# Probability

## Binomial Distribution Formulas

$\Pr(X = x) = {}^{n}C_x\, p^x (1-p)^{n-x}$, where $x = 0, 1, 2, 3 \ldots n$.

$\mathrm{E}(X) = \mu = np$

$\mathrm{Var}(X) = np(1-p)$

$\mathrm{SD}(X) = \sqrt{Var(X)}$

**BinomPDF vs BinomCDF**

Use *BinomPDF* when you need to find the probability of an exact number. e. g. $\Pr(X = 2)$

Use *BinomCDF* when you need to find the probability of a range of numbers. e. g. $\Pr(X \geq 2)$ or $\Pr(3 \leq X \leq 6)$

Not being careful with $\leq$ , $\geq$ , $<$ or $>$ signs.

$\Pr(X < 3) = \Pr(X \leq 2)$
$\Pr(X > 3) = \Pr(X \geq 4)$

$${}^{n}C_n = {}^{n}C_0 = 1$$
$${}^{n}C_{n-1} = {}^{n}C_1 = n$$
$$\Pr(X \geq 1) = 1 - \Pr(X = 0)$$

## Finding the Sample Size

Given the required probability for a number of events, and the probability of success, you can use this information to find the sample size $n$.

**Solving Algebraically.**

1. Use the binomial distribution formula.

**Solving Via CAS Calculator.**

1. Use the binomial distribution formula and solve for $n$.
2. For Ti-Inspire use List & Spreadsheet page, for Casio ClassPad use Graph & Table application.

During a holiday, Mark and John play a total of $n$ games of golf. The probability that John wins any game is 0.3. No games are drawn.

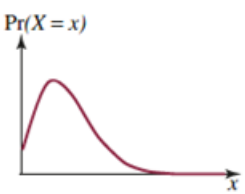
If the probability that John wins no games is 0.0576, the total number of games they play is:

$\boldsymbol{X \sim Bi(n, p), n = ?\ and\ p = 0.3}$

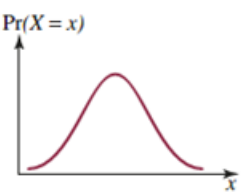
$\Pr(X = 0) = 0.0576$
$\Pr(X = 0) = {}^{n}C_0\ (0.3)^0 (0.7)^n$

${}^{n}C_0\ (0.3)^0 (0.7)^n = 0.0576$
$(0.7)^n = 0.0576$
$n = 8.00234$
$\therefore n = 8$

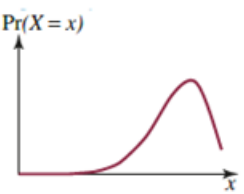
## Graphs of Binomial Distribution




If $p < 0.5$, the graph is positively skewed.




If $p = 0.5$, the graph is symmetrical.




If $p > 0.5$, the graph is negatively skewed.

If the order is specified for a particular scenario, then the binomial probability distribution rule cannot be used. The probabilities need to be multiplied in the given order.