Math 9 LG 14

Statistics in Society

INTRODUCTION:

One of the most important concepts in mathematics is Statistics. Constructing surveys to display information about a topic of interest is what many companies call market research. Knowing what the consumer wants is the quest of any company in order to provide a service or product that will make them money.

LEARNING GUIDE EXPECTATIONS:

On the completion of this learning guide you will be able to:

1) Using your own words, explain how each of the following factors can have an effect on a survey. Such as: **bias**, **use of language**, **ethics, cost**, **time**, **timing**, **privacy** and **cultural sensitivity**.
2) Describe the difference between a **sample** and a **population**, and include a brief description of all 5 different sampling techniques.
3) Formulate an appropriate **representation** of statistical data and be able to identify a **misleading representation** of data.
4) Demonstrate an understanding of the concept of **probability** and be able to calculate the **probability** of (1) an event occurring, and (2) one or more **independent events** occurring.

EVALUATION:

You are ready to progress to the next learning guide when you can demonstrate your understanding of the above expectations. Please refer to your Mathematics 9 Marks Record Sheet to determine the assessment.

RESOURCES NEEDED:

Math Links 8 Text (online; for misleading representations)

Math Links 9 Text

LEARNING ACTIVITIES:

Expectation #1: Using your own words, explain the factors that can have an effect on a survey. Such as: **bias**, **use of language**, **ethics, cost**, **time**, **timing**, **privacy**, and **cultural sensitivity**.

1. In the Math Links 9 text, take notes on Section 11.1. Anything written in italics, inside a purple or blue box should be included in your notes.
2. In the Math Links 9 text, work through Examples1 & 2 on pages 416-417. Now complete #2, 4, 6, 9→12 &14 on pages 418-420.
3. Read Key Ideas on page 418. In your math journal, condense all of the material you have gathered on **influencing factors**.

Expectation #2: Describe the difference between a **sample** and a **population**, and include a brief description of all 5 different sampling techniques.

1. In the Math Links 9 text, take notes on Section 11.2. Anything written in italics, inside a purple or blue box should be included in your notes.
2. In the Math Links 9 text, work through Examples1 & 2 on pages 423-425. Now complete #2, 4, 6, 10 &15 on pages 426-428.
3. Read Key Ideas on page 426. In your math journal, condense all of the material you have gathered on **selecting appropriate samples**.

Expectation #3: Formulate an appropriate **representation** of statistical data and be able to identify a **misleading representation** of data.

1. In the Math Links 8 text (here is the password-protected link to that alternate resource), take notes on Section 1.2 (starting on page 18). The different distortions noted in examples 1-3 from pages 19-22 should form part of your notes.
2. In this alternate resource, complete the following questions: #5, 6, 8, 14 & 16 on pages 23-26.
3. Read Key Ideas on page 22 from the alternate resource. In your math journal, condense all of the material you have gathered on **misleading representation** of stats.

Expectation #4: Demonstrate an understanding of the concept of **probability** and be able to calculate the **probability** of (1) an event occurring, and (2) one or more **independent events** occurring.

1. Read the supplemental information on **probability** provided in the following pages.
2. In this alternate resource, complete questions 1-12 on pp. 5-6 as well as the "Review and Challenge" questions #1-6 on page 8.
3. In your math journal, summarize the concepts you've learning around **probability**.

Math 9 – LG 14 Supplement
Probability

We often hear about the probability of an event happening. For example, the probability of precipitation today is 60% or the chances of winning a prize in a lottery is 1 in 4. Consider the following probabilities:

Example #1: What is the probability of rolling a 4 on a 6 sided die?

Solution: Since each outcome (rolling a 1, 2, 3, 4, 5, or 6) is equally likely, then there is one favourable outcome (rolling a 4) out of a total of 6 possible outcomes. We would say the probability of rolling a 4 is $\frac{1}{6}$ or .167 or 16.7%.

Example #2: What is the probability of rolling an even number on a 6 sided die?

Solution: There are 3 favourable outcomes: 2, 4, and 6.
There are a total of 6 different outcomes: 1, 2, 3, 4, 5, or 6.
So the probability or rolling an even number is $\frac{3}{6}$ or $\frac{1}{2}$ or 0.5 or 50%.

