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- Law of total expectation: $E[E[X|Y]] = E[X]$

- If X and Y are independent, $E[XY] = E[X]E[Y]$

$$* E[XY] = \sum_x \sum_y xy p_{XY}(x, y) = \sum_x x p_X(x) \sum_y y p_Y(y)$$

\uparrow if X and Y are independent \downarrow

$$- P((X \in A) \cap (Y \in B)) = P(X \in A) \cdot P(Y \in B)$$

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$$- \text{Cov}(X, Y) = E[XY] - E[X]E[Y]$$

if X and Y are independent, $E[XY] = E[X]E[Y]$

$$\text{So } \text{Cov}(X, Y) = 0$$

$$- X \sim \text{NB}(\tau, p); E[X] = \frac{\tau}{p}$$

$$\text{Var}(X) = \tau \cdot \frac{1-p}{p^2}$$

* R.V. X is continuous if

$$\forall B \subseteq \mathbb{R} \quad (f_X(x) \geq 0) \quad E[P(X \in B)] = \int_B f_X(x) dx$$

- $f(x)$ is probability density function (pdf) of X .