Joint Probability Mass Function

and

Marginal Probability Mass Function

By

Bindeshwar Singh Kushwaha

www.postnetwork.co

If (X,Y) is a two-dimensional discrete random variable, then joint probability mass function of X and Y denoted by p_{xy} and is defined as

$p_{xy}(x_i, y_j) = P(X = x_i, Y = y_j)$

If you toss three coins the following sample space you will get.

S={TTT, TTH, THT, THH, HTT, HTH, HHT,HHH}

X---- Occurrence of heads

Y---- Occurrence of tails

X={0, 1, 2, 3}

Y={0, 1, 2, 3}

Probabilities of events will be

P(X=0)=1/8, P(X=1)=3/8, P(X=2)=3/8, P(X=3)=1/8

P(Y=0)=1/8, P(Y=1)=3/8, P(Y=2)=3/8, P(Y=3)=1/8

S={TTT, TTH, THT, THH, HTT, HTH, HHT,HHH}

And joint probabilities are

P(X=0,Y=0)=0 **P(X=0,Y=1)=0** **P(X=0,Y=2)=0** **P(X=0.Y=3)= 1/8**	**P(X=1,Y=0)=0** **P(X=1,Y=1)=0** **P(X=1,Y=2)=3/8** **P(X=1, Y=3)=0**	**P(X=2, Y=0)=0** **P(X=2, Y=1)=3/8** **P(X=2, Y=2)=0** **P(X=2, Y=3)=0**	**P(X=3, Y=0)=1/8** **P(X=3, Y=1)=0** **P(X=3, Y=2)=0** **P(X=3, Y=3)=0**

Joint Probability Function $p_{xy}(x_i, y_j)$

X \ Y	0	1	2	3	Distribution of X
0	0	0	0	1/8	1/8
1	0	0	3/8	0	3/8
2	0	3/8	0	0	3/8
3	1/8	0	0	0	1/8
Distribution of Y	1/8	3/8	3/8	1/8	1

Marginal Probability Mass Function of X

$p_x(0) = p_{xy}(0,0) + p_{xy}(0,1) + p_{xy}(0,2) + p_{xy}(0,3) = 0+0+0+1/8 = 1/8$

$p_x(1) = p_{xy}(1,0) + p_{xy}(1,1) + p_{xy}(1,2) + p_{xy}(1,3) = 0+0+3/8+0 = 3/8$

$p_x(2) = p_{xy}(2,0) + p_{xy}(2,1) + p_{xy}(2,2) + p_{xy}(2,3) = 0+3/8+0+0 = 3/8$

$p_x(3) = p_{xy}(3,0) + p_{xy}(3,1) + p_{xy}(3,2) + p_{xy}(3,3) = 1/8+0+0+0 = 3/8$

Marginal Probability Mass Function of Y

$p_y(0) = p_{xy}(0,0) + p_{xy}(1,0) + p_{xy}(2,0) + p_{xy}(3,0) = 0+0+0+1/8 = 1/8$

$p_y(1) = p_{xy}(0,1) + p_{xy}(1,1) + p_{xy}(2,1) + p_{xy}(3,1) = 0+0+3/8+0 = 3/8$

$p_y(2) = p_{xy}(0,2) + p_{xy}(1,2) + p_{xy}(2,2) + p_{xy}(3,2) = 0+3/8+0+0 = 3/8$

$p_y(3) = p_{xy}(0,3) + p_{xy}(1,3) + p_{xy}(2,3) + p_{xy}(3,3) = 1/8+0+0+0 = 3/8$