STATISTICS & PROBABILITY

TYPES OF STATISTICAL STUDIES

Survey: used to gather large quantities of facts or opinions. Surveys are usually asked in the form of a question. For example, "Do you like Algebra, Geometry, or neither?" would be a survey question.
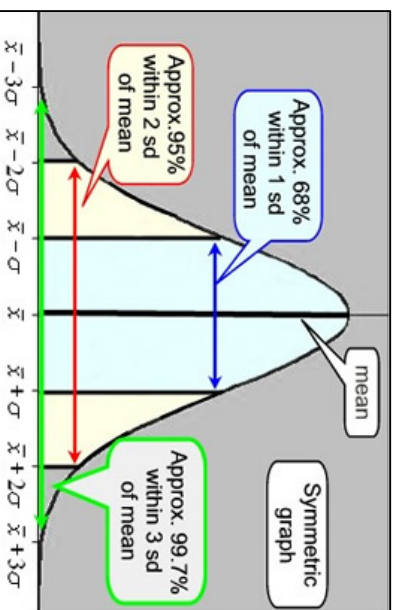
Observational Study: the observer does not have any interaction with the subjects and just examines the results of an activity. For example, the location as to where the Sun rises and sets on each day throughout the year.

Controlled Experiment: two groups are studied while an experiment is performed with one of them but not the other. For example, testing if orange juice has an effect in preventing the "common cold" with a group of 100 people, where 50 people will drink orange juice and the other 50 will not drink the juice. The statistician will then analyze the data of the control group and the experimental group.

SET NOTATION IN PROBABILITY

Universal Set   **Intersection Set of A AND B**

Set of A AND B
A∩B

Union Set of A OR B
A U B

THE NORMAL DISTRIBUTION CURVE

Approx. 68% within 1 sd of mean

Approx.95% within 2 sd of mean

Approx. 99.7% within 3 sd of mean

Symmetric graph

mean

Z-SCORES

A z-score represents the number of standard deviations a given value x falls from the mean, μ.

Formula:
$$z = \frac{number - mean}{standard\ deviation} = \frac{x - \mu}{\sigma}$$

where x is the value being examined, μ is the population mean, and σ is the population standard deviation.

Notes:
- A negative z-score represents a value less than the mean.
- A z-score of zero represents the mean
- A positive z-score represents a value greater than the mean.

CONFIDENCE INTERVALS

A *Confidence interval* is a range or interval of values used to estimate the true value of a population parameter. The formula to calculate the confidence interval is given by:

$$C.I. = \bar{x} \pm z \cdot \frac{\sigma}{\sqrt{n}}$$

where σ is a known value, $\bar{x}$ is the mean, and z changes value depending on the confidence level.

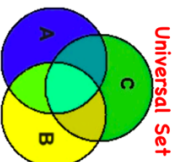| Confidence Level	z
90 %	1.645
95 %	1.96
99 %	2.575

INDEPENDENT & DEPENDENT EVENTS OF PROBABILITY

Independent Event: Two events are independent if one happening (or not happening) has nothing to do whether or not the other happens (or doesn't happen).

Dependent Event: Two events are dependent if the outcome or occurrence of the first affects the outcome or occurrence of the second so that the probability is changed.
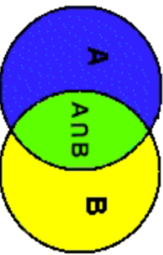
MUTUALLY EXCLUSIVE EVENTS IN PROBABILITY

1) If A and B are mutually exclusive events, $P(A\ or\ B) = P(A) + P(B)$

2) If events A and B are NOT mutually exclusive,
$P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$

CONDITIONAL PROBABILITY

The conditional probability of an event B, in relation to event A, is the probability that event B will occur given the knowledge that an event A has already occurred.

NOTATION: $P(B|A)$
Read as "the probability of B given A"

COMPLEMENT OF EVENTS IN PROBABILITY

The probability of the complement of an event is one minus the probability of the event:
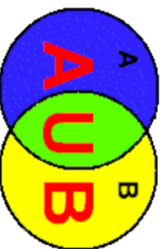$$P(A^C) = 1 - P(A)$$

1. Two number cubes are thrown. Find the probability that the sum turning up is seven given that the first number cube shows a six.

    [1] _____

2. A class of 40 students has 11 honor students and 12 athletes. Three of the honor students are also athletes. One student is chosen at random. Find the probability that this student is an athlete if it is known that the student is not an honor student.

    [2] _____

3. Each person in a group of students was identified by his or her hair color and then asked whether he or she preferred taking classes in the morning, afternoon, or evening. The results are shown in the table below. Find the probability that a student preferred morning classes given he or she has blonde hair.

Preference	Blonde	Brunette	Redhead
Morning	25	5	15
Afternoon	35	45	20
Evening	10	50	30

    [3] _____

4. In order to determine the effectiveness of a new measles antibody test, it is administered to 500 people chosen at random. An older more elaborate test reveals that 425 of the people have the measles antibodies. The new test was positive when administered to 96% of those who have the antibodies and it also gave positive results in 2% of those who do not have them. Based on these results, what is the probability that a randomly chosen person has measles antibodies in his/her blood if the new test indicates their presence?

    [4] _____

5. If a random person is given a medicine and has arthritis A there is a 0.72 probability of having a side effect S from the medicine. The tree diagram shows probabilities of the medicine and its side effects if the patient does or does not have arthritis.

