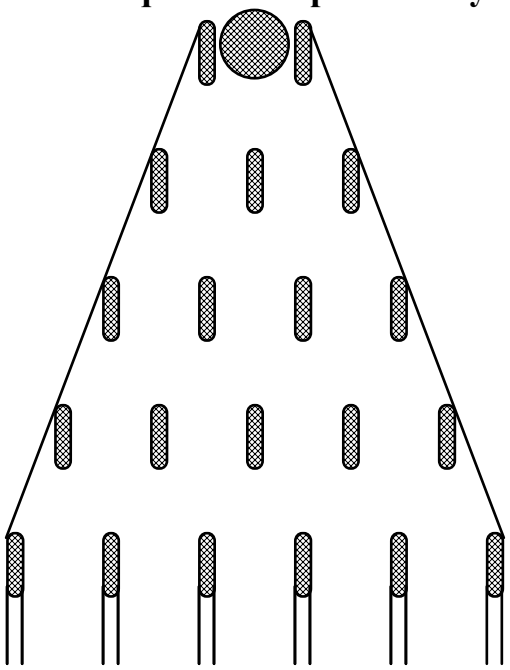
Advanced Challenge Level 1 Problem #32 _____

The Binomial Divider Challenge

The figure below represents a 5-stage binomial divider. It gets its name because the ball, shown here as it drops through the first opening, must pass between 5 pairs of gates in order to fall completely through the device. Assume that when the ball hits a gate it must fall through one of the two openings on each side of that gate. Further assume that the probability of dropping to the left is equal to the probability of dropping to the right.



Your challenge is to do each of the following.

- **1. Draw a picture of a 7-stage binomial divider. Your picture must be neat and accurate.**
- **2. Suppose that 64 balls are to be dropped into a 7-stage binomial divider. Estimate how many of the balls will pass through each of the seven openings on the bottom row. Make sure to do this before you conduct your experiment.**
- **3. Using a model of your own design, conduct an experiment to simulate the problem. Carefully record your results. *** Please see the note on page 2.**
- **4. Determine mathematically the probability (using either fractions, decimals, or percents) that a ball will pass through each of the openings on the last row. Describe how you arrived at each of the probabilities.**
- **5. Draw a graph showing the comparison of (a) your original estimates, (b) the results of your experiment, and (c) the results predicted using your final probabilities. Make your graph neat and large enough to be read from a distance of 10 feet.**

Your group will be assessed using the standards on the back of this sheet.

Binomial Divider Challenge Assessment Tool

1. **The picture of a 7-stage binomial divider was accurate and neatly drawn.**

   0 1 2 3 4 5

2. **The model used to simulate the problem was original and produced reasonable results.**

   0 1 2 3 4 5

3. **The graph clearly shows your original estimates.**

   0 1 2 3 4 5

4. **The graph clearly shows the results of your experiment.**

   0 1 2 3 4 5

5. **The final probabilities given were accurate and the explanation was clear.**

   0 1 2 3 4 5

6. **The graph clearly shows the results predicted using your final probabilities.**

   0 1 2 3 4 5

7. **The graph was neat and large enough to be read from a distance of 10 feet.**

   0 1 2 3 4 5

***** Note: Example of a model: Use a pencil to trace the path of an imaginary ball as it falls through the divider. Whenever the ball hits a gate, flip a coin. If the coin comes up heads, go to the right of the gate. If it comes up tails, go to the left. Keep track of the number of balls that fall through each of the openings on the last row.**

Note: The purpose of this problem is not to have you actually build a binomial divider. The 'model' is what you use to decide whether any particular ball falls to the right or to the left of a gate. The probability must be equivalent to that of the binomial divider. The problem states that when a ball hits a gate 'the probability of dropping to the left is equal to the probability of dropping to the right'. Since a coin has a 50% probability of either a head or a tail, this matches the binomial divider perfectly. Of course, the problem requires that you use a model of your own design. The rest is up to you. Good luck.