Joint distributions summary

	Two discrete random variables	Two continuous random variables
Joint cdf	$F_{X,Y}(x,y) = \mathbb{P}(X \le x, Y \le y)$	$F_{X,Y}(x,y) = \mathbb{P}(X \le x, Y \le y)$
Joint pmf/pdf	$f_{X,Y}(x,y) = \mathbb{P}(X = x, Y = y)$ • $f_{X,Y}(x,y) \ge 0$ • $\sum\limits_x \sum\limits_y f_{X,Y}(x,y) = 1$	$f_{X,Y}(x,y) = \dfrac{\partial^2}{\partial x \partial y} F_{X,Y}(x,y)$ • $f_{X,Y}(x,y) \ge 0$ • $\int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} f_{X,Y}(x,y)\,dxdy = 1$
Marginal pmf/pdf	$f_X(x) = \mathbb{P}(X = x) = \sum\limits_y f_{X,Y}(x,y)$ $= \sum\limits_y f_{X\|Y}(x\|y) f_Y(y)$	$f_X(x) = \int\limits_{-\infty}^{\infty} f_{X,Y}(x,y)\,dy$ $= \int\limits_{-\infty}^{\infty} f_{X\|Y}(x\|y) f_Y(y)\,dy$
Conditional pmf/pdf	$f_{Y\|X}(y\|x) = \dfrac{f_{X,Y}(x,y)}{f_X(x)}$	$f_{Y\|X}(y\|x) = \dfrac{f_{X,Y}(x,y)}{f_X(x)}$
Independence	$\mathbb{P}(X \le x, Y \le y) = \mathbb{P}(X \le x)\mathbb{P}(Y \le y)$ $F_{X,Y}(x,y) = F_X(x) F_Y(y)$ $f_{X,Y}(x,y) = f_X(x) f_Y(y)$ for all x and y	$\mathbb{P}(X \le x, Y \le y) = \mathbb{P}(X \le x)\mathbb{P}(Y \le y)$ $F_{X,Y}(x,y) = F_X(x) F_Y(y)$ $f_{X,Y}(x,y) = f_X(x) f_Y(y)$ for all x and y
Expectation of a function	$\mathbb{E}(g(X,Y)) = \sum\limits_x \sum\limits_y g(x,y) f_{X,Y}(x,y)$	$\mathbb{E}(g(X,Y)) = \int\limits_{-\infty}^{\infty} \int\limits_{-\infty}^{\infty} g(x,y) f_{X,Y}(x,y)\,dxdy$
Covariance	$\mathrm{Cov}(X,\,Y) = \mathbb{E}(XY) - \mathbb{E}(X)\mathbb{E}(Y)$	$\mathrm{Cov}(X,\,Y) = \mathbb{E}(XY) - \mathbb{E}(X)\mathbb{E}(Y)$
Correlation	$\rho_{X,Y} = \dfrac{\mathrm{Cov}(X,\,Y)}{\sqrt{\mathrm{Var}(X)\mathrm{Var}(Y)}}$	$\rho_{X,Y} = \dfrac{\mathrm{Cov}(X,\,Y)}{\sqrt{\mathrm{Var}(X)\mathrm{Var}(Y)}}$
Conditional Expectation	$\psi_Y(x) = \mathbb{E}(Y\|X = x) = \sum\limits_y y f_{Y\|X}(y\|x)$	$\psi_Y(x) = \mathbb{E}(Y\|X = x) = \int\limits_{-\infty}^{\infty} y f_{Y\|X}(y\|x)\,dy$