If the outcomes of an experiment are equally likely, then the probability of an event occurring is:

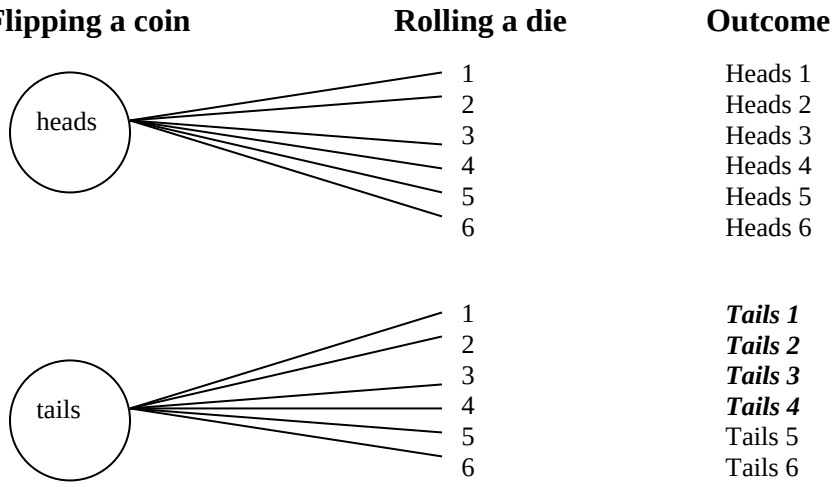
$$PROBABILITY = \frac{NUMBER\ OF\ \ FAVOURABLE\ \ OUTCOMES}{TOTAL\ \ NUMBER\ OF\ \ OUTCOMES}$$

Note: Instead of writing "probability of rolling an even number", we can express this as **P(even number).**

Another Note: Probabilities can be expressed as a fraction, decimal or a percentage as shown in the examples.

Example #3: Suppose a coin is tossed and a six-sided die rolled. What is the probability of getting tails and rolling a number less than 5?

Solution: A tree diagram is often helpful to show the outcomes when there is more than one event.



The bold italicized outcomes represent the favourable outcomes (tails and numbers less than 5). You can see there are a total of 12 outcomes, so the probability is:

$$P(\textit{getting tails and rolling a number less than } 5) = \frac{\textit{\# favourable outcomes}}{\textit{total \# of outcomes}} = \frac{4}{12} = \frac{1}{3} \text{ or .333 or 33.3\%}$$

Another way of finding the probability of two events is to multiply their individual probabilities. In the above example, the probability of getting tails and rolling a number less than 5 is:

$$\text{P(tails \& \# less than 5)} = \text{P(tails)} \times \text{P(\# less than 5)} = \frac{1}{2} \times \frac{4}{6} = \frac{4}{12} = \frac{1}{3}$$

You can see you achieve the same result.

The probability of two or more events can be summarized as follows:

$$\text{P(A and B)} = \text{P(A)} \times \text{P(B)}$$

Example #4: In a standard deck of 52 cards, there are 13 hearts, 13 clubs, 13 diamonds, and 13 spades. What is the probability of drawing 2 spades?

Solution: When you pick the first spade, the probability is $\frac{13}{52}$ but when you go to draw the second spade, there will only be 12 spades left (you have one in your hand) and there will be only 51 cards in total left in the pile. So,

$P(2 \text{ spades}) = P(1^{st} \text{ spade}) \times P(2^{nd} \text{ spade}) = \frac{13}{52} \times \frac{12}{51} = \frac{156}{2652} = \frac{1}{17}$ or about 5.88%

Complete the following exercises. As always, write the question down, show your work, and check your answers.

1. What is the probability of rolling a 1 on a 6-sided die?

2. What is the probability of rolling a 1 or a 5 on a 6-sided die?

3. If a jar contains 3 red marbles, 2 yellow marbles and 4 blue marbles, what is the probability of selecting a blue marble?

4. What is the probability of a family consisting of two girls? Assume there is equal probability of a boy or girl.

5. What is the probability that your birthday would be in the same month as your math teacher's? Assume each month is equally likely.

6. If a die is rolled twice, what is the probability of the following:
   a) rolling a 4 and then rolling another 4?
   b) rolling an odd number then rolling an even number?
   c) rolling a number less than 3 then rolling a number more than 2?
   d) rolling 2 numbers that are the same?

7. A jar contains 37 jelly beans: 8 red, 13 black, 9 orange, and 7 green.
   a) What is the probability of drawing an orange jelly bean?
   b) What is the probability of drawing a red jelly bean followed by a black jelly bean?
   c) What is the probability of drawing a red jelly bean followed by another red jelly bean?
   d) What is the probability of drawing a green jelly bean followed by a black jelly bean followed by another green jelly bean?
   e) What is the probability of not drawing a black jelly bean?

8. Use the following information about a deck of cards to answer the following questions:
   Total number of cards in the deck: **52**
   There are 4 suits: **hearts, clubs, spades, and diamonds.**
   Each suit contains the following 13 cards: **ace, king, queen, jack and card #'s 2 – 10.**
   The hearts and diamonds are **red** and the spades and clubs are **black**.
   a) What is the probability of drawing a heart?
   b) What is the probability of drawing a red card?
   c) What is the probability of drawing an ace?
   d) What is the probability of drawing a king, queen or jack?
   e) What is the probability of drawing a heart and then the ace of spades?
   f) What is the probability of drawing the ace of spades and then a heart?
   g) What is the probability of drawing a 10 and then a 7?

