Joint p.m.f for **discrete** r.v.:

1) $f_{X,Y}(x_i, y_j) \geq 0$
2) $\sum_x \sum_y f_{X,Y}(x_i, y_j) = 1$

Joint p.d.f for **continuous** r.v.:

1) $f_{X,Y}(x, y) \geq 0$
2) $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{X,Y}(x, y) dx dy = 1$

Marginal Distribution for **discrete** r.v.:

$$f_X(x) = \sum_y f_{X,Y}(x, y) \qquad \textit{and} \qquad f_Y(y) = \sum_x f_{X,Y}(x, y)$$

Marginal Distribution for **continuous** r.v.:

$$f_X(x) = \int_y f_{X,Y}(x, y) dy \qquad \textit{and} \qquad f_Y(y) = \int_y f_{X,Y}(x, y) dx$$

Conditional Distribution of Y given $X = x$:

$$f_{Y|X}(y|x) = \frac{f_{X,Y}(x,y)}{f_X(x)}, \qquad \textit{if } f_X(x) > 0.$$

Independent: if x and y are independent,

$$f_{X,Y}(x,y) = f_X(x) f_Y(y), \qquad \textit{for all } x \textit{ and } y.$$