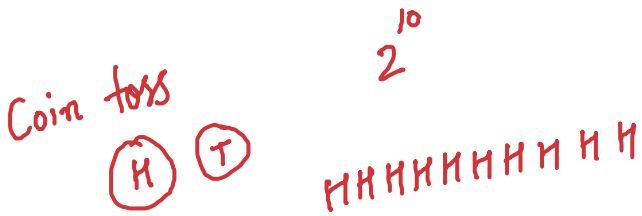

What is the Binomial Distribution?

> The **binomial distribution** models the number of **successes** in a fixed number of **independent yes/no experiments**, where each has the **same probability** of success.

Think of this:

- Toss a coin 10 times
- What's the probability of getting **exactly 6 heads**?

That's a binomial problem.

Key Ingredients:

- `n` = number of trials (e.g., 10 tosses)
- `p` = probability of success (e.g., 0.5 for heads)
- `x` = number of successes (e.g., 6 heads)

$n \rightarrow$ no of times coin is tossed 10
$p \rightarrow$ probability of success 0.5
$x \rightarrow$ no of successes 6

Plain Text Formula:

P(X = x) = C(n, x) × p^x × (1 - p)^(n - x)

$$P(X=x) = {}^{n}C_{x}\, p^{x}(1-p)^{n-x}$$
$$= \frac{\lfloor n}{\lfloor n-x \lfloor x}\, p^{x}(1-p)^{n-x}$$
$$= \frac{\lfloor 10}{\lfloor 4 \lfloor 6} \times \left(\frac{1}{2}\right)^{10} = 0.205$$

Where:

- `C(n, x)` is "n choose x" = combinations = number of ways to pick `x` successes out of `n`
- `p^x` is the probability of `x` successes
- `(1 - p)^(n - x)` is the probability of the remaining being failures

Example:

10 coin tosses, what's the probability of exactly 6 heads?

- n = 10
- x = 6
- p = 0.5

$P(6heads) = C(10, 6) * 0.5^6 * 0.5^4 = 210 * (0.015625) * (0.0625) \approx 0.205$

So there's a ~20.5% chance you'll get exactly 6 heads in 10 tosses.

In Python:

```
from scipy.stats import binom

# Probability of exactly 6 heads in 10 tosses (p = 0.5)
prob = binom.pmf(k=6, n=10, p=0.5)
print(prob)  # Output: ~0.205
```

When to Use:

- Email campaign: Will 40 out of 100 people click the link?
- Quality check: How many out of 10 products will be defective?
- A/B testing: Will 60 out of 200 visitors convert?

Summary:

Concept	Value
Type	Discrete

Concept	Value
Formula	P(X = x) = C(n, x) * p^x * (1 - p)^(n - x)
Python	`scipy.stats.binom.pmf(x, n, p)`
Used for	Count of successes in repeated trials