11.6 Multiple Continuous Random Variables

	Discrete	Continuous
$P[X \in B]$	$\sum_{x \in B} p_X(x)$	$\int_B f_X(x)dx$
$P[(X,Y) \in R]$	$\sum_{(x,y):(x,y)\in R} p_{X,Y}(x,y)$	$\iint_{\{(x,y):(x,y)\in R\}} f_{X,Y}(x,y)dxdy$
Joint to Marginal:	$p_X(x) = \sum_y p_{X,Y}(x,y)$	$f_X(x) = \int_{-\infty}^{+\infty} f_{X,Y}(x,y)dy$
(Law of Total Prob.)	$p_Y(y) = \sum_x p_{X,Y}(x,y)$	$f_Y(y) = \int_{-\infty}^{+\infty} f_{X,Y}(x,y)dx$
$P[X > Y]$	$\sum_x \sum_{y:\, y<x} p_{X,Y}(x,y)$	$\int_{-\infty}^{+\infty} \int_{-\infty}^{x} f_{X,Y}(x,y)dydx$
	$= \sum_y \sum_{x:\, x>y} p_{X,Y}(x,y)$	$= \int_{-\infty}^{+\infty} \int_{y}^{\infty} f_{X,Y}(x,y)dxdy$
$P[X = Y]$	$\sum_x p_{X,Y}(x,x)$	0
$X \perp\!\!\!\perp Y$	$p_{X,Y}(x,y) = p_X(x)p_Y(y)$	$f_{X,Y}(x,y) = f_X(x)f_Y(y)$
Conditional	$p_{X\|Y}(x\|y) = \frac{p_{X,Y}(x,y)}{p_Y(y)}$	$f_{X\|Y}(x\|y) = \frac{f_{X,Y}(x,y)}{f_Y(y)}$
$\mathbb{E}[X^2+Y^2]$ $\mathbb{E}[g(X,Y)]$	$\sum_x \sum_y g(x,y)p_{X,Y}(x,y)$	$\int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} g(x,y)f_{X,Y}(x,y)dxdy$
$P[g(X,Y) \in B]$	$\sum_{(x,y):\, g(x,y)\in B} p_{X,Y}(x,y)$	$\iint_{\{(x,y):\, g(x,y)\in B\}} f_{X,Y}(x,y)dxdy$
$Z = X + Y$	$p_Z(z) = \sum_x p_{X,Y}(x, z-x)$	$f_Z(z) = \int_{-\infty}^{+\infty} f_{X,Y}(x, z-x)dx$
	$= \sum_y p_{X,Y}(z-y, y)$	$= \int_{-\infty}^{+\infty} f_{X,Y}(z-y, y)$

Table 7: pmf vs. pdf