decimal places when working through a problem and present the final answer rounded to two decimal places.

3. Calculations within parentheses, exponents, multiplication, division, addition, and subtraction.

4. A case represents an individual unit of study. A subject or participant represents an individual human being in a study.

Multiple-Choice Questions

1. If $p = .45$, then $q =$
   a. .45
   b. .65
   c. .55
   d. 1

2. The average person drinks approximately 8 glasses of water per day, what is the appropriate symbol to represent this measurement?
   a. N
   b. n
   c. M
   d. X

3. What is another way to express 1/4?
   a. .7
   b. 45%
   c. .9
   d. 25%

4. What is another way to express $\approx .33$?
   a. 4/7
   b. 2/6
   c. 65%
   d. 46%

5. According to the conventions of the social sciences, what is the solution: $4.541 + 6.327$?
   a. 10.868
   b. 10.87

c. 10.9

d. 10

6. What is another method to express $\sum(3X + 4Y)$?

a. $(12)\sum(X + Y)^2$

b. $\sum(3X) + \sum(4Y)$

c. $3+\sum(X) + 4 + \sum(Y)$

d. $\sum(3X)^2 + \sum(4Y)^2$

7. Solve for Z: $15 = \dfrac{Z(12 + 8)}{5}$

a. $Z = 20$

b. $Z = 3.75$

c. $Z = 4.25$

d. $Z = 10.50$

8. Solve for X: $20X - 18 = 6(X + 4)$

a. $X = 4$

b. $X = 5.5$

c. $X = 12$

d. $X = 3$

Multiple-Choice Answers

1. C
2. C
3. D
4. B
5. B
6. B
7. B
8. D

Module Quiz

These questions are designed to touch on the most crucial concepts of the module.

1. Expand and solve the following expressions if $X_1 = 10$; $X_2 = 5$; $Y_1 = 3$; $Y_2 = 2$

a. $\sum(X + Y) =$

b. $\sum(X^2 + Y^2) =$

c. $\sum(X + Y)^2 =$

d. $\sum(2X + 3Y) =$

e. $3\sum(X + 3Y) =$

2. Complete the following chart:

Fraction	Percentage	Decimal
≈6/9		
	43%	
		0.7391

3. Solve for X in the following equations:

   a. $X + 15 = 25$

   b. $2X + 3 = 9$

   c. $6X - 7 = 41$

   d. $\dfrac{12X + 18}{10} = 132$

   e. $\dfrac{12 - 3}{2} = 45X$

4. You are interested in studying the mating habits of the remaining 4,000 chimpanzees in the wild. However, you are unable to find all 4,000 chimps and so you observe 200. In this example, how many chimps are in the population, in the sample, and in a case?

5. According to the conventions of the social sciences, what is the solution: 9.87532 + 10.78672?

Quiz Answers

1.
   a. 20
   b. 138
   c. 218
   d. 45
   e. 90

2.

Fraction	Percentage	Decimal
≈6/9	67%	0.67
43/100	43%	0.43
7391/10000	73.91%	0.7391

3.
   a. $X = 10$
   b. $X = 3$
   c. $X = 8$
   d. $X = 108.50$
   e. $X = 0.10$

4. The 4,000 chimpanzees are a population and the 200 are a sample, and 1 chimp would be a case.

5. 20.66