

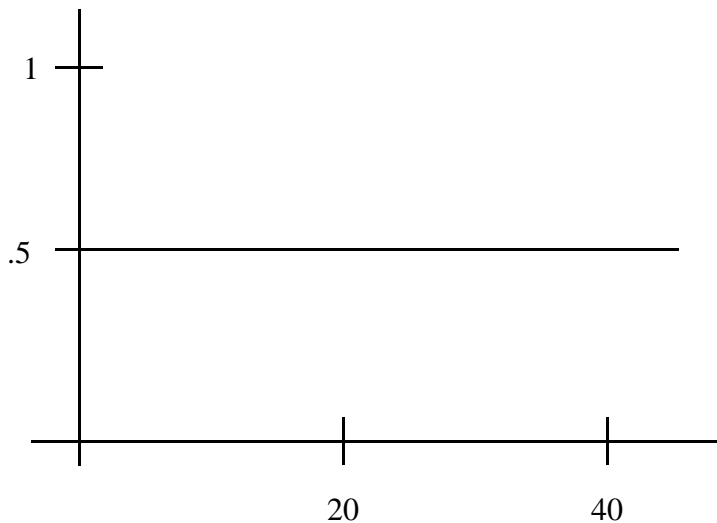
We will play with an applet. The applet simulates tossing a coin, keeping track of the number of heads.

The Website is [http://bcs.whfreeman.com/ips4e/cat\\_010/applets/Probability.html](http://bcs.whfreeman.com/ips4e/cat_010/applets/Probability.html) but you can also visit [www.stlmath.com](http://www.stlmath.com) and then follow Courses > Math 137 > Assorted Handouts and Tutorials where you will find this worksheet and the link.

The default probability of heads is .5. The default number of tosses is 15. If you click the “Toss” button, it simulates the tossing of 15 coins and records the simulated coins above the graph. Try this now. The graph shows the **proportion** of coins that turn up “heads” after each toss. Notice the proportion of heads after the first toss is either 1 or 0, depending on if it was heads or tails. The fraction in the upper left corner tells you how many coins you have tossed as well as the number and proportion of heads.

1. What is the difference between theoretical probability and experimental probability? Relate this concept to the experiment of tossing a coin.

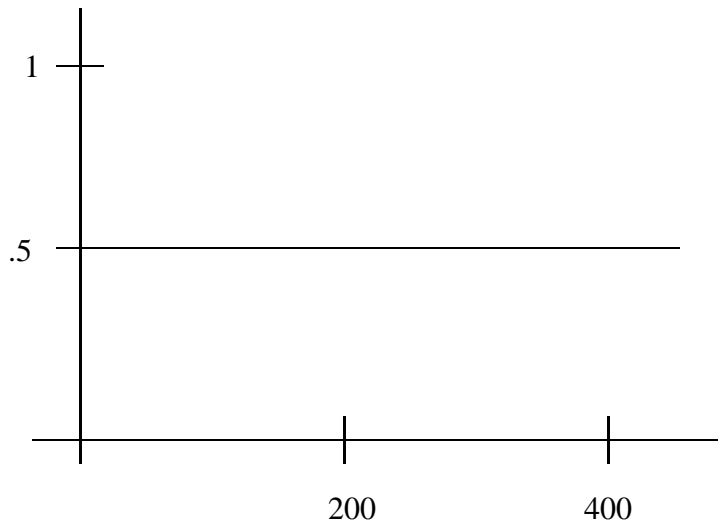
2. Click on the “Reset” button to clear the graph. Bullet the box marked “Show true probability”; this is located to the right of the “Toss” and “Reset” buttons. (This simply puts a horizontal line at the value of the theoretical probability.) Set the number of tosses to 40. Leave the “Probability of heads” at .5. Click the “Toss” button. Copy the graph as best you can. The theoretical probability is marked.



