Investigation: Theoretical vs. Experimental Probability

$P(5) = 1/6$

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Investigation: Theoretical vs. Experimental Probability

Part 1: Theoretical Probability

Probability is the chance or likelihood of an event occurring. We will study two types of probability, theoretical and experimental.

Theoretical Probability: the probability of an event is the ratio or the number of favorable outcomes to the total possible outcomes.

$P(4) = \frac{1}{6}$

$$P(\text{Event}) = \frac{\text{Number or favorable outcomes}}{\text{Total possible outcomes}}$$

Sample Space: The set of all possible outcomes. For example, the sample space of tossing a coin is {Heads, Tails} because these are the only two possible outcomes. Theoretical probability is based on the set of all possible outcomes, or the sample space.

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Sample Space

① Flip a coin twice

{HH, TT, HT, TH}

H For Head, and

T For Tail

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1. List the sample space for rolling a six-sided die (remember you are listing a set, so you should use brackets {}):

{1, 2, 3, 4, 5, 6}

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Find the following probabilities:

P(2) $= 1/6$ P(3 or 6) $= \frac{2}{6} = \frac{1}{3}$ P(odd) $= \frac{3}{6} = \frac{1}{2}$ P(not a 4) $= \frac{5}{6}$

$P(4)^c$

P(1,2,3,4,5, or 6) $= \frac{6}{6} = 1$ P(8) $= \frac{0}{6} = 0$

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2. List the sample space for tossing two coins: {HH, HT, TH, TT}

Find the following probabilities:

P(two heads) $= 1/4$ P(one head and one tail) $= \frac{2}{4} = \frac{1}{2}$ P(head, then tail) $= \frac{1}{4}$

P(all tails) $= \frac{1}{4}$ P(no tails) $= \frac{1}{4}$

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3. Complete the sample space for tossing two six-sided dice:

{(1,1), (1,2), (1,3), (1,4), (1,5), (1,6),
(2,1), (2,2), (2,3), (2,4) (2,5) (2,6)
(3,1), (3,2) (3,3) (3,4) (3,5) (3,6)
(4,1) (4,2) (4,3) (4,4) (4,5) (4,6)
(5,1) (5,2) (5,3) (5,4) (5,5) (5,6)
(6,1) (6,2) (6,3) (6,4) (6,5) (6,6)}

Find the following probabilities:

P(a 1 and a 4) = 2/36 = 1/18 P(a 1, then a 4) 1/36 P(sum of 8) = 5/36

P(sum of 12) = 1/36 P(doubles) = 6/36 = 1/6 P(sum of 15) = 0

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5. When would you expect the probability of an event occurring to be 0, or 0%? Describe an event whose probability of occurring is 0.

Cannot happen

. Prob of rolling a 0

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Part 2: Experimental Probability

Experimental Probability: the ratio of the number of times the event occurs to the total number of trials.

P(Event) = Number or times the event occurs / Total number of trials

1. Do you think that theoretical and experimental probabilities will be the same for a certain event occurring? Explain your answer.

Yes, it could happen.

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2. Roll a six-sided die and record the number on the die. Repeat this 9 more times

Number on Die	Tally	Frequency
1		1
2		4
3		0
4		3
5		2
6		
Total		10

Based on your data, find the following experimental probabilities:

P(2) = 4/10 = 2/5 P(3 or 6) = 2/10 = 1/5 P(odd) = 4/10 = 2/5 P(not a 4) = 10/10 = 1

How do these compare to the theoretical probabilities in Part 1? Why do you think they are the same or different?

Experimental Prob. is based on chance behavior — what actually occurred.

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3. Record your data on the board (number on die and frequency only). Compare your data with other groups in your class. Explain what you observe about your data compared to the other groups. Try to make at least two observations.

Experimental Prob

P(1) = 17/90 = 0.18
P(2) = 12/90 = 0.13
P(3) = 17/90 = 0.18
P(4) = 13/90 = 0.14
P(5) = 10/90 = 0.11
P(6) = 21/90 = 0.23

Theor Prob

P(1) = 1/6 = 0.16
P(2).
.
.
.
P(6) = 1/6 = 0.16

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4. Combine the frequencies of all the groups in your class with your data and complete the following table:

Number on Die	Frequency
1	
2	
3	
4	
5	
6	
Total	

Based on the whole class data, find the following experimental probabilities:

P(2) = 12/90 P(3 or 6) = 38/90 P(odd) = 44/90 P(not a 4) = 77/90

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Counting Principal

When there are **m** ways to do one thing,
and **n** ways to do another,
then there are **m×n** ways of doing both.

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Draw a tree diagram for each of the following problems.

1) You go to the snack bar to buy a bagel and a drink for lunch. You can choose from a plain bagel, a blueberry bagel, or a raisin bagel. The choices for a drink include water or a sports drink. How many different lunches could be made with these choices?

$P = m \cdot n$
$P = 3 * 2 = 6$ Lunchs.

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2. When you get ready to get dressed for school you open your closet to find that you have the following choices: a red, blue, or white shirt; jeans or sweatpants; tennis shoes or sandals. How many different outfits could be made with these choices?

$P = m * n$
$P = 3 \times 3 = 9$ ways

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Use fundamental Counting Principal to answer:

3) You go to Wal-mart to buy batteries. You can choose from EverReady, Duracell, or Ray-O-Vac. Once you decide on the brand you then have to decide whether to get alkaline or non-alkaline batteries. Finally you must decide between AAA, AA, C, or D batteries. How many different kinds of batteries are available for you to buy?

$P = m \cdot n$

$P = 3 \times 4 = 12$ kinds

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4) You toss a penny 4 times. How many different outcomes are there?

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5) In how many ways can the four call letters of a radio station be arranged if the first letter must be W or K and no letters repeat?

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