A = arthritis

not A = no arthritis

S = side effect

not S = no side effect
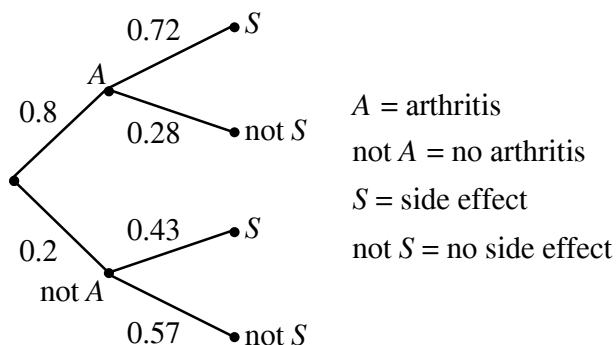
What is the probability that a random person given the medicine has a side effect?

[5] _____

6. Ms. Chin collected data about how long students in two of her classes spent doing homework. This table shows the result.

Did you spend more than $\dfrac{1}{2}$ hour on math homework last night?

	yes	no
3rd period	5	18
4th period	11	9

Suppose a student from her third or fourth period class is selected at random. Find the probability $P(\text{yes} \mid \text{3rd period})$.

[6] _____

Name: _____

S.CP.B.7: Theoretical Probability

1   A suburban high school has a population of 1376 students. The number of students who participate in sports is 649. The number of students who participate in music is 433. If the probability that a student participates in either sports or music is $\frac{974}{1376}$, what is the probability that a student participates in both sports and music?

Name: _____

S.IC.A.2: Analysis of Data

1 Anne has a coin. She does not know if it is a fair coin. She flipped the coin 100 times and obtained 73 heads and 27 tails. She ran a computer simulation of 200 samples of 100 fair coin flips. The output of the proportion of heads is shown below.
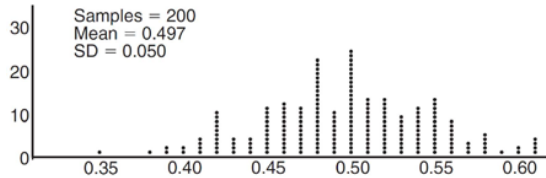
Given the results of her coin flips and of her computer simulation, which statement is most accurate?
1) 73 of the computer's next 100 coin flips will be heads.
2) 50 of her next 100 coin flips will be heads.
3) Her coin is not fair.
4) Her coin is fair.

2 An orange-juice processing plant receives a truckload of oranges. The quality control team randomly chooses three pails of oranges, each containing 50 oranges, from the truckload. Identify the sample and the population in the given scenario. State one conclusion that the quality control team could make about the population if 5% of the sample was found to be unsatisfactory.

S.IC.B.3: Analysis of Data 1

1   A doctor wants to test the effectiveness of a new drug on her patients. She separates her sample of patients into two groups and administers the drug to only one of these groups. She then compares the results. Which type of study *best* describes this situation?
   1) census
   2) survey
   3) observation
   4) controlled experiment

2   A market research firm needs to collect data on viewer preferences for local news programming in Buffalo. Which method of data collection is most appropriate?
   1) census
   2) survey
   3) observation
   4) controlled experiment

3   A school cafeteria has five different lunch periods. The cafeteria staff wants to find out which items on the menu are most popular, so they give every student in the first lunch period a list of questions to answer in order to collect data to represent the school. Which type of study does this represent?
   1) observation
   2) controlled experiment
   3) population survey
   4) sample survey

4   In which method of data collection does the researcher intentionally intervene to arrange for a comparison of results?
   1) taking a survey
   2) making observations
   3) filling out a questionnaire
   4) conducting a controlled experiment

5   Which task is *not* a component of an observational study?
   1) The researcher decides who will make up the sample.
   2) The researcher analyzes the data received from the sample.
   3) The researcher gathers data from the sample, using surveys or taking measurements.
   4) The researcher divides the sample into two groups, with one group acting as a control group.

6   Which statement about statistical analysis is *false*?
   1) Experiments can suggest patterns and relationships in data.
   2) Experiments can determine cause and effect relationships.
   3) Observational studies can determine cause and effect relationships.
   4) Observational studies can suggest patterns and relationships in data.

7   Describe how a controlled experiment can be created to examine the effect of ingredient X in a toothpaste.

8   Howard collected fish eggs from a pond behind his house so he could determine whether sunlight had an effect on how many of the eggs hatched. After he collected the eggs, he divided them into two tanks. He put both tanks outside near the pond, and he covered one of the tanks with a box to block out all sunlight. State whether Howard's investigation was an example of a controlled experiment, an observation, or a survey. Justify your response.

Name: _____

S.IC.B.3: Analysis of Data 2

1   A survey completed at a large university asked 2,000 students to estimate the average number of hours they spend studying each week. Every tenth student entering the library was surveyed. The data showed that the mean number of hours that students spend studying was 15.7 per week. Which characteristic of the survey could create a bias in the results?
1) the size of the sample
2) the size of the population
3) the method of analyzing the data
4) the method of choosing the students who were surveyed

2   The yearbook staff has designed a survey to learn student opinions on how the yearbook could be improved for this year. If they want to distribute this survey to 100 students and obtain the most reliable data, they should survey
1) every third student sent to the office
2) every third student to enter the library
3) every third student to enter the gym for the basketball game
4) every third student arriving at school in the morning

3   Which survey is *least* likely to contain bias?
1) surveying a sample of people leaving a movie theater to determine which flavor of ice cream is the most popular
2) surveying the members of a football team to determine the most watched TV sport
3) surveying a sample of people leaving a library to determine the average number of books a person reads in a year
4) surveying a sample of people leaving a gym to determine the average number of hours a person exercises per week

4   A survey is to be conducted in a small upstate village to determine whether or not local residents should fund construction of a skateboard park by raising taxes. Which segment of the population would provide the most unbiased responses?
1) a club of local skateboard enthusiasts
2) senior citizens living on fixed incomes
3) a group opposed to any increase in taxes
4) every tenth person 18 years of age or older walking down Main St.

