

Question 12.13.3.24

Probability and Random Processes

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Consider the probability distribution of a random variable X:

X	0	1	2	3	4
P(X)	0.1	0.25	0.3	0.2	0.15

(ii) $\text{var}\left(\frac{X}{2}\right)$

$$= E\left(\frac{X^2}{4}\right) - \left[E\left(\frac{X}{2}\right)\right]^2 \quad (11)$$

$$= \frac{1}{4} [E(X^2) - [E(X)]^2] \quad (12)$$

$$= \frac{\text{var}(X)}{4} \quad (13)$$

$$= \frac{1.4475}{4} \quad (14)$$

$$= 0.361875 \quad (15)$$

Calculate

(i) $\text{var}(X)$

(ii) $\text{var}\left(\frac{X}{2}\right)$

Solution:

(i) $\text{var}(X)$

$$= E[X - E(X)]^2 \quad (1)$$

$$= E[X^2 + [E(X)]^2 - 2XE(X)] \quad (2)$$

$$= E(X^2) + [E(X)]^2 - 2[E(X)]^2 \quad (3)$$

$$= E(X^2) - [E(X)]^2 \quad (4)$$

where

$$E(X) = \sum_{k=0}^4 k p_X(k) \quad (5)$$

$$= 2.05 \quad (6)$$

and

$$E(X^2) = \sum_{k=0}^4 k^2 p_X(k) \quad (7)$$

$$= 5.65 \quad (8)$$

Then

$$\text{var}(X) = 5.65 - (2.05)^2 \quad (9)$$

$$= 1.4475 \quad (10)$$