

$$\begin{aligned}
 \text{Mean} = E(X) &= \sum_{i=0}^{\infty} x_i p_i = \sum_{x=0}^{\infty} x \frac{e^{-\lambda} \lambda^x}{x!} \\
 &= \sum_{x=1}^{\infty} \frac{e^{-\lambda} \lambda^x}{(x-1)!} \quad \text{cancel } x \\
 &= e^{-\lambda} \cdot \lambda \sum_{x=1}^{\infty} \frac{\lambda^{x-1}}{(x-1)!} \quad \text{took out } \lambda \\
 &= e^{-\lambda} \cdot \lambda \sum_{x=1}^{\infty} \frac{\lambda^{x-1}}{(x-1)!} \quad \left[\sum \frac{a^x}{x!} = e^a \right] \text{ use this} \\
 &= \cancel{e^{-\lambda}} \cdot \lambda \cdot \cancel{e^{\lambda}} = \lambda
 \end{aligned}$$

$x=0 \Rightarrow$ no need for sum

$$\text{Mean} = \lambda$$

$$\text{Var} = \sum x^2 - (\sum x)^2 = \underbrace{\sum x^2 - \sum(x)}_{\text{combine}} + \sum(x) - (\sum x)^2 =$$

$$= \sum (x^2 - x) + \sum(x) - \underbrace{(\sum x)^2}_{\text{Mean}^2}$$

\downarrow Mean

$$= \sum_{x=0}^{\infty} x(x-1) \frac{e^{-\lambda} \lambda^x}{x!} + \lambda - \lambda^2$$

$$= \sum_{x=2}^{\infty} \frac{e^{-\lambda} \lambda^x}{(x-2)!} + \lambda - \lambda^2$$

$$= \lambda^2 e^{-\lambda} \sum_{x=2}^{\infty} \frac{\lambda^{x-2}}{(x-2)!} + \lambda - \lambda^2$$

$$= \lambda^2 \cancel{e^{-\lambda}} \cdot \cancel{e^{\lambda}} + \lambda - \lambda^2 = \lambda^2 - \lambda^2 + \lambda = \lambda$$

use some approach

$x=0$ is zero
 $x=1$
cancel $x(x-1)$
from $x!$

take λ^2 out