5   A principal is concerned about the decline in the number of students who purchase food from the cafeteria. A survey was developed to assist the principal. The most appropriate method would be for the principal to randomly select 100 students from
1) the junior class
2) the student directory
3) the Algebra 2/Trigonometry classes
4) the students who are eating during fourth period lunch in the cafeteria

6   High school officials wanted to assess the need for a new diving board. They created a survey and distributed it to a large, diverse crowd at the State Swim Meet held at their school. Which characteristic of the survey is most likely to create a bias?
1) the number of participants
2) the height of the participants
3) the way the set of data from the survey was analyzed
4) the way the participants were selected to take the survey

7 Which statement(s) about statistical studies is true?

I. A survey of all English classes in a high school would be a good sample to determine the number of hours students throughout the school spend studying.

II. A survey of all ninth graders in a high school would be a good sample to determine the number of student parking spaces needed at that high school.

III. A survey of all students in one lunch period in a high school would be a good sample to determine the number of hours adults spend on social media websites.

IV. A survey of all Calculus students in a high school would be a good sample to determine the number of students throughout the school who don't like math.

1) I, only
2) II, only
3) I and III
4) III and IV

8 Four surveys are described below. Which survey methodology would lead to the *least* biased conclusion?

1) One hundred randomly chosen heart surgeons were polled by telephone about how to get children to eat healthier foods.

2) A country and western radio station asked one hundred of its listeners to call a telephone number and answer a question about rap music.

3) From calls made to one hundred randomly generated telephone numbers, people replied to a question about television shows they watch.

4) The first one hundred people who left the World of Baseball Bookstore replied to a question about the importance of baseball to society.

Name: _____

S.ID.A.4: Normal Distributions 1a

1 On a standardized test, Cathy had a score of 74, which was exactly 1 standard deviation below the mean. If the standard deviation for the test is 6, what is the mean score for the test?
   1) 68
   2) 71
   3) 77
   4) 80

2 On a standardized test, a score of 82 falls exactly 1 standard deviation below the mean. If the standard deviation for the test is 4, what is the mean score for the test?
   1) 78
   2) 80
   3) 84
   4) 86

3 On a standardized test, Phyllis scored 84, exactly one standard deviation above the mean. If the standard deviation for the test is 6, what is the mean score for the test?
   1) 72
   2) 78
   3) 84
   4) 90

4 On a standardized test, a score of 86 falls exactly 1.5 standard deviations below the mean. If the standard deviation for the test is 2, what is the mean score for this test?
   1) 84
   2) 84.5
   3) 87.5
   4) 89

5 On a standardized examination, Laura received a score of 85, which was exactly 2 standard deviations above the mean. If the standard deviation for the examination is 4, what is the mean for this examination?
   1) 93
   2) 87
   3) 83
   4) 77

6 In the accompanying diagram, the shaded area represents approximately 95% of the scores on a standardized test. If these scores ranged from 78 to 92, which could be the standard deviation?
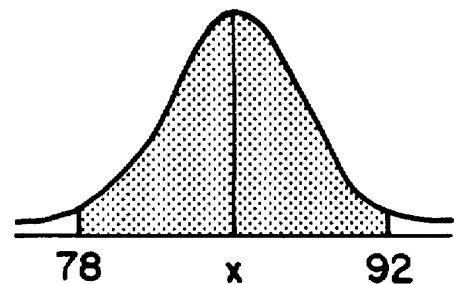
   1) 3.5
   2) 7.0
   3) 14.0
   4) 20.0

7   In the accompanying diagram, about 68% of the scores fall within the shaded area, which is symmetric about the mean, $\bar{x}$. The distribution is normal and the scores in the shaded area range from 50 to 80.

50   $\bar{x}$ 80
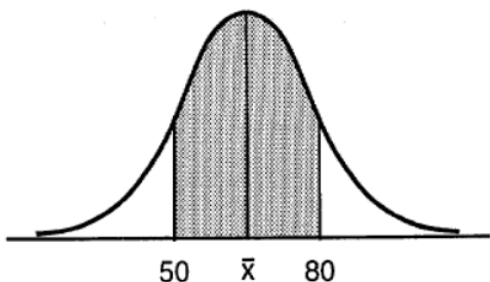
What is the standard deviation of the scores in this distribution?
1) $7\frac{1}{2}$
2)   15
3)   30
4)   65

8   The heights of the members of a high school class are normally distributed. If the mean height is 65 inches and a height of 72 inches represents the 84th percentile, what is the standard deviation for this distribution?
1)   7
2)   11
3)   12
4)   137

9   The heights of a group of girls are normally distributed with a mean of 66 inches. If 95% of the heights of these girls are between 63 and 69 inches, what is the standard deviation for this group?
1)   1
2)   1.5
3)   3
4)   6

10   In a normal distribution, $\bar{x} + 2\sigma = 80$ and $\bar{x} - 2\sigma = 40$ when $\bar{x}$ represents the mean and σ represents the standard deviation. The standard deviation is
1)   10
2)   20
3)   30
4)   60

11   In a normal distribution, 68% of the scores fall between 72 and 86 and the mean is 79. What is the standard deviation?

12   In a certain school district, the ages of all new teachers hired during the last 5 years are normally distributed. Within this curve, 95.4% of the ages, centered about the mean, are between 24.6 and 37.4 years. Find the mean age and the standard deviation of the data.

13   On a test that has a normal distribution of scores, a score of 57 falls one standard deviation below the mean, and a score of 81 is two standard deviations above the mean. Determine the mean score of this test.

