

Discrete vs Continuous

Mathematics

How the two kinds of random variable differ in every operation.

Discrete

- Takes countably many values
- PMF: $P(X = x)$, summing to 1
- $P(X = x)$ can be positive
- $E[X] = \sum x P(X = x)$
- Binomial, Poisson, Geometric
- The CDF is a step function

Continuous

- Takes values across an interval
- PDF: $f(x) \geq 0$, integrating to 1
- $P(X = x) = 0$ for every single x
- $E[X] = \int x f(x) dx$
- Normal, Exponential, Uniform
- The CDF is continuous

THE DIFFERENCE THAT MATTERS

For a continuous variable, only intervals carry probability. A density is not itself a probability.

$f(x)$ may well exceed 1: it is probability per unit x , not probability. Only its integral is bounded by 1.