



# DIY Air Force Activities: Probability Penny



## Materials:

- penny (or any coin)
- calculator
- pencil or pen and paper

Statistics can help you figure out how likely something is to happen. Scientists use statistics to help them analyze the large amount of data collected from their experiments. Once they collect, organize, and process their data using statistics from a large population, or many trials, information is gained that helps them understand a phenomenon. In the following activity, you will learn how to determine a probability! Probability is the chance something will happen, or the likelihood a particular outcome will occur.

What are the odds that after tossing a coin in the air, it lands heads up? Rationally, since the coin has only 2 sides, there are 2 options, and we can estimate that probability to be  $\frac{1}{2}$ , or 50%. This assumes that the coin will land heads up the exact same amount of times as it lands tails up. We can calculate this:

$$\# \text{ of times the coins lands heads up} / \text{number of possible outcomes} = \frac{1}{2}$$

$$\frac{1}{2} * 100 = 50\%$$

The \* symbol means to multiply!

But will the coin land heads up with the same frequency that it lands tails up? Instead we can do what's called a *relative frequency estimate*. Sounds fancy, but it lets us figure out how realistic that  $\frac{1}{2}$  estimate is. You can test this yourself using the worksheet on the other side of this page! Is the  $\frac{1}{2}$  estimate fair? Why or why not?

Heads...



... or tails?!

## Air Force Associations:

Mathematical statistics is a highly interdisciplinary field, which means that almost every type of scientist, from biologists, to engineers, chemists and even astronauts use statistics in their work. The Air Force Institute of Technology (AFIT) offers graduate programs to train scientists in this field. They publish research articles and present their work at major conferences around the world. Many researchers there hold grants from national agencies and some even serve on editorial boards for research journals.



**Directions:** Flip a coin and record whether it lands heads up or tails up. Repeat this according to the number of tosses listed. Then use the formula to calculate the probability!

Total Number of Tosses (N)	Number of Heads (n <sub>H</sub> )	Number of Tails (n <sub>T</sub> )	Probability of Heads	Probability of Tails
3	1	2	$\frac{1}{3} * 100 = 33\%$	$\frac{2}{3} * 100 = 67\%$
4				
6				
10				
20				
50				
100				

Probability of getting Heads:

# of times you get heads ( $n_H$ ) / Number of times you flip coin (N) =  
 or  $\frac{n_H}{N} * 100 = \%$

Probability of getting Tails:

# of times you get tails ( $n_T$ ) / Number of times you flip coin (N) =  
 or  $\frac{n_T}{N} * 100 = \%$

As you flip the coin more times (increasing the amount of data you have gathered) you should notice that the probability gets closer to the estimated 50%! This is why scientists have to gather a large amount of data to achieve a meaningful statistical result!

\*\*\*\* Instead of flipping a coin you can do a web search for “random number generator” and set the minimum to “0” and the maximum to “1.” This will simulate your coin toss! You can also search “coin flip” using google and a simulation will come up.