S.ID.A.4: Normal Distributions 2a

1 In a standard distribution, what is the greatest percent of the data that falls within 2 standard deviations of the mean?
1) 95
2) 81.5
3) 68
4) 34

2 The national mean for verbal scores on an exam was 428 and the standard deviation was 113. Approximately what percent of those taking this test had verbal scores between 315 and 541?
1) 68.2%
2) 52.8%
3) 38.2%
4) 26.4%

3 On a standardized test with a normal distribution, the mean was 64.3 and the standard deviation was 5.4. What is the best approximation of the percent of scores that fell between 61.6 and 75.1?
1) 38.2%
2) 66.8%
3) 68.2%
4) 95%

4 A set of scores with a normal distribution has a mean of 50 and a standard deviation of 7. Approximately what percent of the scores fall in the range 36-64?
1) 34%
2) 68%
3) 95%
4) 99%

5 The scores of an exam have a normal distribution. The mean of the scores is 48 and the standard deviation is 5. Approximately what percent of the students taking the exam can be expected to score between 43 and 53?
1) 95%
2) 68%
3) 34%
4) 13%

6 On a standardized test, the mean is 48 and the standard deviation is 4. Approximately what percent of the scores will fall in the range from 36-60?
1) 34%
2) 68%
3) 95%
4) 98%

7 The scores on an examination have a normal distribution. The mean of the scores is 50, and the standard deviation is 4. What is the best approximation of the percentage of students who can be expected to score between 46 and 54?
1) 95%
2) 68%
3) 50%
4) 34%

8 On a standardized test, the mean is 68 and the standard deviation is 4.5. What is the best approximation of the percent of scores that will fall in the range $59 - 77$?
1) 34%
2) 68%
3) 95%
4) 99%

9 If the mean on a standardized test with a normal distribution is 54.3 and the standard deviation is 4.6, what is the best approximation of the percent of the scores that fall between 54.3 and 63.5?
1) 34
2) 47.5
3) 68
4) 95

10 On a standardized test with a normal distribution, the mean is 88. If the standard deviation is 4, the percentage of grades that would be expected to lie between 80 and 96 is closest to
1) 5
2) 34
3) 68
4) 95

11 On a standardized test, the mean is 83 and the standard deviation is 3.5. What is the best approximation of the percentage of scores that fall in the range 76 – 90?
1) 34
2) 68
3) 95
4) 99

12 The students' scores on a standardized test with a normal distribution have a mean of 500 and a standard deviation of 40. What percent of the students scored between 420 and 580?
1) 47.5%
2) 68%
3) 95%
4) 99.5%

13 On a mathematics quiz with a normal distribution, the mean is 8. If the standard deviation is 0.5, what is the best approximation of the percentage of grades that lie between 7 and 9?
1) 5%
2) 34%
3) 68%
4) 95%

14 Battery lifetime is normally distributed for large samples. The mean lifetime is 500 days and the standard deviation is 61 days. Approximately what percent of batteries have lifetimes *longer than* 561 days?
1) 16%
2) 34%
3) 68%
4) 84%

15 The scores on a test approximate a normal distribution with a mean score of 72 and a standard deviation of 9. Approximately what percent of the students taking the test received a score greater than 90?
1) $2\frac{1}{2}\%$
2) 5%
3) 10%
4) 16%

16 A test was given to 120 students, and the scores approximated a normal distribution. If the mean score was 72 with a standard deviation of 7, approximately what percent of the scores were 65 or higher?
1) 50%
2) 68%
3) 76%
4) 84%

2

17 The heights of women in the United States are normally distributed with a mean of 64 inches and a standard deviation of 2.75 inches. The percent of women whose heights are between 64 and 69.5 inches, to the *nearest whole percent*, is
1) 6
2) 48
3) 68
4) 95

18 Assume that the ages of first-year college students are normally distributed with a mean of 19 years and standard deviation of 1 year. To the *nearest integer*, find the percentage of first-year college students who are between the ages of 18 years and 20 years, inclusive. To the *nearest integer*, find the percentage of first-year college students who are 20 years old or older.

19 The heights of a sample of female students at Oriskany High School are normally distributed with a mean height of 65 inches and a standard deviation of 0.6 inch. What percent of this sample is between 63.8 inches and 66.2 inches? Above what height, in inches, would the top 2.3% of this sample population be found?

20 Twenty high school students took an examination and received the following scores:
    70, 60, 75, 68, 85, 86, 78, 72, 82, 88,
    88, 73, 74, 79, 86, 82, 90, 92, 93, 73
Determine what percent of the students scored within one standard deviation of the mean. Do the results of the examination approximate a normal distribution? Justify your answer.

21 On a standardized test, the distribution of scores is normal, the mean of the scores is 75, and the standard deviation is 5.8. If a student scored 83, the student's score ranks
1) below the 75th percentile
2) between the 75th percentile and the 84th percentile
3) between the 84th percentile and the 97th percentile
4) above the 97th percentile

22 The scores on a standardized exam have a mean of 82 and a standard deviation of 3.6. Assuming a normal distribution, a student's score of 91 would rank
1) below the 75th percentile
2) between the 75th and 85th percentiles
3) between the 85th and 95th percentiles
4) above the 95th percentile

23 The lengths of 100 pipes have a normal distribution with a mean of 102.4 inches and a standard deviation of 0.2 inch. If one of the pipes measures exactly 102.1 inches, its length lies
1) below the 16th percentile
2) between the 50th and 84th percentiles
3) between the 16th and 50th percentiles
4) above the 84th percentile

Name: _____

S.ID.A.4: Normal Distributions 3a

1 In a New York City high school, a survey revealed the mean amount of cola consumed each week was 12 bottles and the standard deviation was 2.8 bottles. Assuming the survey represents a normal distribution, how many bottles of cola per week will approximately 68.2% of the students drink?
   1) 6.4 to 12
   2) 6.4 to 17.6
   3) 9.2 to 14.8
   4) 12 to 20.4

