

Binomial Probability Distribution

Bernoulli Processes:

Abduction:

Process in nature ==> Measurements with only two categories ==> Prob

| | | |
|----------------------|-------------------------------------|-----------------|
| A Human Birth | Birth weight | |
| | Number of minutes of labor | |
| | Categorize by gender (male, female) | Bernoulli Trial |
| | Etc. | |

| | | |
|------------------|------------------------|-----------------|
| Coin Flip | Number of turns in air | |
| | Time spent in air | |
| | Side facing up | Bernoulli Trial |
| | Etc. | |

Jargon

Success

Failure

$P(\text{Success}) = p$

$q =$

$p + q =$

Binomial Distribution:

1) Some Number (N) of independent Bernoulli trials

e.g.,

2) What is probability of...

e.g.,

Standard symbols

N = # of Trials (Flips)

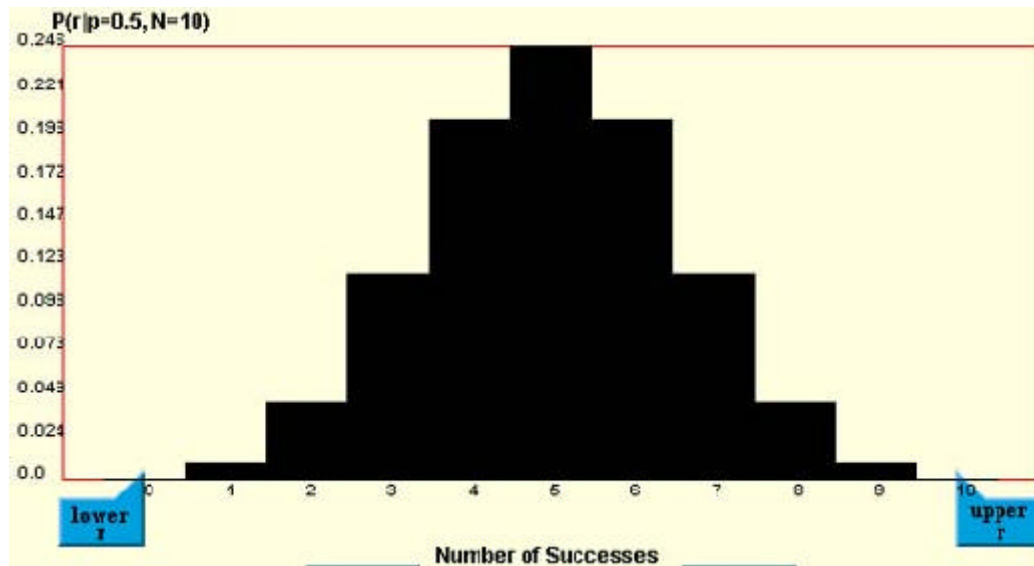
r =

p =

P(r; p, N)

Between

Outside

Binomial Probability Distribution**For $p = .5$ and $N = 10$** Gives probability for each value of r from 0 to 10

Example: A fair coin is flipped 8 times. What is the probability of getting exactly 4 heads?

