# Probability Revision Sheet

## ■ Probability Functions

**1. Probability Mass Function (PMF)**: Defines probability for discrete random variables.
**Formula:** $P(X = x) = p(x)$, where $\Sigma p(x) = 1$

**2. Probability Density Function (PDF)**: Defines probability for continuous random variables.
**Formula:** $f(x) \geq 0$ and $\int f(x)\, dx = 1$

**3. Cumulative Distribution Function (CDF)**: Probability that $X \leq x$.
**Formula:** $F(x) = P(X \leq x)$

## ■ Types of Probability Distributions

| Distribution | Type | Formula | Mean | Variance | When to Use |
|---|---|---|---|---|---|
| Bernoulli | Discrete | p^x(1-p)^(1-x) | p | p(1-p) | Single trial |
| Binomial | Discrete | C(n,k)p^k(1-p)^(n-k) | np | np(1-p) | Fixed trials |
| Poisson | Discrete | λ^k e^-λ / k! | λ | λ | Rare events |
| Normal | Continuous | $(1/\sqrt{(2\pi\sigma^2)})e^{(-(x-\mu)^2/2\sigma^2)}$ | μ | $\sigma^2$ | Symmetric data |
| Std Normal | Continuous | $Z=(x-\mu)/\sigma$ | 0 | 1 | Hypothesis testing |
| Log-Normal | Continuous | $\ln(X) \sim N(\mu,\sigma^2)$ | - | - | Skewed positive |

## ■ Important Properties

**Bernoulli:** Two outcomes (0,1), success probability p.
**Binomial:** Fixed trials, each trial independent.
**Poisson:** Events occur randomly over time/space.
**Normal:** Symmetric, 68-95-99 rule.
**Log-Normal:** Data is positive and skewed right.

## ■ Standard Normal & Z-Score

$Z = (x - \mu) / \sigma$