2 The amount of juice dispensed from a machine is normally distributed with a mean of 10.50 ounces and a standard deviation of 0.75 ounce. Which interval represents the amount of juice dispensed about 68.2% of the time?
   1) 9.00–12.00
   2) 9.75–10.50
   3) 9.75–11.25
   4) 10.50–11.25

3 On a standardized test, the mean is 76 and the standard deviation is 4. Between which two scores will approximately 68% of the scores fall?
   1) 68 and 84
   2) 72 and 80
   3) 74 and 78
   4) 76 and 80

4 In a certain high school, a survey revealed the mean amount of bottled water consumed by students each day was 153 bottles with a standard deviation of 22 bottles. Assuming the survey represented a normal distribution, what is the range of the number of bottled waters that approximately 68.2% of the students drink?
   1) $131 - 164$
   2) $131 - 175$
   3) $142 - 164$
   4) $142 - 175$

5 A survey of high school girls found that the mean number of text messages sent per day by the girls was 62, with a standard deviation of 12. If a normal distribution is assumed, which interval represents the number of texts sent by 68.2% of the girls?
   1) 38–86
   2) 44–80
   3) 50–74
   4) 56–68

6 In 2013, approximately 1.6 million students took the Critical Reading portion of the SAT exam. The mean score, the modal score, and the standard deviation were calculated to be 496, 430, and 115, respectively. Which interval reflects 95% of the Critical Reading scores?
   1) 430 ± 115
   2) 430 ± 230
   3) 496 ± 115
   4) 496 ± 230

7 The mean of a normally distributed set of data is 56, and the standard deviation is 5. In which interval do approximately 95.4% of all cases lie?
   1) 46–56
   2) 46–66
   3) 51–61
   4) 56–71

8 The heights of the girls in the eleventh grade are normally distributed with a mean of 66 inches and a standard deviation of 2.5 inches. In which interval do approximately 95% of the heights fall?
   1) $61 - 66$ inches
   2) $61 - 71$ inches
   3) $63.5 - 68.5$ inches
   4) $66 - 71$ inches

Name: _____

9 The mean of a normally distributed set of data is 52 and the standard deviation is 4. Approximately 95% of all the cases will lie between which measures?
1) 44 and 52
2) 44 and 60
3) 48 and 56
4) 52 and 64

10 On a standardized test with a normal distribution of scores, the mean score is 82 and the standard deviation is 6. Which interval contains 95% of the scores?
1) 70 – 82
2) 70 – 94
3) 76 – 88
4) 76 – 94

11 A standardized test with a normal distribution of scores has a mean score of 43 and a standard deviation of 6.3. Which range would contain the score of a student in the 90th percentile?
1) 30.4 – 36.7
2) 36.7 – 43.0
3) 43.0 – 49.3
4) 49.3 – 55.6

12 On a standardized test with a normal distribution, the mean is 20 and the standard deviation is 2.6. In which interval would the greatest number of scores occur?
1) 12.2 – 14.8
2) 17.4 – 20.0
3) 22.6 – 25.2
4) 27.8 – 30.4

13 A set of test scores is normally distributed with a mean of 80 and a standard deviation of 8. Between what two scores should 68 percent of the scores fall?

14 A set of test scores is distributed normally with a mean of 70 and a standard deviation of 6. Between which two scores could 68% of the scores lie?

15 A set of boys' heights is distributed normally with a mean of 58 inches and a standard deviation of 2 inches. Express, in inches, between which two heights should 95% of the heights fall.

16 A survey of the soda drinking habits of the population in a high school revealed the mean number of cans of soda consumed per person per week to be 20 with a standard deviation of 3.5. If a normal distribution is assumed, find an interval that the total number of cans per week approximately 95% of the population of this school will drink. Explain why you selected that interval.

17 Mrs. Ramírez is a real estate broker. Last month, the sale prices of homes in her area approximated a normal distribution with a mean of $150,000 and a standard deviation of $25,000. A house had a sale price of $175,000. What is the percentile rank of its sale price, to the *nearest whole number*? Explain what that percentile means. Mrs. Ramírez told a customer that most of the houses sold last month had selling prices between $125,000 and $175,000. Explain why she is correct.

Name: _____

S.ID.A.4: Normal Distributions 4

1   The scores on a 100 point exam are normally distributed with a mean of 80 and a standard deviation of 6. A student's score places him between the 69th and 70th percentile. Which of the following best represents his score?
1) 66
2) 81
3) 84
4) 86

2   In a standardized test with a normal distribution of scores, the mean is 63 and the standard deviation is 5. Which score can be expected to occur most often?
1) 45
2) 55
3) 65
4) 74

3   In a certain population, the mean score on a test is 420. The standard deviation is 105. If the distribution of scores is normal, which of these scores should occur most often?
1) 540
2) 526
3) 385
4) 314

4   In a set of scores has a normal distribution and the mean is 200, which score has the greatest probability of being chosen at random?
1) 230
2) 228
3) 176
4) 168

5   A set of scores with a normal distribution has a mean of 32 and a standard deviation of 3.7. Which score could be expected to occur the *least* often?
1) 26
2) 29
3) 36
4) 40

6   The mean score on a normally distributed exam is 42 with a standard deviation of 12.1. Which score would be expected to occur *less than* 5% of the time?
1) 25
2) 32
3) 60
4) 67

7   If the mean of a test score is 30 and the standard deviation is 3.7, which score could be expected to occur less than 5% of the time?
1) 35
2) 33.8
3) 25
4) 22

8   On a standardized test, the mean is 61 and the standard deviation is 3.2. Which score can be expected to occur *less than* 3% of the time?
1) 50
2) 56
3) 62
4) 65

