Assignment 2

Date : / /

Mayuri Kadam

Q8) Dataset : $(x) = \{x_1, x_2 \ldots x_N\}$

$$p(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{1}{2\sigma^2}(x-\mu)^2}$$

$$LL(\mu;x) = \ln\left(\frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{1}{2\sigma^2}(x-\mu)^2}\right)$$

$$= \ln\left(\frac{1}{\sqrt{2\pi\sigma}}\right) + \ln\left(e^{-\frac{1}{2\sigma^2}(x-\mu)^2}\right)$$

$$= \ln\left(\frac{1}{\sqrt{2\pi}\sigma}\right) - \frac{1}{2\sigma^2}(x-\mu)^2$$

$$\frac{\delta LL(\mu;x)}{\delta\mu} = 0 - \frac{1}{2\sigma^2} \times 2(x-\mu)$$

To maximize : equating $\frac{\delta LL(\mu;x)}{\delta\mu} = 0$

$$\therefore 0 = 0 - \frac{1}{\cancel{2}\sigma^2} \times \cancel{2}(x-\mu)$$

$$\therefore \boxed{\mu = x}$$

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Q8.1) Dataset : $(x) = \{x_1, x_2 \dots x_N\}$

$$p(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2\sigma^2}(x-\mu)^2}$$

$$LL(\sigma;x) = \ln\left(\frac{1}{\sqrt{2\pi}\sigma}\right) + \ln\left(e^{-\frac{1}{2\sigma^2}(x-\mu)^2}\right)$$

$$= \ln\left(\frac{1}{\sqrt{2\pi}}\right) + \ln\left(\frac{1}{\sigma}\right) \cancel{e^{-\frac{1}{2\sigma^2}(x}} - \frac{1}{2\sigma^2}(x-\mu)^2$$

$$\frac{\delta LL(\sigma;x)}{\delta\sigma} = 0 - \frac{\delta}{\delta\sigma}\left(\ln(\sigma)\right) - \frac{1}{2}(x-\mu)^2 \times -2 \times \sigma^{-3}$$

$$= -\frac{1}{\sigma} + \frac{(x-\mu)^2}{\sigma^3}$$

To maximize : equating $\frac{\delta LL(\sigma;x)}{\delta\sigma} = 0$

$$\therefore 0 = -\frac{1}{\sigma} + \frac{(x-\mu)^2}{\sigma^3}$$

$$\therefore 0 = -\sigma^2 + (x-\mu)^2$$

$$\therefore \boxed{\sigma = x-\mu}$$