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**Empirical vs. Theoretical Probability**

**What is Probability?**

* Probability is how likely something is to happen.
* This can simply be done by flipping a coin and seeing whether or not you get heads (H) or tails (T), or rolling a dice and seeing whether or not you get a 1, 2,3,4,5 or 6.

**Empirical Probability**: The empirical probability of an event is an "estimate" that the event will happen based on how often the event occurs after collecting data or running an experiment (in a large number of trials).  It is based specifically on direct observations or experiences.

**Formula:** P (e) =

**Theoretical Probability**: The Theoretical probability of an event is the number of ways that the event can occur, divided by the total number of outcomes. It is finding the probability of events that come from a sample space of known equally likely outcomes

**Formula:** P (e) =

**Objectives:**

* What I wanted to find out was the difference between Empirical and Theoretical probability, I can figure out specific examples of rolling a dice or flipping a coin and figuring out a specific probability for each case using both types and how they relate to each other.

**Material for this activity:**

1. 60 Jelly beans (6 colors)/ cup for jelly beans.
2. Quarters
3. 12 sided die (3 colors)

**Example #1: Jelly Beans**

I want the class to find the empirical and theoretical probability of picking a yellow jelly bean from the cup.

|  |  |  |  |
| --- | --- | --- | --- |
| Trials | Colors | Trials | Colors |
| 1 |  | 13 |  |
| 2 |  | 14 |  |
| 3 |  | 15 |  |
| 4 |  | 16 |  |
| 5 |  | 17 |  |
| 6 |  | 18 |  |
| 7 |  | 19 |  |
| 8 |  | 20 |  |
| 9 |  | 21 |  |
| 10 |  | 22 |  |
| 11 |  | 23 |  |
| 12 |  | 24 |  |

Record what you find in the chart above, then you may want to try some examples:

Find the empirical and theoretical probability of:

1. Getting 4 Pink jelly beans \_\_\_\_\_\_\_.
2. Getting 6 Red jelly beans \_\_\_\_\_\_\_\_.
3. Getting 3 Purple jelly beans \_\_\_\_\_\_\_.

Extended thinking problem to try on your own:

Find the probability of:

1. Picking 4 green jelly beans but taking away one each time you pick one out\_\_\_\_\_\_\_.

**Example #2: Rolling a Die**

I want the class to figure out the empirical and theoretical probability of rolling a blue on a twelve sided die. Roll the dice 12 times and record what you get:

|  |  |
| --- | --- |
| Trials | Colors |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| 11 |  |
| 12 |  |

Once you have recorded what you found, try some other examples below:

Find the empirical and theoretical probability of:

1. Rolling 4 Blues. \_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Rolling 3 Orange. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Rolling 1 Green. \_\_\_\_\_\_\_\_\_\_\_\_.

Extended thinking problem for you to try on your own:

* Say you were given the twelve sided die and wanted to figure out the empirical and theoretical. Would the order matter if you wanted to get a Blue, then Orange then Green and if it would be different or similar to what we just found out above?

**Example #3: Flipping a fair coin.**

I want the class to figure out the empirical and theoretical probability of flipping a fair coin 10 times and seeing how many heads you get.

|  |  |
| --- | --- |
| Trials | Outcome |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

Then find the probability for the number of tails flipping it 10 times and record what you get:

|  |  |
| --- | --- |
| Trials | Outcomes |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

Here are some other examples you may want to try on you own:

Find empirical and theoretical probability of flipping a fair coin 50 times:

1. Getting 30 heads \_\_\_\_\_\_\_\_\_.
2. Getting 25 tails \_\_\_\_\_\_\_\_\_\_.
3. Getting 15 heads or 15 tails \_\_\_\_\_\_\_\_\_.

Extended problem you may want to try on your own: - Find the empirical and theoretical probability of getting **exactly** 5 heads when flipping a coin 10 times.