9   On a test, the mean score is 25 and the standard
deviation is 2.3. Which score could be expected to
occur *less than* 5% of the time?
1)   20
2)   28
3)   23
4)   24

10 Liz has applied to a college that requires students to
score in the top 6.7% on the mathematics portion of
an aptitude test. The scores on the test are
approximately normally distributed with a mean
score of 576 and a standard deviation of 104. What
is the minimum score Liz must earn to meet this
requirement?
1)   680
2)   732
3)   740
4)   784

11 One thousand students took a test resulting in a
normal distribution of the scores with a mean of 80
and a standard deviation of 5. Approximately how
many students scored between 75 and 85?
1)   950
2)   815
3)   680
4)   475

12 On a standardized test with normal distribution, the
mean is 75 and the standard deviation is 6. If 1200
students took the test, approximately how many
students would be expected to score between 69
and 81?
1)   408
2)   600
3)   816
4)   1140

13 The amount of ketchup dispensed from a machine
at Hamburger Palace is normally distributed with a
mean of 0.9 ounce and a standard deviation of 0.1
ounce. If the machine is used 500 times,
approximately how many times will it be expected
to dispense 1 or more ounces of ketchup?
1)   5
2)   16
3)   80
4)   100

14 The scores of 1000 students on a standardized test
were normally distributed with a mean of 50 and a
standard deviation of 5. What is the expected
number of students who had scores greater than 60?
1)   1.7
2)   23
3)   46
4)   304

15 An amateur bowler calculated his bowling average
for the season. If the data are normally distributed,
about how many of his 50 games were within one
standard deviation of the mean?
1)   14
2)   17
3)   34
4)   48

16 The heights of a group of 1000 women are normally distributed. The mean height of the group is 170 centimeters (cm) with a standard deviation of 10 cm. What is the best approximation of the number of women between 170 cm and 180 cm tall?
1) 950
2) 680
3) 340
4) 170

17 The weights of the boxes of animal crackers coming off an assembly line differ slightly and form a normal distribution whose mean is 9.8 ounces and whose standard deviation is 0.6 ounce. Determine the number of boxes of animal crackers in a shipment of 5,000 boxes that are expected to weigh *more than* 11 ounces.

18 In a certain school, the heights of the population of girls are normally distributed, with a mean of 63 inches and a standard deviation of 2 inches. If there are 450 girls in the school, determine how many of the girls are *shorter than* 60 inches. Round the answer to the *nearest integer*.

19 Professor Bartrich has 184 students in her mathematics class. The scores on the final examination are normally distributed and have a mean of 72.3 and a standard deviation of 8.9. How many students in the class can be expected to receive a score between 82 and 90?

20 On the Algebra 2/Trigonometry midterm at Champion High School, the scores of 210 students were normally distributed with a mean of 82 and a standard deviation of 4.2. Determine how many students scored between 79.9 and 88.3.

21 In a study of 82 video game players, the researchers found that the ages of these players were normally distributed, with a mean age of 17 years and a standard deviation of 3 years. Determine if there were 15 video game players in this study over the age of 20. Justify your answer.

Name: _____

S.ID.A.4: Normal Distributions 5a

1 The scores on a test have a normal distribution. The mean of the scores is 40 and the standard deviation is 6. The probability that a score chosen at random lies between 34 and 46 is closest to
1) .34
2) .68
3) .95
4) .99

2 The average score for a Latin test is 77 and the standard deviation is 8. Which percent best represents the probability that any one student scored between 61 and 93 on the test?
1) 95%
2) 99.5%
3) 68%
4) 34%

3 If the amount of time students work in any given week is normally distributed with a mean of 10 hours per week and a standard deviation of 2 hours, what is the probability a student works between 8 and 11 hours per week?
1) 34.1%
2) 38.2%
3) 53.2%
4) 68.2%

4 The lifespan of a 60-watt lightbulb produced by a company is normally distributed with a mean of 1450 hours and a standard deviation of 8.5 hours. If a 60-watt lightbulb produced by this company is selected at random, what is the probability that its lifespan will be between 1440 and 1465 hours?
1) 0.3803
2) 0.4612
3) 0.8415
4) 0.9612

5 A set of normally distributed student test scores has a mean of 80 and a standard deviation of 4. Determine the probability that a randomly selected score will be between 74 and 82.

6 The amount of time that a teenager plays video games in any given week is normally distributed. If a teenager plays video games an average of 15 hours per week, with a standard deviation of 3 hours, what is the probability of a teenager playing video games between 15 and 18 hours a week?

7 A shoe manufacturer collected data regarding men's shoe sizes and found that the distribution of sizes exactly fits the normal curve. If the mean shoe size is 11 and the standard deviation is 1.5, find:
a the probability that a man's shoe size is greater than or equal to 11
b the probability that a man's shoe size is greater than or equal to 12.5
c $\dfrac{P(\text{size} \geq 12.5)}{P(\text{size} \geq 8)}$

8 Two versions of a standardized test are given, an April version and a May version. The statistics for the April version show a mean score of 480 and a standard deviation of 24. The statistics for the May version show a mean score of 510 and a standard deviation of 20. Assume the scores are normally distributed. Joanne took the April version and scored in the interval 510-540. What is the probability, to the *nearest ten thousandth*, that a test paper selected at random from the April version scored in the same interval? Maria took the May version. In what interval must Maria score to claim she scored as well as Joanne?

Use the information provided to answer Part A and Part B for question 20.

The two-way table shows the classification of students in a mathematics class by gender and dominant hand. A student who is ambidextrous uses both hands equally well.

