Discrete vs. Continuous Probability

Discrete	Continuous

Single variable X

$$\text{cdf: } F_X(x) = P(X \le x)$$

Discrete	Continuous
pmf: $p_X(x) = P(X = x)$	pdf: $f_X(x) = F'(x)$
$P(X \in A) = \sum_{x \in A} p_X(x)$	$P(X \in A) = \int_A f_X(x)\ dx$
$E(X) = \sum_x x\ p_X(x)$	$E(X) = \int_{-\infty}^{\infty} x\ f_X(x)\ dx$
$E(g(X)) = \sum_x g(x)\ p_X(x)$	$E(g(X)) = \int_{-\infty}^{\infty} g(x)\ f_X(x)\ dx$

$$V(X) = \sigma_X^2 = E(X^2) - (E(X))^2$$

$$\sigma_X = \sqrt{V(X)}$$

Bivariate X, Y

$$\text{cdf: } F_{X,Y}(x,y) = P(X \le x\ \&\ Y \le y)$$

Discrete	Continuous
joint pmf: $p_{X,Y}(x,y) = P(X = x\ \&\ Y = y)$	joint pdf: $f_X(x) = \dfrac{\partial^2 F(x)}{\partial x\ \partial y}$
$P((X,Y) \in A) = \sum_{(x,y) \in A} p_{X,Y}(x,y)$	$P((X,Y) \in A) = \int \int_A f_{X,Y}(x,y)\ dx\ dy$
marginal pmf: $p_X(x) = \sum_y p_{X,Y}(x,y)$	marginal pdf: $f_X(x) = \int_{-\infty}^{\infty} f_{X,Y}(x,y)\ dy$
conditional pmf: $p_{Y\|X}(y\|x) = \dfrac{p_{X,Y}(x,y)}{p_X(x)}$	conditional pdf: $f_{Y\|X}(y\|x) = \dfrac{f_{X,Y}(x,y)}{f_X(x)}$
$E(g(X,Y)) = \sum_{x,y} g(x,y)\ p_{X,Y}(x,y)$	$E(g(X,Y)) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} g(x,y)\ f_{X,Y}(x,y)\ dx\ dy$

$$\text{Cov}(X,Y) = E(XY) - E(X)E(Y)$$

$$\rho_{X,Y} = \frac{\text{Cov}(X,Y)}{\sigma_X\ \sigma_Y}$$