COEN 240

HW 7

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$$\text{Poisson}(x \mid \lambda) = e^{-\lambda} \frac{\lambda^{x}}{x!} \quad \text{for } x \in \{0,1,2,\dots\}$$

$$L(\lambda) = \prod_{i=1}^{n} e^{-\lambda} \frac{\lambda^{x_i}}{x_i!}$$

$$l(\lambda) = \log(L(\lambda))$$

$$= \log\left(\prod_{i=1}^{n} e^{-\lambda} \frac{\lambda^{x_i}}{x_i!}\right)$$

$$= \sum_{i=1}^{n} \log\left(e^{-\lambda} \frac{\lambda^{x_i}}{x_i!}\right)$$

$$= \sum_{i=1}^{n} \left[\log(e^{-\lambda}) + \log(\lambda^{x_i}) - \log(x_i!)\right]$$

$$= \sum_{i=1}^{n} \left[-\lambda + x_i \log\lambda - \log(x_i!)\right]$$

$$l(\lambda) = -n\lambda + \log\lambda \sum_{i=1}^{n} x_i - \sum_{i=1}^{n} \log(x_i!)$$

do $\dfrac{\partial l(\lambda)}{\partial \lambda} = 0$ for λ_{MLE}

$$\frac{\partial l(\lambda)}{\partial \lambda} = -n + \frac{1}{\lambda}\sum_{i=1}^{n} x_i$$

$$-n + \frac{1}{\lambda}\sum_{i=1}^{n} x_i = 0$$

$$\sum_{i=1}^{n} x_i = n\lambda$$

$$\boxed{\lambda_{MLE} = \frac{1}{n}\sum_{i=1}^{n} x_i}$$

Which is mean of the n observations.