DISCRETE

conditional pmf: $p_{X|Y}(x \mid y) = \dfrac{p(x,y)}{p_Y(y)}$

Conditional probability:

CONTINUOUS

conditional pdf: $f_{X|Y}(x \mid y) = \dfrac{f(x,y)}{f_Y(y)}$

$P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$

Use the conditional pmf or pdf to compute conditional expectation and conditional variance.

Law of Total Expectation: $E(E(Y \mid X)) = E(Y)$

Law of Total Variance: $\mathrm{Var}(Y) = \mathrm{Var}(E(Y \mid X)) + E(\mathrm{Var}(Y \mid X))$