Simple Probabilities

Lesson objectives

- I can use probability to describe the likelihood of something occurring
- I can measure and calculate simple probabillities

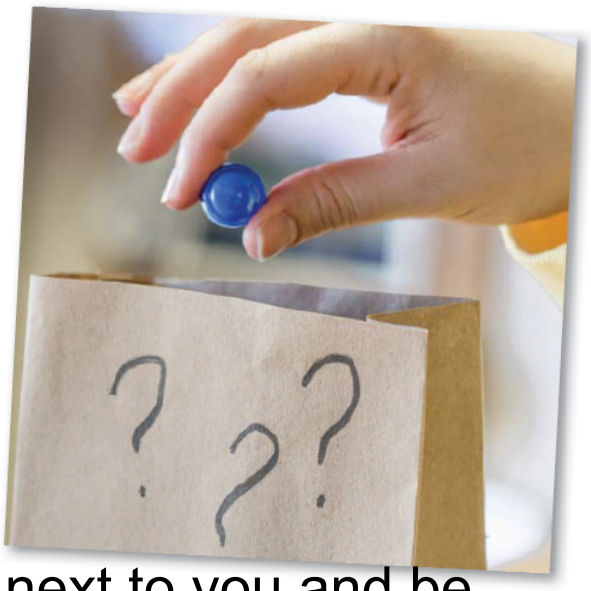
1.1 Lesson objectives Teachers' notes Lesson notes

MHR Page 13 #s 1 - 7 & 9 - 12

Warm Up

The students know there are 10 coloured counters in the bag; however, they do not know how many of each colour there are.

- How could they estimate the number of each colour?
- What mathematical processes could they use to determine the bag's contents?



Discuss with the person next to you and be prepared to share your answers.

Definitions

Probability
- The likelihood of something occurring

Outcome
- A possible result of an experiment

Experimental Probability
- Probability based on experimental trials
- Number of times an outcome happens divided by total number of trials
- Sometimes called statistical or empirical probability

$$P(A) = \frac{n(A)}{n(T)}$$

where P(A) is the probability that outcome A occurs, n(A) is the number of times outcome A occurred and n(T) is the number of trials

Subjective Probability
- A probability **estimate** based on intuition
- Often involves little or no mathematical data

Example 1

Calculate Experimental Probability

A student spins a mystery spinner 24 times. The table shows the results.

Colour	Favourable Outcomes, $n(A)$
Red	12
Yellow	4
Blue	8

a) Determine the experimental probability of the spinner landing on each colour. Express your answers as a fraction, a decimal, and a percent.

b) Determine the sum of the probabilities and explain what it means.

c) What could this spinner look like? Can you be certain this is what the spinner looks like?

a) $P_{Red} = \frac{12}{24} = \frac{1}{2} = 0.5 = 50\%$

$P_{Yellow} = \frac{4}{24} = \frac{1}{6} = 0.1\overline{6} = 16.\overline{6}\%$

$P_{Blue} = \frac{8}{24} = \frac{1}{3} = 0.\overline{3} = 33.\overline{3}\%$

b) Sum $= \frac{1}{2} + \frac{1}{6} + \frac{1}{3}$

$= \frac{3}{6} + \frac{1}{6} + \frac{2}{6}$

$= \frac{6}{6} = 1 \Rightarrow$ Certain to get one of these colours.

c)

Your Turn

A mystery spinner produces these results.

Colour	Favourable Outcomes, $n(A)$
Orange	8
Red	4
Purple	8
Green	12

a) Determine the experimental probability of the spinner landing on each colour. Express your answers as a fraction, a decimal, and a percent.

b) What could this spinner look like?

c) Is it possible that there is a fifth colour? Explain your answer.

a) Total number of trials = 8+4+8+12
= 32

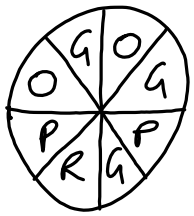
$P_O = \frac{8}{32} = \frac{1}{4} = 0.25 = 25\%$

$P_R = \frac{4}{32} = \frac{1}{8} = 0.125 = 12.5\%$

$P_P = \frac{8}{32} = \frac{1}{4} = 0.25 = 25\%$

$P_G = \frac{12}{32} = \frac{3}{8} = 0.375 = 37.5\%$

b)



c) Yes. It just hasn't been selected yet.

