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NOTATION SUMMARY (UP THROUGH WEEK 3)

Typically we use a capital letter like X to denote a random variable, a script (or calligraphic) letter $\mathcal{X}$ to denote a set (or an event), and a lowercase letter like x to refer to a nonrandom variable. Occasionally we will also use capital letters to refer to a constant that is not varying throughout the problem (in contrast to using a lowercase letter like x that can be a “dummy" variable such as in a summation $\sum_x p_X(x)$, for which lowercase x refers to a specific constant value but we are varying what x is and it is effectively a temporary variable that we do not need after computing the summation).

p_X or $p_X(\cdot)$	probability table/probability mass function (PMF)/probability distribution/marginal distribution of random variable X
$p_X(x)$ or $\mathbb{P}(X = x)$	probability that random variable X takes on value x
$p_{X,Y}$ or $p_{X,Y}(\cdot,\cdot)$	joint probability table/joint PMF/joint probability distribution of random variables X and Y
$p_{X,Y}(x,y)$ or $\mathbb{P}(X = x, Y = y)$	probability that X takes on value x and Y takes on value y
$p_{X\mid Y}(\cdot \mid y)$	conditional probability table/conditional PMF/conditional probability distribution of X given Y takes on value y
$p_{X\mid Y}(x \mid y)$ or $\mathbb{P}(X = x \mid Y = y)$	probability that X takes on value x given that Y takes on value y
$X \sim p$ or $X \sim p(\cdot)$	X is distributed according to distribution p
$X \perp Y$	X and Y are independent
$X \perp Y \mid Z$	X and Y are independent given Z

We will also of course be dealing with many events or many random variables. For example, $\mathbb{P}(\mathcal{A}, \mathcal{B}, \mathcal{C} \mid \mathcal{D}, \mathcal{E})$ would be the probability that events $\mathcal{A}$, $\mathcal{B}$, and $\mathcal{C}$ all occur, given that both events $\mathcal{D}$ and $\mathcal{E}$ occur, which

Homework due Oct 05, 2016 at 21:00 UTC

Notation Summary (Up Through Week 3)

Mini-project 1: Movie Recommendations (Week 3)
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by the definition of conditional probability would be

$$\mathbb{P}(\mathcal{A}, \mathcal{B}, \mathcal{C} \mid \mathcal{D}, \mathcal{E}) = \frac{\mathbb{P}(\mathcal{A}, \mathcal{B}, \mathcal{C}, \mathcal{D}, \mathcal{E})}{\mathbb{P}(\mathcal{D}, \mathcal{E})}.$$

Similarly, $p_{X,Y,Z|V,W}$ would refer to a joint conditional distribution of random variables X, Y, and Z given both V and W taking on specific values together:

$$p_{X,Y,Z|V,W}(x, y, z \mid v, w) = \frac{p_{X,Y,Z,V,W}(x, y, z, v, w)}{p_{V,W}(v, w)}.$$

When we have a collection of random variables, e.g., W, X, Y, Z, if we say that they are independent (without specifying what type of independence), then what we mean is mutual independence, which means that the joint distribution factorizes into the marginal distributions:

$$p_{W,X,Y,Z}(w, x, y, z) = p_W(w) p_X(x) p_Y(y) p_Z(z) \qquad \text{for all } w, x, y, z.$$