Coin Toss 2 of 5 – Worksheet with Two Guided Activities

Guided Activity 1: 2 out of 5

Do the experiment once by clicking Toss. Do you understand what a winning combination is?

Do the experiment 1000 times by clicking 1000.

- What is the percent of Wins?
- What is the percent of Losses?
- Here, which should be easier to calculate - the theoretical probability of winning or losing?

Now for some dreaded theory ...

1. An example of a winning combination is TTHHT. What is the probability of getting this combination?
2. Another example of a winning combination is HHTHT. What is the probability of getting this combination?
3. A third example is HTTHH.
   - Is this combination is "similar to" example 1 or example 2? Why?
   - What "identifies" combinations with probability: $(0.4)^4 \cdot (0.6)^1$?
   - How many different combinations are there of this type (i.e. with this probability)? Think combinatorics.

Losing combinations

- How many **types** of losing combinations are there?
- What is the **probability of each of these types** of losing combinations?
- What is the probability of losing?

Winning combinations

- What is the probability of winning?
- Does this correspond to your empirical results when you ran the experiment 1000 times?

Change the weight of getting a heads, click 1000, calculate the theoretical probability and compare your results.

Guided Activity 2: Other Bernoulli* experiments

Example: What is the probability of k=12 or more successes in n=15 trials of a Bernoulli experiment with p=0,75 ?

- Download the zip and open the scratch file CoinToss2of5 (you must have scratch installed).
- Click on the **3rd** sprite TossM (1000).
- In the script *When TossM clicked*:
  - Change the number of trials by changing the value of Number Coins from 5 to 15.
  - Change the number of success required by changing the value of Number of Heads to Win from 2 to 12.
  - Click and drag the slider p to 75.
  - Run the experiment at least 1000 times.
- Calculate the theoretical probability of winning.

  Recall: The theoretical probability of getting exactly k successes in n trials with a probability p of success in any individual trial is:

$$\Pr(k,n,p)=\binom{n}{k}p^k(1-p)^{n-k}=\frac{n!}{k!(n-k)!}p^k(1-p)^{n-k}$$

  Think before calculating: What are the possible values for k?
- Does your theory match your experiment?

A *Bernoulli or Binomial Trial* has exactly 2 mutually exclusive events:
Success (Win) and Fail (Lose) with p=Pr(Success).