Assignment

EE23010: Probability and Random Processes
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Question: For the following probability distribution determine standard deviation of the random variable X.

X	2	3	4
p_X	0.2	0.5	0.3

Solution: Given, X be the random variable and p_X is the probability distribution.
Variance of X is given by

$$\sigma_X^2 = E[X - E(X)]^2 \tag{1}$$
$$= E[X^2 + [E(X)]^2 - 2XE(X)] \tag{2}$$
$$= E(X^2) + [E(X)^2 - 2[E(X)]^2] \tag{3}$$
$$= E(X^2) - [E(X)]^2 \tag{4}$$

and, Standard deviation is given by

$$\sigma_X = \sqrt{E(X^2) - [E(X)]^2} \tag{5}$$
$$= \sqrt{\sum_{i=1}^{n} X_i^2 p_{Xi} - [\sum_{i=1}^{n} X_i p_{Xi}]^2} \tag{6}$$

Now,

$$E(X^2) = \sum_{i=1}^{n} X_i^2 p_{Xi} \tag{7}$$
$$= 10.1 \tag{8}$$

Similarly,

$$[E(X)]^2 = [\sum_{i=1}^{n} X_i p_{Xi}]^2 \tag{9}$$
$$= 9.61 \tag{10}$$

Now putting the values in eqn (2):

$$\sigma_X = \sqrt{10.1 - 9.61} \tag{11}$$
$$= 0.7 \tag{12}$$