**Spinning Pennies**

Have you ever tried spinning a penny? Take a penny, hold it on its edge on a flat surface using the tip of your finger. With the head facing you, flick the penny using the index finger of your other hand. Does it land heads up or heads down? Which outcome is more likely?

Stanford math professor Persi Diaconis has researched this question and gives his conclusions in “What are the odds? New study shows how guessing heads or tails isn’t really a 50-50 game.” (Daily Mail <http://www.dailymail.co.uk/news/article-2241854/What-odds-New-study-shows-guessing-heads-tails-isnt-really-50-50-game.html> ). What percentage of the time does a spinning coin land tails up according to Professor Diaconis? \_\_\_\_\_\_\_\_\_\_

**Part I Formulate a question**

If Professor Diaconis’ conclusion is correct, when we spin a penny 40 times, what percent of the time would we expect to get a tail? \_\_\_\_\_\_\_\_\_ How many tails would we get in 40 spins? \_\_\_\_\_\_\_

Question #1: What is the probability of a spinning penny landing tails up?

Question #2: What is the probability that a spinning penny lands tails up at least \_\_\_\_\_\_ of the time?

**Part 2 Design and implement a plan to collect data**

Take a few practice spins before beginning the experiment.

A trial will consist of 40 spins. Each student will spin a penny 40 times and count the total number of times the penny lands tails up. Record this value on the class dot pot on the chalkboard.

Repeat this process four more times.

**Part 3 Analyze the data by measures and graphs**

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**Number of Tails in 40 Spins**

**Part 4 Interpret the results in the context of the original question.**

How many of total trials were conducted? \_\_\_\_\_\_\_\_\_\_

How many trials resulted in 80% or more tails? \_\_\_\_\_\_\_\_\_

Based on your data, what is the probability of a spinning penny landing tails at least 80% of the time? \_\_\_\_\_\_\_\_\_\_

How many total penny spins are represented by all the class trials?\_\_\_\_\_\_\_

How many total times in all the class trials did the penny land tails up? \_\_\_\_\_\_\_

What is the experimental probability of a spinning penny landing tails up? \_\_\_\_\_\_

(Find the total times a penny landed tails up divided by the total class spins.)

If we continued to spin pennies, we would obtain a long run probability. The experimental probability approaches the theoretical probability as the number of trials increases. Theoretical probability is the long-run probability.

What do you think the theoretical probability of having a penny land tails up? \_\_\_\_\_\_\_

Do the class results support Professor Diaconis’ conclusions? Explain.

**Teacher Notes**

New Illinois Learning Standards addressed by this activity:

Content Standards

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| --- | --- | --- | --- |
| Supporting | S | IC.2 | Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model*? |

Primary Math Practices

MP 1 Make sense of problems and persevere in solving them.

MP 2 Reason abstractly and quantitatively.

MP 4 Model with mathematics.

MP 5 Use appropriate tools strategically.

**Acknowledgements**

Daily Mail. (2012, December 2). *What are the odds? New study shows how guessing heads or tails isn’t really a 50-50 game*. Retrieved from <http://www.dailymail.co.uk/news/article-2241854/What-odds-New-study-shows-guessing-heads-tails-isnt-really-50-50-game.html>.

**Guidance for Class Activity**

While this activity has been written with guidance provided for each step of the statistical process, teachers should evaluate if their students are ready to complete each of the four steps with less guidance. As a class, they may be able to formulate their own question about spinning pennies, design a data collection plan, collect data, analyze the results, and draw conclusions. If students are capable of running this simulation with limited teacher guidance, try giving students the template of the four steps and have them run the entire process.