Uniform Distribution

What It Is:

> A **uniform distribution** is when **every outcome is equally likely**.

Simple Example: Rolling a Fair Die

- Possible outcomes: {1, 2, 3, 4, 5, 6}
- Each number has a **1/6** chance → That's a **discrete uniform distribution**

Continuous Version:

Let's say we randomly pick a number between 0 and 1.

- Every value in that range is **equally likely**.
- That's a **continuous uniform distribution**.

Graphs to Visualize

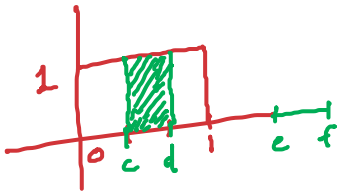
1. Discrete Uniform (like a die roll)

```
Outcome:     1   2   3   4   5   6
Probability:|---|---|---|---|---|---|
              1/6 for each → flat bars
```

Discrete Uniform Distribution Formula:

P(X = x) = 1 / n

- Where `n` is the number of possible outcomes (e.g., for a 6-sided die, P(rolling a 4) = 1/6)



2. Continuous Uniform (0 to 1)

- It's just a **flat horizontal line** from x = 0 to x = 1
- The probability density is constant (say 1.0) across that interval

PDF → Probability density.
PMF → Exact Probabilities

Continuous Uniform Distribution Formula:

f(x) = 1 / (b - a) for values between `a` and `b`

- Outside the range `a` to `b`, the probability is 0

Why It's Useful in Data Science

- It models **pure randomness**
- It's used to **simulate random choices**
- Used in:
  - Generating random numbers (`np.random.uniform`)
  - Monte Carlo simulations
  - Bootstrapping

In Code (Python):

```
import numpy as np
import matplotlib.pyplot as plt
```

```python
# Continuous uniform from 0 to 1
samples = np.random.uniform(0, 1, 10000)

plt.hist(samples, bins=50, density=True, alpha=0.6, color='skyblue')
plt.title("Continuous Uniform Distribution (0 to 1)")
plt.xlabel("Value")
plt.ylabel("Probability Density")
plt.grid(True)
plt.show()
```

You'll see a **flat histogram** showing uniform probability.

Summary:

Property	Uniform Distribution
Type	Discrete or Continuous
Shape	Flat
Real-world example	Die roll, random number gen
Python function	`np.random.uniform(a, b)`