# Q-10.13.3.10

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**Question:** A die is tossed twice. A 'success' is getting an even number on a toss. Find the variance of the number of successes.

**Solution:**

| Parameter | Value | Description |
|---|---|---|
| $X_i$ | 0,1 | 0-Not a success, 1-Success and it represents outcome of $i^{th}$ throw |

pmf of $X_i$ is

$$p_{X_i}(k) = \begin{cases} \frac{1}{2}, & k = 0 \\ \frac{1}{2}, & k = 1 \end{cases} \quad \forall \quad 1 \le i \le 2 \tag{1}$$

Mean value of $X_i$ is

$$\mu_X = E[X_i] \quad i = 0, 1 \tag{2}$$

$$= \frac{1}{2} \tag{3}$$

Variance of $X_i$ is

$$\sigma_X = E[(X_i - \mu_X)^2] \quad i = 0, 1 \tag{4}$$

$$= \frac{1}{4} \tag{5}$$

Variance of getting successes in two throws of a die is

$$= E[((X_1 - \mu_X) + (X_2 - \mu_X))^2] \tag{6}$$

$$= E[(X_1 - \mu_X)^2] + E[(X_2 - \mu_X)^2] + E[(X_1 - \mu_X) \times (X_2 - \mu_X)] \tag{7}$$

$$= \frac{1}{4} + \frac{1}{4} + 0 \tag{8}$$

$$= \frac{1}{2} \tag{9}$$