	Right-handed	Left-handed	Ambidextrous	Total
Male	11	4	1	16
Female	12	2	0	14
Total	23	6	1	30

20. Part A

What is the probability that a randomly selected student in the class is female given that the student is right-handed?

A. $\frac{1}{12}$

B. $\frac{12}{30}$

C. $\frac{12}{23}$

D. $\frac{23}{30}$

Part B

One student will be selected at random from the class.

Consider the events:

X: the selected student is female

Y: the selected student is right-handed

Which statement about events X and Y is true?

A. The events are independent because the number of right-handed students in the class is larger than the number of female students.

B. The events are independent because the number of categories for dominant hand is different from the number of categories for gender.

C. The events are not independent because for one of the dominant hand categories the number of female students is 0.

D. The events are not independent because the probability of X is not equal to the probability of X given Y.

22. The heights of the male students at a college are approximately normally distributed. Within this curve, 95% of the heights, centered about the mean, are between 62 inches and 78 inches. The standard deviation is 4 inches. Use this information to estimate the mean height of the males. Approximate the probability that a male student is taller than 74 inches. Explain how you determined your answers.

Enter your answers and your explanation in the space provided.

26. A circular spinner is divided into five sectors of different colors. A student spun the arrow on the spinner 200 times and recorded that the arrow stopped on the orange sector 38 times out of the 200 spins. To test whether the spinner was fair, the student used a computer to simulate the number of times the arrow stops on orange in 200 spins of a fair spinner equally divided into five sectors of different colors. The results of 1,000 trials of the simulation are shown.

Simulation Results

Number of Orange Spins
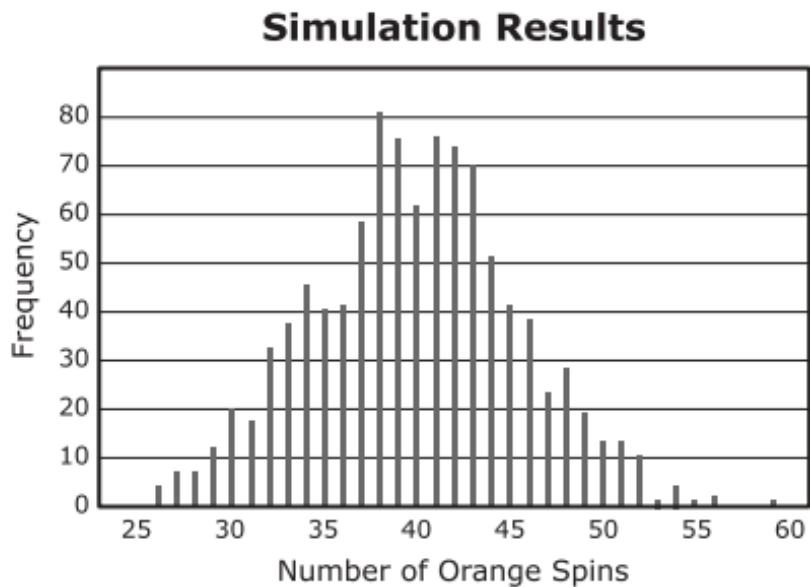
Based on the results of the simulation, is there statistical evidence that the spinner is not fair?

A. Yes, because 38 was the most frequent outcome.

B. Yes, because about 8% of the outcomes were 38.

C. No, because the distribution is approximately normal.

D. No, because an outcome of 38 or less is not unusual.

Use the information provided to answer Part A and Part B for question 29.

The manager of food services at a local high school is interested in assessing student opinion about a new lunch menu in the school cafeteria. The manager is planning to conduct a sample survey of the student population.

29. **Part A**

   Which of the listed methods of sample selection would be the **most** effective at reducing bias?

   A. Randomly select one day of the week and then select the first 30 students who enter the cafeteria on that day.

   B. Post the survey on the school Web site and use the first 30 surveys that are submitted.

   C. Randomly select 30 students from a list of all the students in the school.

   D. Randomly select one classroom in the school and then select the first 30 students who enter that classroom.

Part B

The manager wants to know if a student's gender is related to the student's opinion about the menu. Which statement **best** describes the study?

A. This is an observational study, and therefore, the manager will be able to establish a cause-and-effect relationship between gender and opinion.

B. This is an observational study, and therefore, the manager will not be able to establish a cause-and-effect relationship between gender and opinion.

C. This is an experimental study, and therefore, the manager will be able to establish a cause-and-effect relationship between gender and opinion.

D. This is an experimental study, and therefore, the manager will not be able to establish a cause-and-effect relationship between gender and opinion.

PARCC PAPER TEST PRACTICE PROBLEMS

Use the information provided to answer Part A and Part B for question 31.

The distribution of weights (rounded to the nearest whole number) of all boxes of a certain cereal is approximately normal with mean 20 ounces and standard deviation 2 ounces.

A sample of the cereal boxes was selected, and the weights of the selected boxes are summarized in the histogram shown.
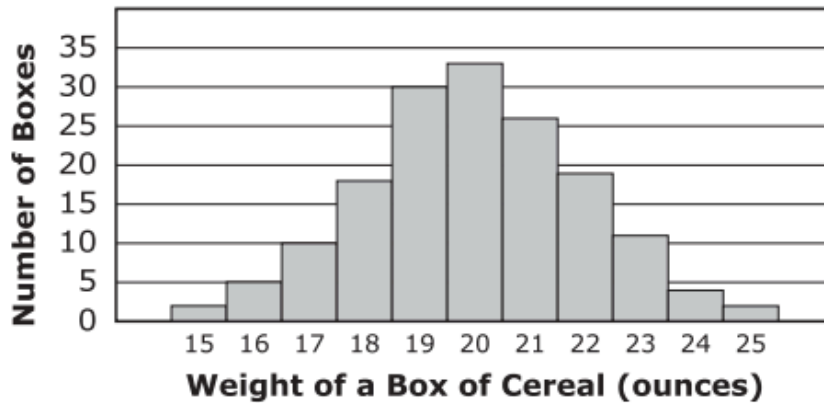
31. Part A

If *w* is the weight of a box of cereal, which range of weights includes all of the weights of cereal boxes that are within 1.5 standard deviations of the mean?

