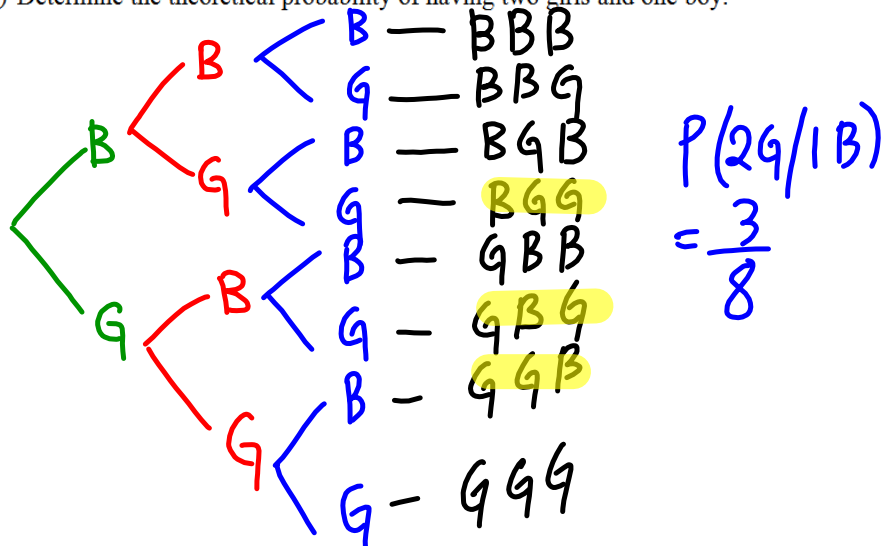


Worksheet 2-3: Experimental Probability vs. Theoretical Probability

Real-life situations can be simulated by probability experiments.

The theoretical probability and experimental probability of an event are not necessarily the same. As the number of trials increases, the experimental probability usually gets closer to the theoretical probability.

1. Suppose a couple would like to have three children.
  - (a) Determine the theoretical probability of having two girls and one boy.



- (b) Explain how your answer in part (a) can help determine the theoretical probability of having two boys and one girl.

See Answer key

- (c) Determine the theoretical probability of having at least one girl.

$$\begin{aligned} \textcircled{1} P(1g) + P(2g) + P(3g) \\ = \frac{3 + 3 + 1}{8} \\ = \frac{7}{8} \end{aligned}$$

$$\begin{aligned} \textcircled{2} 1 - P(\text{No girls}) \\ = 1 - \frac{1}{8} \\ = \frac{7}{8} \end{aligned}$$

2. You toss a coin 10 times. It turns up heads 8 times. ← Observation

(a) What is the experimental probability of turning up heads?

$$P_e(\text{Head}) = \frac{8}{10} \\ = \frac{4}{5}$$

∴ The probability of turning up heads is  $\frac{4}{5}$ .

(b) What is the theoretical probability of turning up heads?

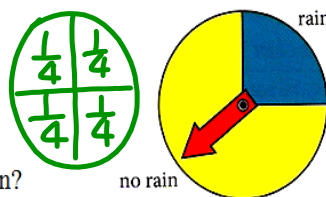
↑ in theory → NOT actual

$$P(\text{Head}) = \frac{1}{2} \quad \because \text{you have 2 possible outcomes}$$

(c) If you tossed the coin several more times, would you expect the experimental probability to increase or decrease? Explain.

Since experimental probability is  $\frac{4}{5}$  which is higher than the theoretical probability of  $\frac{1}{2}$ , I expect the experimental probability to decrease. As the number of trials increases, experimental probability gets closer to theoretical probability.

3. Consider the spinner shown.



(a) What is the theoretical probability of the spinner landing on rain?

$$P(\text{rain}) = \frac{1}{4}$$

The theoretical probability of landing on rain is  $\frac{1}{4}$ .

(b) If the spinner lands on no rain 13 times in 15 trials, what would be the experimental probability of a day having no rain?

$$P_e(\text{no rain}) = \frac{13}{15}$$

The experimental probability of a day having no rain is  $\frac{13}{15}$ .

4. A random number generator is used to simulate the results of rolling a die 30 times. The results are shown in the table.

Outcome	1	2	3	4	5	6
Frequency	4	6	7	5	6	2

Total  
30

- (a) Determine the probability of each outcome.

(i) rolling a 1

$$P_e(1) = \frac{4}{30}$$

$$= \frac{2}{15}$$

(ii) rolling a 2

$$P_e(2) = \frac{6}{30}$$

$$= \frac{1}{5}$$

(iii) rolling a 3

$$P_e(3) = \frac{7}{30}$$

(iv) rolling a 4

$$P_e(4) = \frac{5}{30}$$

$$= \frac{1}{6}$$

(v) rolling a 5

$$P_e(5) = \frac{6}{30}$$

$$= \frac{1}{5}$$

(vi) rolling a 6

(b) Is each probability in part (a) theoretical or experimental? Explain your reasoning.

Each probability in part (a) is experimental because the results come from an actual experiment of 30 trials.

6. During the month of April 2006, at least some rainfall was recorded on 12 different days at the Sarnia Airport weather station. Suppose one day in April 2006 is selected at random. What is the probability of choosing a day on which it rained as a percent?

Experimental Probability (April, 2006)

Rained 12 days      No rain 18 days  
(30 days in April)

$$P_e(\text{Rained}) = \frac{12}{30}$$

$$= \frac{2}{5}$$

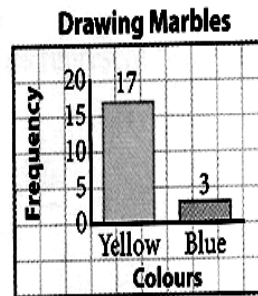
$$= 40\%$$

$$\rightarrow \frac{2}{5} \times 100 = 40\%$$

$\therefore$  The probability of choosing a day on which it rained is 40%.

7. In a bag, there are 14 yellow marbles and 6 blue marbles. A marble is removed, the colour is recorded, and then it is put back into the bag. This is repeated for a total of 20 times. The results are displayed on the bar graph.

Theoretical uses given info on the numbers of yellow & blue marbles.



- (a) What is the experimental probability of drawing a yellow marble?

Express your answer as a percent.

Experimental uses the graph

$$P_e(\text{yellow}) = \frac{17}{20} \times 100$$

$$= 85\%$$

- (b) What is the theoretical probability of drawing a yellow marble?

Express your answer as a percent.

$$P(\text{yellow}) = \frac{14}{20} \times 100$$

$$= 70\%$$

In the bag:  
14 yellow  
6 blue

Theoretical probability → math sense with what we have  
Experimental probability → data collected from observation



Tree Diagram for Having Three Children:

