

Binomial Probability Hand-out

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We can use binomial probability to calculate the probability of a particular outcome (or series of events) in which there are two possibilities for each event. For example, if I flip a coin ten times, how can I figure out the probability that out of my ten flips, two will be heads and eight will be tails?

This is a more complicated probability question than one in which the order of the outcome is specified because there are many ordered outcomes that include two heads and eight tails. We can use the following equation as a short-cut to calculate binomial probabilities:

$$P = \frac{N!}{X! (N-X)!} \times p(A)^X p(B)^{N-X}$$

P: probability of event A happening X times in N trials

N: total number of trials or events

X: number of times event A occurs

N-X: number of times event B occurs

p(A): probability of event A per trial

p(B): probability of event B per trial

This is a lot of abstract terms at one time, so let's look at an example.

If a couple has eight children, what is the probability that they will have five boys and three girls?

Let's start by assigning numbers to each variable for the equation above.
Let event A = boy and event B = girl.

P = what we are trying to calculate.

N = 8 trials (in this example, each "trial" is one child)

X = 5 boys

N-X = 3 girls

p(A) = $\frac{1}{2}$ (Each time the couple has a child, they have a $\frac{1}{2}$ chance of having a boy.)

$p(B) = \frac{1}{2}$ (Each time the couple has a child, they have a $\frac{1}{2}$ chance of having a girl.)

$$P = \frac{N!}{X! (N-X)!} \times p(A)^X p(B)^{N-X}$$

$$P = \frac{8!}{5! (8-5)!} \times (1/2)^5 (1/2)^{8-5}$$

$$P = \frac{8 \times 7 \times 6}{3 \times 2 \times 1} \times (1/2)^8$$

$$P = 56 \times 1/256$$

$$P = 0.21875$$