

ASSIGNMENT 11

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Download all python codes from

https://github.com/manik2255/AI1103-PROBABILITY-AND-RANDOM-VARIABLES/blob/main/ASSIGNMENT_11/assign_11.py

and latex-tikz codes from

https://github.com/manik2255/AI1103-PROBABILITY-AND-RANDOM-VARIABLES/blob/main/ASSIGNMENT_11/ASSIGNMENT_11.tex

given that,

$$E[X] = E[Y] \quad (2.0.5)$$

$$np = \lambda \quad (2.0.6)$$

from (2.0.2),

$$Var(X) = np(1 - p) \quad (2.0.7)$$

using (2.0.6),

$$Var(X) = \lambda(1 - p) \quad (2.0.8)$$

1 CSIR UGC NET EXAM (JUNE 2015), PROBLEM.53

Assume that $X \sim \text{Binomial}(n, p)$ for some $n \geq 1$ and $0 < p < 1$ and $Y \sim \text{poisson}(\lambda)$ for some $\lambda > 0$. Suppose $E[X] = E[Y]$. Then

1) $var(X) = Var(Y)$

2) $var(X) < Var(Y)$

3) $var(Y) < Var(X)$

4) $Var(X)$ may be larger or smaller than $Var(Y)$ depending on the values of n, p and λ

TABLE 4: Mean and Variance for random variables X and Y

	X	Y
E	λ	λ
var	$\lambda(1 - p)$	λ

using (2.0.4),

$$Var(X) = Var(Y)(1 - p) \quad (2.0.9)$$

$$\frac{Var(X)}{Var(Y)} = 1 - p \quad (2.0.10)$$

as,

$$1 - p < 1 \quad (2.0.11)$$

$$\frac{Var(X)}{Var(Y)} < 1 \quad (2.0.12)$$

$$Var(X) < Var(Y) \quad (2.0.13)$$

2 SOLUTION

For the random variable

$$X \sim \text{Binomial}(n, p)$$

As we know,

$$E[X] = np \quad (2.0.1)$$

$$Var(X) = np(1 - p) \quad (2.0.2)$$

for the random variable

$$Y \sim \text{poisson}(\lambda)$$

As we know,

$$E[Y] = \lambda \quad (2.0.3)$$

$$Var(Y) = \lambda \quad (2.0.4)$$

$\therefore Var(Y) > Var(X)$, independent of n, p and λ .

1) $var(X) = Var(Y)$

using TABLE 4,

$$\lambda(1 - p) = \lambda \quad (2.0.14)$$

$$1 - p = 1 \quad (2.0.15)$$

$$p = 0 \quad (2.0.16)$$

which is wrong as per the question ($0 < p < 1$). hence the option is incorrect.

- 2) $\text{var}(X) < \text{Var}(Y)$
using TABLE 4,

$$\lambda(1 - p) < \lambda \quad (2.0.17)$$

$$1 - p < 1 \quad (2.0.18)$$

$$p > 0 \quad (2.0.19)$$

which is true as per the question ($0 < p < 1$).
hence the option is correct.

- 3) $\text{var}(Y) < \text{Var}(X)$
using TABLE 4,

$$\lambda(1 - p) > \lambda \quad (2.0.20)$$

$$1 - p > 1 \quad (2.0.21)$$

$$p < 0 \quad (2.0.22)$$

which is wrong as per the question ($0 < p < 1$).
hence the option is incorrect.

- 4) $\text{Var}(X)$ may be larger or smaller than $\text{Var}(Y)$
depending on the values of n, p and λ .
Wrong, since we have shown that irrespective
of the values of λ, n , and p , $\text{var}(y) > \text{var}(x)$