A. $17 \leq w \leq 23$

B. $18.5 \leq w \leq 21.5$

C. $19 \leq w \leq 21$

D. $20 \leq w \leq 23$

Part B

Which of these values is the **best** estimate of the number of boxes in the sample with weights that are more than 1.5 standard deviations above the mean?

A. 2

B. 6

C. 17

D. 36

38. Part A

The histograms show the distribution of heart rates of randomly selected adult males between the ages of 40 and 45 after 20 minutes of continuous exercise. The adult males were randomly assigned to use either a new elliptical machine (Experimental Group) or a traditional treadmill machine (Control Group).
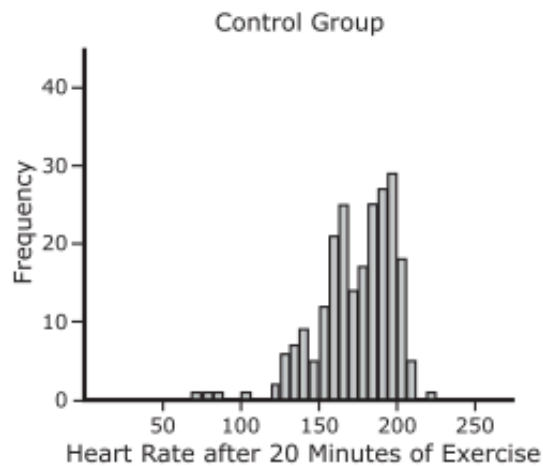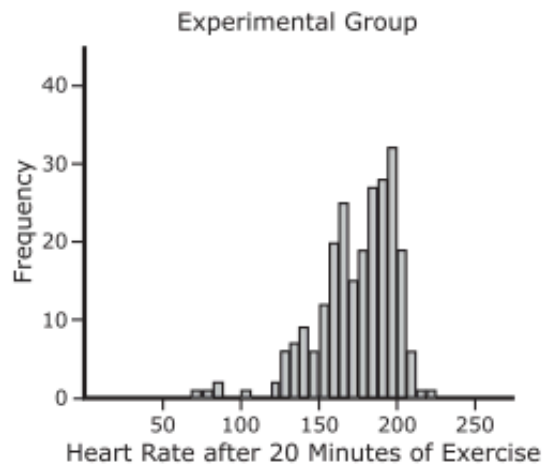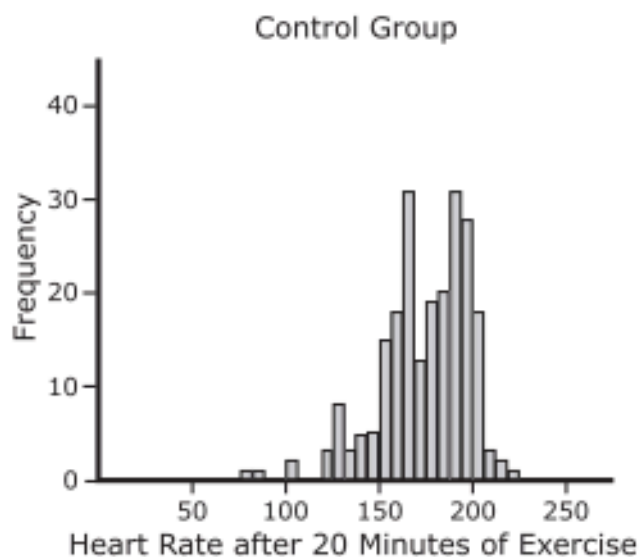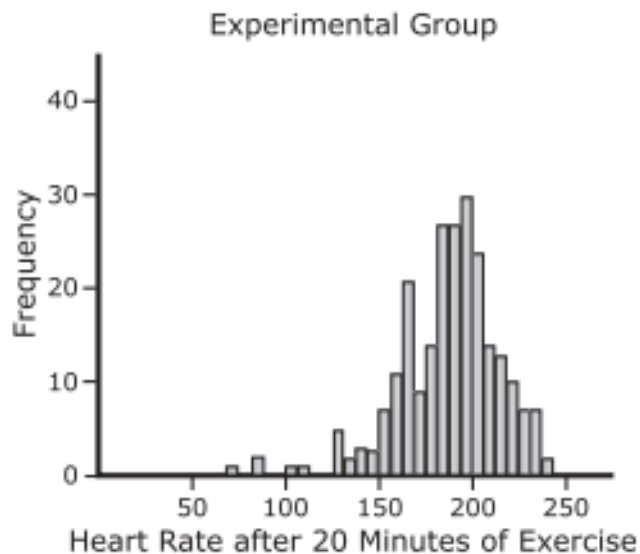

Experimental Group

Control Group

What conclusion about the difference between the distributions of the heart rates for these two groups can be drawn? Justify your answer.

Enter your answer and your justification in the space provided.

Part B

After the participants worked out three times per week for four weeks solely on their assigned machines, participants' heart rates were collected again after 20 minutes of continuous exercise. The data are shown in the histograms.

Experimental Group

Control Group

What conclusion about the difference between the distributions of the heart rates for the two groups can be drawn? Justify your answer.

If the target heart rate range for adult males aged between 40 and 45 after 20 minutes of exercise is around 175 beats per minute, what recommendation would you make in terms of which machine to use? Justify your answer.

Based upon these data, what conclusion about exercise machines in general can be made?