

6.3 Binomial Distributions

A **binomial experiment** is an experiment that yields 2 possibilities.

All binomial experiments must have these 4 characteristics.

1. Each trial only has 2 outcomes denoted as "success" or "failure".
2. The trials are independent.
3. There is a fixed number of trials (n).
4. The probability for success (p) is the same for each trial.

The **binomial random variable** is the # of successes in the n trials.
It is a whole number between 0 and n .

Ex.1

A coin is flipped 5 times. Define success as getting tails and let x = the number of tails. Is this a binomial experiment? If so, define n and p .



Definition:

The number of ways of arranging k successes among n observations is given by the **binomial coefficient**

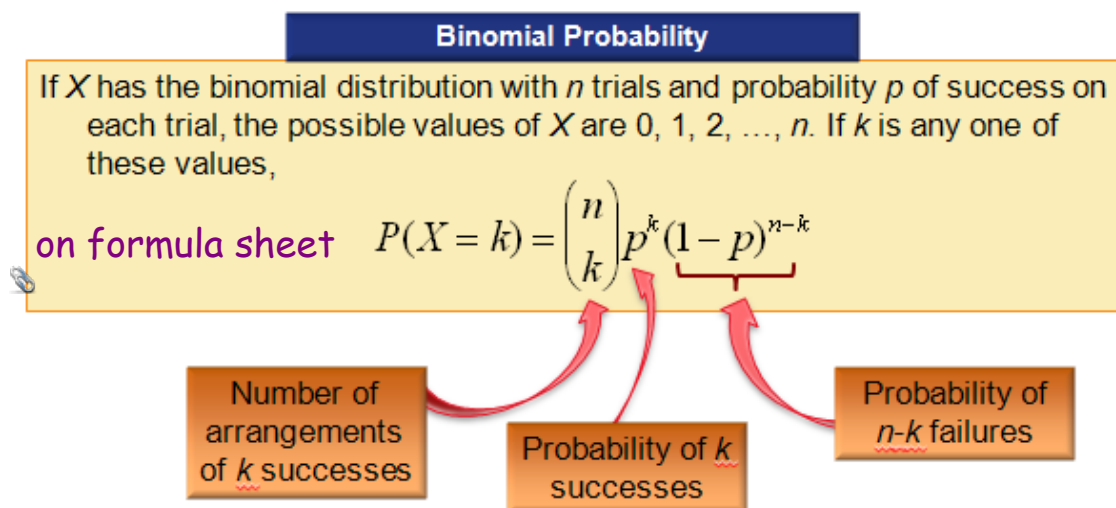
$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

for $k = 0, 1, 2, \dots, n$ where

$$n! = n(n-1)(n-2) \cdots (3)(2)(1)$$

and $0! = 1$.

For example, how many ways are there to get 2 tails out of 5 flips?



Calculator Shortcut:

[2nd] [vars] A (TI-84)

binompdf(n, p, x)

Note: THE AP EXAM REQUIRES YOU TO SHOW THE FORMULA so use the calculator to find the answer **BUT WRITE OUT THE FORMULA.**

Ex.2

On a roulette wheel, the probability of "red" is $18/38$. In 10 spins,

a) what is the probability of exactly 8 red outcomes?



b) what is the probability of getting at least 8 red outcomes?

Ex.3

Each child of a particular pair of parents has probability 0.25 of having blood type O. Suppose the parents have 5 children

(a) Find the probability that exactly 3 of the children have type O blood.

Example



(b) Should the parents be surprised if more than 3 of their children have type O blood?

Mean and Standard Deviation of a Binomial Random Variable

If a count X has the binomial distribution with number of trials n and probability of success p , the **mean** and **standard deviation** of X are

on formula sheet

$$\mu_X = np$$
$$\sigma_X = \sqrt{np(1-p)}$$

Note: These formulas work ONLY for binomial distributions.
They can't be used for other distributions!

Ex.4

Can you tell the difference from bottle water and tap water?

In a taste test, people were given three cups of water to taste. One was bottled water and the other two were tap water. Mr. Bullards' class of 21 students participated in this experiment. Assuming you cannot tell the difference, what is the mean and standard deviation for the number of correct guesses.



Using `binomcdf`

When you need to add many probabilities, it is quicker to use `binomcdf`. **This will add the probabilities from 0 to the x value.**

For example, `binomcdf(5, .25, 2)` will add the probabilities for $x =$ and 2.

This will tell you the probability of getting at most 2 questions correct.

Ex.5

30% of Elm trees have a certain disease. If you sample 80 elm trees, what is the probability that

a) less than 20 trees have the disease?

b) more than 35 trees have the disease?

c) what is the probability between 20 and 35 of the trees have the disease?



Attachments

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