

Joint Distributions

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Joint distributions are multivariate probability distributions

Conditional Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \text{ when } P(B) > 0$$

An example: $P_{X|A}(x_i) = \frac{P(X=x_i | A)}{P(A)}$
 $= \frac{P(X=x_i \text{ and } A)}{P(A)}$



<5!

If this is a fair die what's the PMF of the outcomes?

The event $A = \{x < 5\}$
 $P(A) = \frac{4}{6}$

$$P_{X|A}(1) = \frac{P(X=1 \cap X < 5)}{P(X < 5)} = \frac{\frac{1}{6}}{\frac{4}{6}} = \frac{1}{4}$$

$$P_{X|A}(2) = P_{X|A}(3) = P_{X|A}(4) = P_{X|A}(1)$$

$$P_{X|A}(5) = \frac{P(X=5 \cap X < 5)}{P(X < 5)} = \frac{0}{1} = 0 = P_{X|A}(6) = 0$$

Now when using two random variables!

$$P_{X|Y}(x_i | y_j) = P(X=x_i | Y=y_j)$$

$$= \frac{P(X=x_i \cap Y=y_j)}{P_Y(y_j)}$$

$$= \frac{P_{XY}(x_i, y_j)}{P_Y(y_j)}$$

The value of the joint PMF is 0 if