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M\$6 Binomial Probability (Bernoulli Experiments)

1. Each time a coin is tossed, there are two possible outcomes: a head (“success”) and a tail (“failure”). Finding the probability of getting 3 heads in 5 tosses of a coin is an example of a *binomial probability experiment* with 5 repetitions called trials. A binomial probability experiment has these features:

   - There is a fixed number of repeated trials (e.g. 5 tosses of the coin)
   - Each trial has two possible outcomes: success and failure (e.g. heads or tails)
   - The probability of success is the same for each trial (e.g. chance of getting heads is always $\frac{1}{2}$; result of one toss of the coin does not affect the result of the next toss.)

2. Suppose a coin is weighted so that it is more likely to get heads (H) than tails (T). On any given toss of this coin, the probability of getting heads is $\frac{2}{3}$. (So, the probability of getting tails is the *complement*, $\frac{1}{3}$.)

   Problem: If this coin is tossed 4 times, find the probability of getting exactly 3 heads.

Remember that probability is expressed as a number between 0 and 1 (e.g. 40% is 0.4).

n = # of trials

r = # of successes

$${}_nC_r\,\underset{\substack{\uparrow\\ \boxed{\text{Probability of success}}}}{(\qquad)}^{r}\,\underset{\substack{\uparrow\\ \boxed{\text{Probability of failure}}}}{(\qquad)}^{n-r}$$

Examples

1. Find the probability of obtaining *exactly* eight heads in ten tosses of a fair coin.

2. If the probability that it will rain on any given day this week is 60%, find the probability it will rain *exactly* 3 out of 7 days this week.

3. After studying a couple's family history, a doctor determines that the probability of any child born to this couple having a gene for disease *X* is 1 out of 4. If the couple has three children, what is the probability that *exactly* two of the children have the gene for disease *X*?

4. At a certain intersection, the light for eastbound traffic is red for 15 seconds, yellow for 5 seconds, and green for 30 seconds. Find, to the *nearest tenth*, the probability that out of the next eight eastbound cars that arrive randomly at the light, exactly three will be stopped by a red light.