$N =$

$p =$

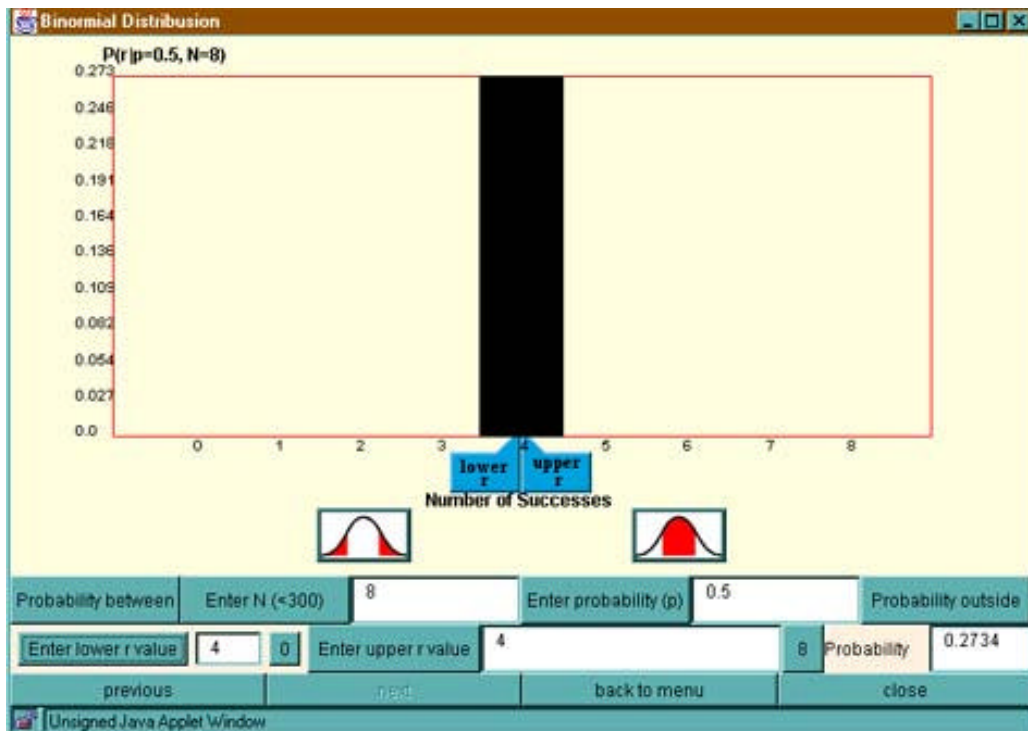
$r =$

What is the probability of getting 4 heads given that

You flip 8 times and $P(\text{Head}) = .5$

OR: $P(r=4 \mid N = 8, p = .5)$

Use StatCenter's **Binomial Probability Tool**



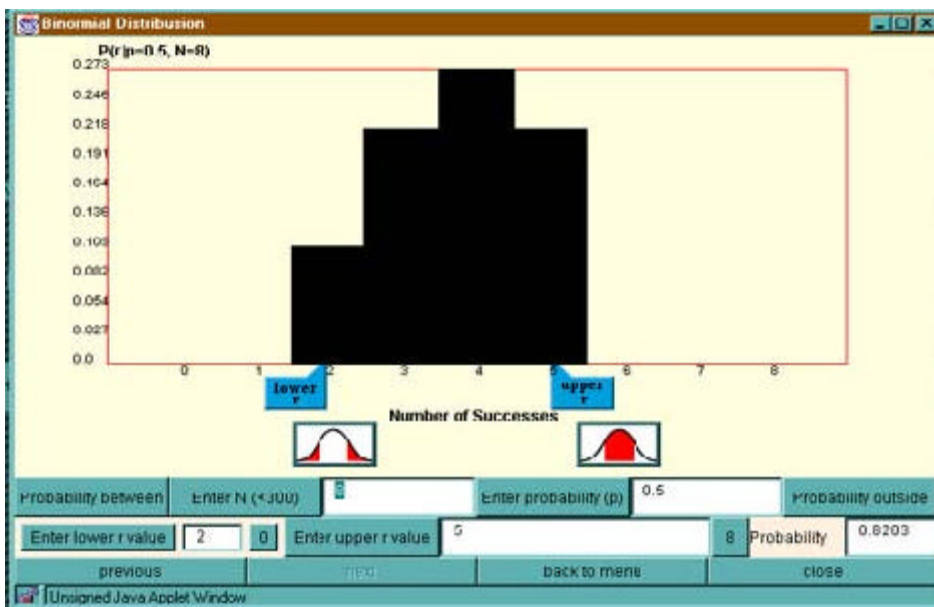
Notice that Probability = 0.2734

For $N = 8$, $p = .5$, what are the chances of getting BETWEEN 2 and 5 heads?

BETWEEN is inclusive...

In this case it means....