9. One lottery claims there is a 1 in 7 chance of winning a prize. Another lottery claims there is a 1 in 9 chance of winning a prize. If you entered both lotteries, what is the chance you win something from both lotteries?

10. The probability of precipitation in Vancouver on a given day in August is 30%. In the same month, the probability of precipitation in Kamloops is 20% and the probability of precipitation in Prince Rupert is 60%. What is the probability that it rains in all 3 cities?

11. A true-false test consists of 5 questions. What is the probability of getting 100% on the test?

12. A multiple choice test has 5 questions. Each question has 4 choices. What is the probability of getting all 5 questions correct?

13. **BONUS**: You are on a game show where you are presented with three closed doors behind which are a goat, another goat, and a new car (respectively). You choose a door. The game show host then reveals a goat from behind a different door, and gives you the option of switching your guess to the other remaining closed door. Do you have a better chance of winning the car if you switch your guess?

SOLUTIONS FOR PROBABILITY

NOTE: You can express your answer as a fraction or a decimal or a percent.

1. $\frac{1}{6}$ or 0.167 or 16.7%

2. $\frac{1}{3}$ or 0.333 or 33.3%

3. $\frac{4}{9}$ or 0.444 or 44.4%

4. $\frac{1}{4}$ or 0.25 or 25%

5. $\frac{1}{12}$ or 0.083 or 8.3%

6.a) $\frac{1}{36}$ or 0.028 or 2.8% b) $\frac{1}{4}$ or 0.25 or 25% c) $\frac{2}{9}$ or 0.222 or 2.22%

d) $\frac{1}{6}$ or 0.167 or 16.7%

7.a) $\frac{9}{37}$ or 0.243 or 24.3% b) $\frac{26}{333}$ or 0.078 or 7.8% c) $\frac{14}{333}$ or 0.042 or 4.2%

d) $\frac{13}{1110}$ or 0.012 or 1.2% e) $\frac{24}{37}$ or 0.649 or 64.9%

8.a) $\frac{1}{4}$ or .25 or 25% b) $\frac{1}{2}$ or 0.5 or 50% c) $\frac{1}{13}$ or 0.077 or 7.7%

d) $\frac{3}{13}$ or 0.231 or 23.1% e) $\frac{1}{204}$ or 0.005 or 0.5% f) $\frac{1}{204}$ or 0.005 or 0.5%

g) $\frac{4}{663}$ or 0.006 or 0.6%

9. $\frac{1}{63}$ or 0.016 or 1.6%

10. $\frac{9}{250}$ or 0.036 or 3.6%

11. $\frac{1}{32}$ or 0.031 or 3.1%

12. $\frac{1}{1024}$ or 0.000977 or .0977%

13. Hint: research the "Monty Hall Problem" (Monty was the a famous game show host).

☺The answers to questions 11 & 12 prove it is always a good idea to study well for tests! ☺

Review and Challenge

1. What is the probability of rolling a 2 on a 5 sided die?

2. What is the probability of rolling an odd number on a 6 sided die?

3. A jar contains 4 blue marbles, 3 red marbles and 6 green marbles. What is the probability of drawing:
   a) a red marble?
   b) a green marble followed by a blue marble?

4. Use the following information about a deck of cards to answer the following questions:
   Total number of cards in the deck: **52**
   There are 4 suits: **hearts, clubs, spades, and diamonds.**
   Each suit contains the following 13 cards: **ace, king, queen, jack and card #'s 2 – 10.**
   The hearts and diamonds are **red** and the spades and clubs are **black**.
   a) What is the probability of drawing an ace?
   b) What is the probability of drawing a black card?
   c) What is the probability of drawing a king followed by another king?
   d) What is the probability of not drawing a king, queen or jack?

5. A true-false test has 6 questions. What is the probability of getting all of them correct?

6. A multiple choice test has 6 questions. What is the probability of getting them all correct if each question has 4 choices?

SOLUTIONS FOR "REVIEW AND CHALLENGE"

1. $\frac{1}{5}$ or 0.2 or 20%

2. $\frac{1}{2}$ or 0.5 or 50%

3. a) $\frac{3}{13}$ or 0.231 or 23.1%

   b) $\frac{2}{13}$ or 0.154 or 15.4%

4. a) $\frac{1}{13}$ or 0.077 or 7.7%

   b) $\frac{1}{2}$ or 0.5 or 50%

   c) $\frac{1}{221}$ or 0.0045 or 0.45%

   d) $\frac{10}{13}$ or 0.769 or 76.9%

5. $\frac{1}{64}$ or 0.016 or 1.6%

6. $\frac{1}{4096}$ or 0.000244 or 0.0