

Coin Toss 2 of 5 – Worksheet with Two Guided Activities

Guided Activity 1: 2 out of 5

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

Do the experiment 1000 times by clicking .

- 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 , 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 $p=\Pr(\text{Success})$.