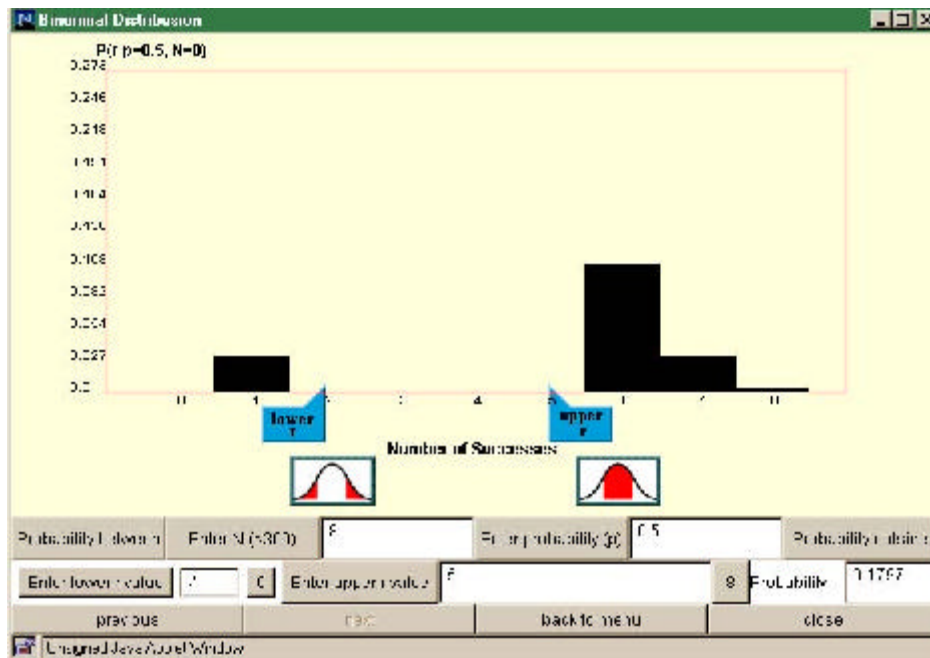
Use StatCenter Binomial Distribution Tool:



Black area is...

Probability = 0.8203

Outside 2 & 5



Cold example:

Suppose the probability of catching a cold during January and February in Utah is equal to .5. Suppose that a scientist develops a cold vaccine. After receiving IRB approval, the researcher administers the vaccine to 10 volunteers. The scientific hypothesis is that the vaccine will reduce the number of colds. This is a directional scientific hypothesis.

Suppose for the moment that, unknown to the researcher, the vaccine is completely worthless. It will have no effect on the chances of catching a cold. Therefore these 10 research participants have the same chance as anyone else of catching a cold.

If a cold is counted as being a success,

Then $N =$

$p =$

Let $r = \#$ of participants who...

What are the chances of

$r = 0$?

$r = 0$ or 1 ?

$r = 0$ or 1 or 2 ?

Use the Binomial Probability tool.

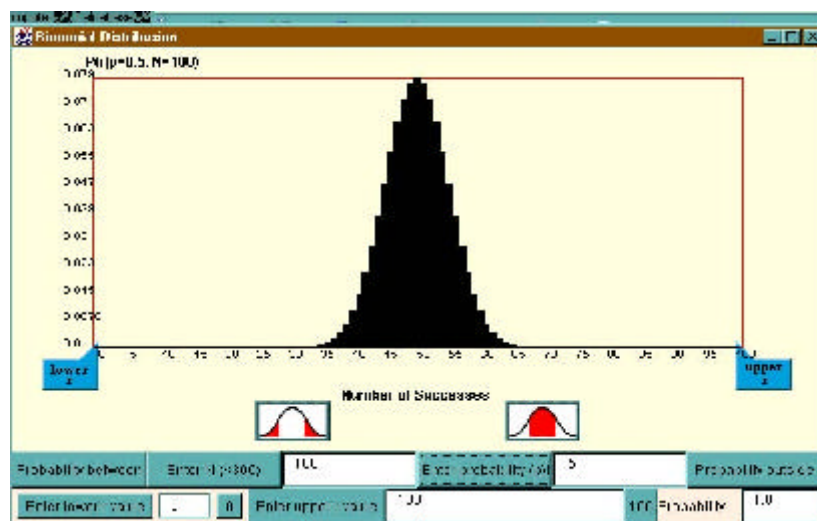
Normal approximation to Binomial

When N is large (> 100)...

.... closely approximates...

If N is infinite then...

Demonstration using Binomial Tool



Check effects of changing p from .5 to .1 to .05