Sum of Probabilities

If you add all probabilities in an experiment, the total will always equal one.

Each probability represents the fraction of times an outcome occurred.

All fractions combined make up the whole set of outcomes that occurred during the experiment.

Sum of Probabilities

For a probability experiment in which there are n outcomes,

$P_1 + P_2 + P_3 + \ldots P_n = 1$

where $P_1, P_2, P_3, \ldots P_n$ are the probabilities of the individual outcomes.

Example 2

Apply Experimental Probability

Tia is the manager of a pizza shop. The table shows the number of pizza slices ordered during the lunch rush over several days.

Pizza Type	Number of Slices
Pepperoni	98
Hawaiian	48
Vegetarian	51

a) Determine the experimental probability that a customer will order each type of pizza slice.

b) Based on this information, what advice should Tia offer her chef in order to be ready for the lunch rush?

a) Total slices sold $= 98+48+51$
$= 197$

$P_P = \frac{98}{197} = 0.497 \approx 50\%$

$P_H = \frac{48}{197} = 0.243 \approx 24\%$

$P_V = \frac{51}{197} = 0.258 \approx 26\%$

b) Bake the same amount of Hawaiian as Vegetarian pizzas. But bake twice as many Pepperoni pizzas.

Your Turn

A market researcher is conducting a telephone poll to gather data about which type of television service families use the most. The table illustrates the results.

Television Service	Tally
Cable	48
Satellite	42
Internet	15
Antenna	4
None	6

a) Determine the experimental probability of using each television service the most.

b) Who might be interested in these results, and for what purpose?

c) Suggest how these results may change over time. Explain why you think so.

a) Total number of services $= 48+42+15+4+6$
$= 115$

$P_C = \frac{48}{115} = 0.417 \approx 42\%$

$P_S = \frac{42}{115} = 0.365 \approx 37\%$

$P_I = \frac{15}{115} = 0.130 \approx 13\%$

$P_A = \frac{4}{115} = 0.035 \approx 4\%$

$P_N = \frac{6}{115} = 0.052 \approx 5\%$

b) Service providers! How many have what and why.

c) Some providers may have promotions, so customers may switch. Streaming may become even more popular, so Internet TV may increase.

Example 3

Estimate Subjective Probability

Match each scenario with its most likely subjective probability.

	Scenario	Subjective Probability, $P(A)$
a)	A person randomly selected from your high school is a student.	0.2 0.9 0.5
b)	A shaker randomly picked from a dining room table contains pepper.	
c)	You turn on the radio at some random time and an advertisement is playing.	

a) = 0.9 Could be an adult, but far more likely to be a student.

b) = 0.5 Usually only have two options: salt or pepper.

c) = 0.2 It may seem like they are always playing commercials, but that isn't true. You are far more likely to hear music.

Your Turn

Estimate the subjective probability of each of the following outcomes. Justify your estimates.

a) You will have a snow day in July where you live.

b) The sun will set in the west tonight.

c) The next person to enter the school cafeteria will be female.

a) = 0.001 Highly unlikely. Typical temperatures are in the range of 27°C – 33°C.

b) = $0.\overline{9}$ OK, it's certain unless something VERY strange happens.

c) = 0.5 Either male or female is possible. If we knew the number of each gender then we could make a more accurate estimate.

Reflect

R1. a) What is meant by the term "experimental probability"? Explain how it is calculated.

b) Explain why experimental probability is a useful strategy for making predictions.

c) Explain why experimental probability is not a perfect strategy for making accurate predictions.

a) Probability based on trials. Calculated by # of sucesses ÷ Total attempts.

b) Gives a liklihood of something happening based upon observations.

c) Can give a guide, but repeating the experiment won't necessarily give you the same results.

R2. a) The probability of an outcome is 0. What does this mean?

b) The probability of an outcome is 1. What does this mean?

c) Why does the probability of an outcome always have a value between 0 and 1?

a) The outcome is impossible.

b) The outcome is certain to happen.

c) Outcomes must be either impossible, certain, or somewhere inbetween.

Homework

MHR Page 13 #s 1 - 7 & 9 - 12