3. Record the information for your first 40 tosses in the table below. Get these numbers from the upper left corner of the applet, for example “# Heads = 28/40 = .70”. Without resetting the graph, click the “Toss” button again and again, filling in the table as you go. (Wait for it to finish tossing those in cue before clicking the Toss button again.) Notice the simulation continues. Fill in the table with the data it gives you.

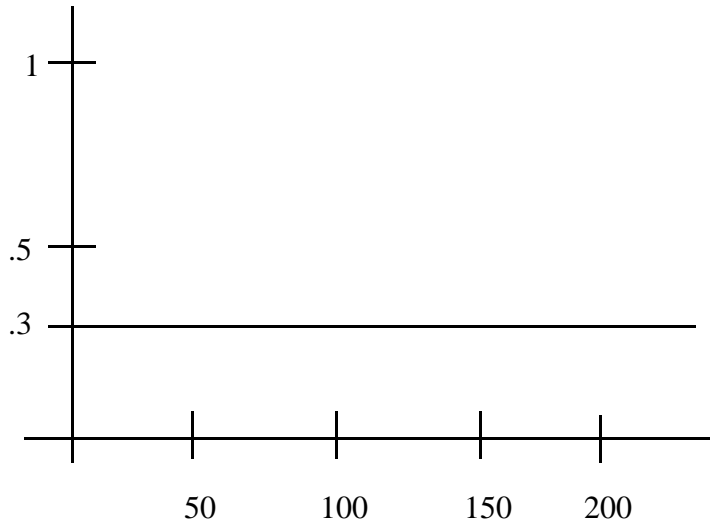
Number of tosses	40	80	120	160	200	240	280	320	360	400
Probability of heads in fraction form										
Probability of heads in decimal form										

You should see that the probability of heads is leveling off as more and more coins are tossed. If this is not obvious, keep tossing until it looks to be leveling off. Copy the graph as best you can, focusing less on specific details and more on general trends.

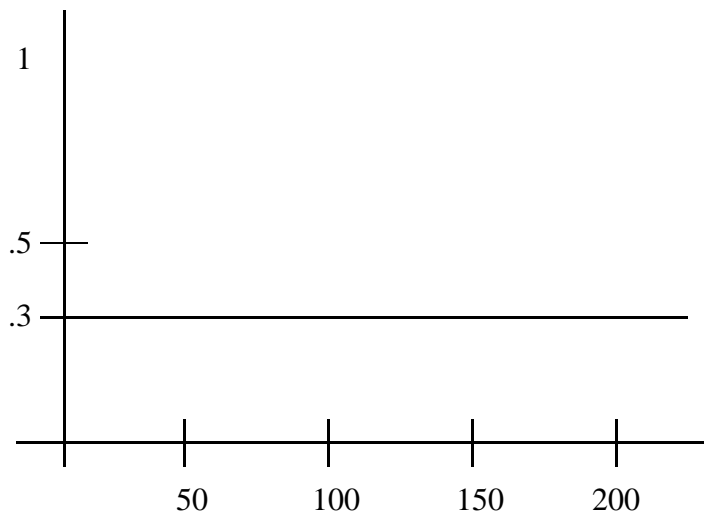


What value does the proportion of heads seem to be approaching? Why do you think it approaches this value?

4. It seems that the experimental probability of getting heads approaches the theoretical probability as we do more and more trials. This is often called the **Law of Large Numbers**. Without doing the simulation, what do you think would happen if we set the “Probability of heads” to be .3? Draw a **hypothetical** graph of the result of 200 tosses. The theoretical probability is marked for you.



5. Now, actually change the applet’s “Probability of heads” to .3. Click on the “Reset” button to erase your graph and redraw the horizontal line at  $y = .3$ . Then have it simulate 200 or so tosses. Did you guess correctly in the last question? Copy the graph as best you can.



What were the differences between your graph in question 4 and the actual graph that the computer generated for question 5? Were they superficial or meaningful differences? Explain.